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TRIBUTE VOLUME:

LORRAINE EDEN

International Business **in the Information and Digital Age**

EDITED BY

Rob van Tulder • Alain Verbeke • Lucia Piscitello

INTERNATIONAL BUSINESS IN THE INFORMATION AND DIGITAL AGE

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EDITED BY

ROB VAN TULDER
Erasmus University, The Netherlands

ALAIN VERBEKE
University of Reading, United Kingdom; Vrije Universiteit Brussel, Belgium; University of Calgary, Canada

LUCIA PISCITELLO
Politecnico di Milano, Italy

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LIST OF CONTRIBUTORS

Mohamed Amal	Regional University of Blumenau, Brazil
Pierfrancesco Arrabito	Federal University of Rio Grande do Sul, Brazil
Richard Bolwijn	UNCTAD, Switzerland
Keith D. Brouthers	King's College London, UK
Filippo Buonafede	Politecnico di Milano, Italy
John Cantwell	Rutgers Business School, USA
Bruno Casella	UNCTAD, Switzerland
Keren Caspin-Wagner	Duke University, USA
Maria Chiarvesio	University of Udine, Italy
Lorraine Eden	Texas A&M University, USA
Jonas Eduardsen	Aalborg University, Denmark
Maria Elo	University of Turku, Finland
Giulia Felice	Politecnico di Milano, Italy
Igor Filatotchev	King's College London, UK
Gary Gereffi	Duke University, USA
Marta Götz	Vistula University, Poland
Christopher Hazlehurst	King's College London, UK
Barbara Jankowska	Vistula University, Poland
Kai Jia	University of Electronic Science and Technology of China, China
Bart Kamp	Orkestra-Basque Institute of Competitiveness and Deusto University, Spain

Martin Kenney	University of California, USA
Fabio Lamperti	Politecnico di Milano, Italy
Andre Laplume	Michigan Technological University, USA
Arie Y. Lewin	Duke University, USA
Silvia Massini	The University of Manchester, UK
Jakob Müllner	Vienna University of Economics and Business, Austria
Lucia Piscitello	Politecnico di Milano, Italy
Rubina Romanello	University of Udine, Italy
Jessica Salmon	Siena College, USA
Susana Costa e Silva	Universidade Católica Portuguesa, Portugal
Jurema Tomelin	Univille University, Brazil
Rob van Tulder	Rotterdam School of Management, Erasmus University, The Netherlands
Alain Verbeke	University of Reading, UK; Vrije Universiteit Brussel, Belgium; University of Calgary, Canada
Xinyi Wu	Duke University, USA
Aurora Caneiro Zen	Federal University of Rio Grande do Sul, Brazil
James Zhan	UNCTAD, Switzerland
John Zysman	University of California, USA

PREFACE

LORRAINE EDEN – A TRIBUTE

The Progress in International Business Research (PIBR) series is an initiative of the European International Business Academy, in collaboration with Emerald Group Publishing. Since 2014, each volume has been dedicated to an International Business (IB) scholar, who has made important and lasting contributions to the scholarly IB community, both in intellectual and institutional building terms. The first two tribute volumes were dedicated posthumously to pinnacle leaders and beloved figures in the IB field, who had unexpectedly passed away at the height of their influence, namely Daniël van den Bulcke (University of Antwerp, Belgium) and Alan M. Rugman (University of Reading, UK). The subsequent two volumes were dedicated to institution builders who are still very active in the field, namely Louis T. Wells (Harvard University, USA) and Rosalie Tung (Simon Fraser University, Canada). In the latter cases, these scholars were selected because their scholarly oeuvre represented an almost perfect fit with the corresponding research volume's theme, respectively advances in IB research on emerging markets (with a focus on the 'BRIC (Brazil, Russia, India and China)' countries) and distance (with a focus on its cultural and institutional dimensions). The PIBR series aims to publish collections of papers on subject matter that is not necessarily considered 'mainstream' at the time of research, or that requires novel ways of approaching it. The selection of tribute volume awardees also signals the Editors' appreciation for innovative, out-of-the-box thinkers in the IB research area.

Following this tradition, the present volume in the PIBR series also covers a relatively new area of research, namely the interaction between multinational enterprises (MNEs) and the digital and information age. This includes, on the one hand, an account of the role that MNEs can have in shaping the new age. On the other hand, the 'maturing' of the Internet creates challenges as well as opportunities for established, emerging and new MNEs, often independently of company size or home country. This volume brings together creative contributions from mainstream IB scholars, and includes work from scholars in adjacent disciplines, such as economic geography, international relations and political science, strategic management and technology studies. IB as a scholarly discipline always faces a challenge when addressing major societal and technological developments; in particular, those that involve multilevel and multimethod research, and placed at the interface between company strategies and government regulation. Studying the 'fourth industrial revolution' is a prime example of such a challenge.

IB studies that cover the interface between technology, regulatory regimes and business strategy in a rigorous fashion, demand that scholars combine qualitative and quantitative insights in a robust manner.

This is where the life-long contributions of Lorraine Eden deserve particular praise. She has contributed immensely to scholarly inquiry into novel and intellectually challenging IB phenomena, and this is the first reason for this tribute. Lorraine Eden is presently a Professor of Management and holds the Gina and Anthony Bahr Professor in Business at Texas A&M University (USA). She is also associated as a Faculty Member with the Bush School of Government and Public Service at the same institution. Her research interests lie, in her own words: 'at the intersection of economics, international business and public policy'. Her current and past research interests have focused primarily on two areas: Transfer pricing (the pricing of transactions among related parties) and strategies of MNEs to cope with institutional distance, liability of foreignness and the challenges of 'hot spots' (e.g., conflict zones, corrupt economies, tax havens). Her books include *Taxing Multinationals* (1998), *Multinationals in North America* (1994), *Retrospectives on Public Finance* (1991), *Multinationals and Transfer Pricing* (1985, 2017) and *The Economics of Transfer Pricing* (2018). Lorraine Eden's 170+ scholarly publications have earned more than 11,000 citations on Google Scholar. In the period 2005–2015, she ranked fourth as most productive scholar among Management faculty and the 13th most productive scholar among Business School faculty in terms of articles published in 24 'journals of distinction'. Her most influential publications (in terms of citations) cover four very different areas of research. These papers signal her broad scholarly interests and willingness to collaborate with other researchers: more than 3,500 citations for an *AMJ* paper on emerging economies (Hoskisson, Eden, Lau, & Wright, 2000), 1,400 citations for a *JIBS* paper on IB methods (Chang, Van Witteloostuijn, & Eden, 2010), and more than 500 citations for both a book chapter (Elsevier) contributing to the literature on distance and liability of foreignness (Eden & Miller, 2004), and for an *AMR* article on government corruption and MNE strategies (Rodriguez, Uhlenbruck, & Eden).

The second reason to pay tribute to Lorraine Eden is her life-long engagement in support of creating a vibrant, global disciplinary community of IB researchers. She has done this in many capacities. First, as an active participant in the annual meetings organised by the Academy of International Business (AIB), over a period spanning decades. She was elected as the AIB fellow as early as 2004, in part because of her lead role in stimulating female participation in the IB research community, for instance, by founding the Women in the Academy of International Business network. Second, as the editor-in-chief of *JIBS*, the top-ranked journal in the field of international business, whereby she consolidated the status of *JIBS* as a recognised 'A' level outlet in the broader management sciences. Third, as the 2017–2018 president of the AIB, a scholarly association in which she also held a Vice President position during the period 2000–2002. As the AIB President elect, she was instrumental in developing Codes of Ethics for the AIB Membership, the AIB Leadership and the AIB journals. These codes outline standards of professional and ethical conduct and procedures for handling violations thereof. In an increasingly complex and volatile world, IB scholars must abide by the most stringent possible norms of professional conduct and ethical behaviour, whereby criteria of scientific integrity are paramount. Lorraine Eden is owed a depth of gratitude for her trailblazing role in this discourse.

The third reason to pay tribute to Lorraine Eden is her unrelenting focus on the societal responsibilities of the IB teacher and scholar, whereby she has never shied away from addressing controversial areas of MNE involvement. At Texas A&M, she teaches courses on transfer pricing and MNEs. Her Transfer Pricing Aggies programme has trained more than 300 masters- and PhD-level students. Over 100 graduates have used this training as a platform to pursue transfer-pricing careers. More generally, she has been actively involved in establishing linkages between academia and society, by participating in a large number of high-level advisory committees and networks. As one example, in 2015, she acted as a member of the E15 Task Force on Trade and Investment, an expert task force within the E15 Initiative on Strengthening the Global Trade and Investment System for Sustainable Development. Particularly relevant for the topic of the present PIBR volume has been her recent (2014–2016) membership of the Research Advisory Network to the Global Commission on Internet Governance. This is a joint project of The Centre for International Governance Innovation and Chatham House (the Royal Institute of International Affairs), on the future of multistakeholder Internet governance. Her technical paper for the Task force (Eden, 2016) established clear linkages among digitisation, foreign direct investment and sustainable development. Lorraine Eden's oeuvre of policy-oriented papers, written during the past 35 years, provides a wealth of genuine insight on the complexity of policy processes and the impact of public policy, and much of this insight remains as relevant today as when these pieces were first composed.

Lorraine Eden's paper prepared for this volume (Chapter 1) shows in a very personal manner how her scholarship developed over the years and how she managed to relate her research to relevant societal themes and to her service to the wider IB community. We hope that Lorraine Eden's account of her personal journey, which truly reflects the philosophy of 'service above self', may inspire the coming generation of IB scholars to follow in her footsteps.

The Editors,
Rob van Tulder, Alain Verbeke and Lucia Piscitello

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INTRODUCTION: INTERNATIONAL BUSINESS IN THE INFORMATION AND DIGITAL AGE – AN OVERVIEW OF THEMES AND CHALLENGES

Rob van Tulder, Alain Verbeke and Lucia Piscitello

1. INTRODUCTION: A CHALLENGING AGENDA

The emergence of the "information and digital age" is rapidly changing the face of international business (IB) activity (Alcacer, Cantwell, & Piscitello, 2016; Friedman, 2005). Some call the present stage of transition the "third industrial revolution" (Rifkin, 2011), others refer to it as the "fourth industrial revolution," Industry 4.0, or the "digital" or "new economy" (Schwab, 2016). There appears to be broad agreement on the fundamental and "disruptive" nature of the ongoing transformation.

Features relevant for IB studies, which have been suggested as characterizing the new age, include: organizational decentralization (Ghoshal & Bartlett, 1998), vertical disintegration and specialization (Langlois, 2003), modularity (Baldwin & Clark, 2000), flexibility (Volberda, 1998), accelerated knowledge creation, exchange or diffusion, and increased knowledge complexity (Foss & Pedersen, 2004), inter-organizational collaboration and openness (Chesbrough, 2003), various kinds of networks (Ghoshal & Bartlett, 1990; Zander, 2002), new manufacturing technologies (Laplume, Petersen, & Pearce, 2016), and new business models leading to a "(digital) platform" or "network economy" (Kenney & Zysman, 2016).

Institutional settings have also evolved alongside the new wave of technological innovation, leading to changes across countries in the mechanisms responsible for standardization, intellectual property rights protection, and the institutional conditions fostering individual and local creativity (Mowery, 2009). The rules of the competitive game (North, 1990) are changing. Consequently, new regulatory challenges have appeared – requiring a new take on not only what constitutes

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effective industrial and trade policies, but also on effective privatization and liberalization measures. Many of the new organizational forms around the world that shape the digital (Internet) economy have benefited from two particular regulatory characteristics: (1) the absence of government regulation and involvement at a global scale and (2) the introduction of hybrid governance structures for the Internet. In particular, the creation of the Internet Corporation for Assigned Names and Numbers (ICANN) in 1998 as a private, non-profit making and public benefit corporation signaled a new approach to global governance. ICANN succeeded in taking over the centralized coordination and management of the Internet's Domain Name System from the United States government (Muldoon, Aviel, Reitano, & Sullivan, 2011) – thus, facilitating a much more rapid spread of the Internet than had previously been thought possible. *The Economist* (July 12, 2017) talks about an "era of digital exceptionalism," in which online platforms in America, and to some extent in Europe, "have been inhabiting a parallel legal universe (… in which) they are not legally responsible, either for what their users do or for the harm that their services can cause in the real world."

Compared with the early twenty-first century, the rapid global spread of the digital age to almost all corners of the world has raised the competitive and regulatory stakes. Consequently, the argument is also mounting that many of the new organizational forms have become either too dominant – because of being concentrated in the hand of a few multinational enterprises (MNEs) – or are undermining local regulatory regimes and social contracts (see also, Chapter 3 of this book). The former relates to the dominant position of a limited number of digital network companies such as Google, Apple, or Amazon (Moore & Tambini, 2018). The latter relates to new business models deployed by centralized platform companies such as Uber, Facebook, Alibaba, or Airbnb. In response, some regulatory agencies have started enacting antitrust laws to push back on the dominance of a limited number of digital age companies. Witness for instance the €4.3 billion fine imposed in July 2018 by the European Commission on Google for abusing its dominant (network) position to discriminate against rivals (and, thus, in the longer run lowering the innovative potential of the Internet). This fine was the largest antitrust penalty ever – and reminiscent of comparable antitrust cases against earlier carriers of the information age, such as Microsoft in the 1990s. Airbnb and Uber are centralized platforms that are increasingly criticized for undermining local safety regulations (to be respected by hotels) or minimum wage conventions (to be respected by tax drivers). The Chinese government's monitoring of its citizens, and the role played by leading MNEs such as Alibaba and Tencent, has triggered other concerns over the "neutrality of the net" – which in its original setup had been favorable to maximizing (democratic) participation across the world. But, in a 2018 UK parliamentary committee report, Facebook and Twitter have been accused of "undermining democracy" through a systematic manipulation of information, and usage of private information of their subscribers for commercial goals.

A new "breed" of MNEs (e.g., Brouthers, Geisser, & Rothlauf, 2016) and business models (Baden-Fuller & Haefliger, 2013) is rapidly developing, and redefining the boundaries of what constitutes a firm and a society. The extent to which this contributes to positive or negative transition processes, is open to debate.

The Economist (June 30, 2018) has argued that, while "the Internet was meant to make the world a less centralized place (…) the opposite has happened." They even quote Tim Berners-Lee, the inventor of the world-wide-web (www), who stated that the Internet "has failed to deliver the positive, constructive society many of us had hoped for." The main criticism is that the Internet has become much more centralized than originally envisaged, and is dominated by a few giant firms, in particular from the United States and China, such as Facebook, Amazon, Apple, Google, Alibaba, and Tencent. The positive and negative impacts of the information and digital age are in any case heavily influenced by the strategies adopted by leading enterprises. A key characteristic of these enterprises is their multinational nature. Analysis of the interactions between the shape of the information age and MNE strategies has thus become an important area of study for IB scholars.

2. THE STATUS OF IB RESEARCH

The IB discipline is faced with a sizable challenge: how to cover these trends and come up with meaningful, robust, and timely insights. Two chapters in this volume assess the present status of the scientific discourse as covered by IB studies (Chapters 4 and 5). They come to contradictory conclusions: Hazlehurst and Brouthers (Chapter 3) argue that the interest shown in new information and communication technologies by IB and strategy scholars is far lower than that of marketing and information systems scholars. Müllner and Filatotchev (Chapter 4), on the other hand, present a more positive assessment of the status of IB research in analyzing the effects of the information age on firm-level internationalization strategies.

Both chapters use different methodologies to cover the literature; thus, we complemented their search with a more focused check on the way seven[1] of the leading IB journals over the 1990–2018 period have covered *key concepts* within three dimensions of the information and digital age:

1. *The organizational dimension*: Specific functional concepts related to the information age like "algorithm," "artificial intelligence," and "e-commerce" have received some attention in IB journals. Most articles on e-commerce already appeared in the 2001–2003 period as part of a special issue of Journal of International Business Studies (JIBS) (De la Torre & Moxon, 2001; Lynch & Beck, 2001; Oxley & Yeung, 2001; Singh & Kundu, 2002), to be followed by a new batch of studies that were triggered by the entry of Chinese e-commerce companies (Shen & Kim, 2016). In the early twenty-first century, some studies also appeared on the role of Information and communications technology (ICT) on the international organization of companies – for instance in innovation (Santangelo, 2001). In IB studies, algorithms have primarily functioned as a methodology, rather than as a topic of research. Linking the influence of major Internet companies like Facebook and Google to their use of algorithms has hardly reached mainstream IB research (cf., Allen & Aldred, 2013). The same applies to the topic of artificial intelligence, which is primarily used as an analytical technique (e.g., neural network analysis, see Veiga, Lubatkin, Calori, Very, & Tung, 2000), rather than studied as a new tool to organize business.

2. *The regulatory dimension*: More generic and governance-related concepts like "cyberspace" (Ching & Ellis, 2006; Kobrin, 2001) or "industry 4.0" (Strange & Zucchella, 2017) have been haphazardly covered by IB scholars. The most popular concept has been that of "platform," which has traditionally been used in the context of "export platforms," but has recently been linked to the Internet revolution, either from the perspective of companies (Ojala, Evers, & Rialp, 2018) or from the perspective of activists who organize themselves digitally against MNEs (Benmamoun, Kalliny, & Cropf, 2012; Fiorito, 2005; Lewis, 2005). More controversial governance concepts, such as "net neutrality," have not received any attention in the IB discourse yet. Although research on intellectual property rights and competition policies has been prolific – with a few exceptions (Brander, Cui, & Vertinsky, 2017; Ivus, Park, & Saggi, 2017; Peng, Ahlstrom, Carraher, & Shi, 2017) – largely unrelated to the companies that lead the Internet revolution and that are criticized for protecting their dominant position through sheltering their source codes and intellectual property.
3. *The case study/corporate dimension*: Conducting case studies represent a valuable approach for the analysis of new empirical phenomena. Specific information and digital era MNEs are coming of age – in particular, MNEs from the United States and China. Since 2011, IB scholars have been looking at the American companies at a modest scale and mostly adopting a critical perspective (Roberts & Dörrenbächer, 2016). Half of the papers that have been published since 2010 on companies such as Facebook, Google, Uber, and Airbnb (and to a lesser extent, Microsoft) have appeared in issues of *Critical Perspectives on International Business*. The coverage of Chinese information and digital MNEs has been more limited, and primarily focused on Alibaba and Tencent (Brander et al., 2017; Shen & Kim, 2016; Strange & Zucchella, 2017).

Part of the problem of adequately taking stock of present IB research on the information and digital age is related to the delineation of a relevant research field: where to start; where to draw the boundary. Sizable empirical gaps must be covered, but the pervasive character of the information and digital age raises many questions on how to study MNE strategies: what actually defines the "ICT sector"; how relevant are countries (home or host) in this digital age; and how to look at traditional value chains. Studying MNEs in the digital age requires new types of benchmarking as to what constitutes a successful strategy and corporate social responsibility, and this may also influence the foundations of mainstream IB theory.

3. TOPICS FOR THE PRESENT IB DISCOURSE

For the IB discipline, the information and digital age presents a new research agenda of themes that has empirical as well as theoretical repercussions. As regards empirics, it important to understand the rise of new MNE types. In terms of theory, the role of new information and digital management tools, and the linkages with regulations affecting IB, will undoubtedly affect mainstream theorizing on the MNE. The following themes would appear to be particularly relevant:

- Information and communication technologies have given rise to both a *new type of firms* offering a platform for users to interact with each other and generate value through user co-creation of content, and to *new business models*. What defines the success of these business models from an international and comparative perspective?
- *The international fragmentation of production systems and the geographic dispersion* of the value chain have opened up *novel* opportunities and related growth scenarios for new actors. How has the relative importance of location factors and geographical hierarchies changed? How are emerging market countries capturing these opportunities to catch up and shift their role in global supply/value chains? How have recent processes of back-sourcing and back-shoring been affected (and possibly facilitated) by the information and digital age?
- Increasing *de-verticalization* and *modularity* of products and processes foster complex and dispersed network organizations. How do firms manage multifaceted portfolios, including various forms of corporate partnering, external collaboration, and non-equity forms across borders? What governance structures have been adopted to manage cross-country inter-organizational networks? What creative value chain orchestration and governance approaches are needed in this landscape?
- How do changes in the international economic, technological, and social *environments* create new *opportunities* and *roles for small and medium-sized enterprises* (*SMEs*)*, international new ventures, international entrepreneurship*, and *global start-ups*? Conversely, what is the evolution in the role of large, global companies when they metamorphose from being primary producers and distributors to becoming aggregators? Have they successfully developed a new capacity to act as knowledge and capability coordinators or integrators?
- Technological revolutions and the *transformation* of industrial structures: How do information and communication, as well as *new digital technologies, change sectoral boundaries* (e.g., between manufacturing and non-manufacturing industries), deconstruct traditional industries, and stimulate the emergence of new sectors and/or *cross-industry convergence*? Are reallocation and recombination of innovative efforts among international intra-firm and external actors facilitated by these new, general-purpose technologies? How do changes in sectoral boundaries impact corporate diversification and stimulate new organizational forms to manage geographic dispersion?
- Organizations evolve and adapt to their technological and institutional environments, and these changes are not unidirectional. What are the conditions enabling the (harmonious) co-evolution of MNE international networks with their institutional environment and policy context? What is the *role of country-specific institutional systems*? Do changes in the relationship between the public and private spheres, such as public–private partnerships, play different roles in different industries and countries?
- How, and to what extent, does the *emergence of new manufacturing technologies, the Internet of Things, 3D printing (Additive Manufacturing)*, and *Industry*

4.0 lead to the international reorganization of production networks? How, and to what extent, do information technologies and increasing flexibility impact upon *labor market and employment practices*?

- Are *new forms of national* or *regional regulation necessary*? How to take *into account* the different regulatory environments from which some of the leading companies are *developing* their network and internationalization strategies? In particular, the difference between the leading United States and Chinese companies has received attention. But, at present, the European Union is providing the most advanced regulatory environment in dealing with privacy considerations. What will happen if the principle of "net neutrality" was treated differently around the world?
- Can the *global, hybrid regulatory regime be sustained*? The regulatory "void" that enabled hybrid forms of regulation (through ICANN, in particular) to mature will probably not be sustained due to increasing tensions between lead companies that represent different regulatory systems. What will be the implications for other regulatory agencies, that is, in the context of intellectual property (the World Intellectual Property Organization) or new digital forms of payment (like crypto-currencies that have an impact on, for instance, the effectiveness of Basel III banking regulations).
- Can the same *network effects* be created after some companies lose their dominant position? What will happen in case hybrid regulations lose their legitimacy?

4. THIS VOLUME: EXPLORING NEW AREAS FOR IB RESEARCH

This PIBR Volume #13 provides a first effort to address some of the aforementioned themes. It is dedicated to exploring the new opportunities and challenges that the information and digital age have created for established MNEs, small and medium sized MNEs, international new ventures, and global start-ups, as well as for developing and developed countries. Some MNEs actively shape this era, while some are heavily influenced by the coming-of age of the information and digital age. This volume focuses, in particular, on the interaction between MNE strategies and the shape of the information and digital age along four tracks: Part I takes stock of trends and explores new concepts and theoretical approaches, needed to fully cover the role played by MNEs in the information and digital age. Part II looks at present trends from an "entrepreneurial" perspective: what strategies are employed in what areas and why? Part III zooms in on a number of functional areas of management that are particularly susceptible to influences of the information and digital age: employees, services, and value chains. Part IV takes a step back and includes a number of chapters that take a more macroeconomic, theoretical, and regulatory point of view: what does "industry 4.0" look like, whether from a comparative perspective or at different levels of regulation and organization?

5. PART I: TRENDS, CONCEPTUALIZATIONS, AND THEORETICAL DEVELOPMENTS

Chapter 2 provides a conceptual framework for most of the other chapters. In 2017, United Nations Conference on Trade and Development (UNCTAD) produced a timely "World Investment Report" on the digital economy. Bolwijn, Casella, and Zhan use the classifications that were developed in that report to further channel their research efforts, understand trends, and define the challenges for policy areas such as taxation and investment policies. They argue that a deep re-think of the MNE internationalization theory is needed to explain the transformations at work in international production as a result of digitization. They show that digital MNEs represent by far the most dynamic and pervasive players among the world's largest multinationals. It has become imperative to follow these firms' strategies and understand their impacts on the global economy.

Chapters 3 and 4 build upon these ambitions: on the basis of a systematic literature reviews to (a) identify relevant research that has considered the use by MNEs of new information and communication technologies (Hazlehurst & Brouthers, Chapter 3), and (b) identify fundamental external uncertainties for MNEs related to the information age that require particular strategies (Mullner & Filatochev, Chapter 4). Both chapters employ different search approaches, which make their conclusions largely complementary. Hazlehurst and Brouthers conclude that the study of ICT as a management tool in internationalization processes has not really kept pace with their actual implementation. The chapter, therefore, focuses primarily on identifying relevant research areas for IB and strategy researchers; in particular, in such areas as location choice, internationalization processes, and entry mode decisions. The authors' implicit message, however, is that IB scholars can learn a lot from other research disciplines such as marketing and information systems research. Mullner and Filatochev develop a more integrated approach to the various functional areas of management that are influenced by new stakeholder relations, and by the various degrees of uncertainty. They use recent developments in the information age as a relevant context for identifying six relevant IB themes: peer-to-peer communication, crowd-based organizations, changed industry dynamics (favoring small innovative firms), collaborative (networking) strategies, connectivity, artificial intelligence, and blockchain.

Chapter 5 by Cantwell and Salmon provides a largely theoretical account of the new complexities that MNEs face in the information age. They focus, in particular, on the way in which knowledge re-combinations can be influenced by two dimensions of distance: disparate knowledge fields and distinct geographic locations. They argue that little research has been done on this in the innovation strategy literature. The information age creates new potential for creating informal networks. One challenge for MNEs is to organize these informal, relational networks over longer distances – thereby linking formal governance structure and informal networks.

6. PART II: ENTREPRENEURIAL STRATEGIES

The four chapters in this part consider the more dynamic and entrepreneurial aspects of the information age. Laplume (Chapter 6) takes a look at the phenomenon of "initial coin offerings" (ICOs). The phenomenon of bitcoins is related to the use of blockchain technology. In this chapter, he links ICOs to the well-known topic in IB research of "born global" start-ups. The entrepreneurial challenge for blockchain start-ups is that they need to solve the problem of network effects – that is, how to create critical mass for a product or service that is not regulated by banks or other authorities. This not only presents particular challenges, but also opportunities to the internationalization of the business model.

Eduardsen (Chapter 7) focuses on the effect of e-commerce on internationalization processes. He uses the Uppsala process model of internationalization and his chapter is one of the few in this volume that actually tries to link a study of corporate strategies in the information and digital age to mainstream IB theory. The Uppsala model is largely one of entrepreneurial decisions, in this case, around the use of the Internet as a means to provide information about the firm. This chapter uses a rich and extensive database, and reaches conclusions supported by statistically significant results. An interesting conclusion is for instance that – for SMEs – using the Internet facilitates international transactions and diversification. But, e-commerce does not automatically results in higher degrees of internationalization.

Jia, Kenney, and Zysman (Chapter 8) attempt to understand and document the (entrepreneurial) motives of Chinese digital platforms to internationalize. Their strategies cannot be separated from the impact of the home market and related government influence. Their chapter provides an important contribution to the discussion on new business models in the information age. Platform competition presents different managerial logics as compared to traditional markets, whereby success is characterized by strong network effects, winner-take-all dynamics, increasing returns, and lock-in outcomes. These elements are highlighted in the context of Chinese platform companies. Effects can be noted on their general strategies, but perhaps even more so on their internationalization strategies. The chapter primarily covers three Chinese platform firms: Tennent, Alibaba, and Baidu. But, it also considers the extent to which these examples can be generalized to other Chinese platform firms, and what this implies for the study of internationalization processes of Chinese firms in general. The conclusions on platform and networking effects are generalizable beyond Chinese information companies.

In Chapter 9, Costa e Silva and Elo present a condensed and exploratory case study, in the business-to-business area. The entrepreneurial element in this chapter is highlighted, inter alia*,* by the search for managerial capabilities in the realm of new ventures and digital relationship management. The authors present a case study that illustrates how a firm can progress in relationship management, for instance, through building up trust through a particular social media strategy. They conclude that neither national context, nor small size, necessarily need to be impediments to internationalization, provided that companies can develop a sophisticated combination of "digital layers" of business relationships.

7. PART III: FUNCTIONAL STRATEGIES

The information age also has repercussions for functional areas of management. A first, concrete example can be found in the creation of online marketplaces for talent.

Chapter 10 by Caspin-Wagener, Massini, and Lewin looks at this issue from different levels of analysis, and assesses the new ways in which work in general, and innovation-related work in particular, is being organized. The authors identified more than one hundred online platforms in the Science, Technology, Engineering, and Math arena that operate as brokers or intermediaries between employers and freelancers. Little is known on the actual operation and effects of these online platforms, and the authors, therefore, explored the key dynamics and events driving the development of these online marketplaces, the types of innovation-related work brokered by these platforms, as well as the geographic dispersion of users and earnings. The chapter uses an extensive database (with over 23 million registered users), as well as extensive research on other platforms. The chapter provides a rich analysis of the present use of these platforms for innovation and human resource management processes, for instance, by describing how external knowledge is engaged in internal innovation processes, and the related incentive and reward system needed to make such engagement work.

A second concrete application of information technologies can be found in the integration of "smart services" in a business-to-business context. Kamp (Chapter 11) uses an exploratory multiple-case method to find out whether companies in the machine tool industry can get a firmer grip on their installed base through the application of "Industry 4.0" practices and whether this allows them to get a firmer grip on their international (service) business. The results are positive, but do depend on the ability to capitalize on these advanced services – for instance, the positive effects are moderated by the willingness of buyers to pay for the extra service. The author concludes that the expectation described in the existing literature of advanced services becoming subject to market pull, may be elusive. The motivation to add smart services based on Industry 4.0 practices should therefore come primarily from the supplier, rather than the buyer.

A final and very concrete application of the information age can be found in new production techniques, such as "additive manufacturing" (AM). This is also known as 3D printing: joining materials in a layer-upon-layer manufacturing process. The authors of this chapter make clear that their approach is broader because it refers to any professional production technique based on layered processes that are clearly distinct from conventional manufacturing methods based on subtractive processes. In Chapter 12, Buonfede, Felice, Lampertia, and Piscitello present evidence on the influence of AM on a country's position in global value chains. The main predicted impact of AM is that it may reduce incentives for firms to offshore phases of the production process. AM technologies reduce the potential of exploiting scale economies and achieving labor cost reductions by moving abroad. The statistical analysis in this chapter indeed suggests a negative and statistically significant relationship between AM adoption and global value chain participation. Future research, especially building upon case-based evidence, should help specify the conditions under which this expectation is likely to materialize.

8. PART IV: INDUSTRY 4.0

The four chapters in the final part of this volume concentrate largely on the regulatory context – or the Industry 4.0 "ecosystem" – and its impact on internationalization strategies of individual companies, clusters, and networks of companies and science parks.

Chapter 13 by Wu and Gereffi builds upon the digital ecosystem concept as defined by UNCTAD staff (Chapter 3) to compare two different Internet governance systems – namely those of the United States and China – and its impact on the business model and internationalization strategies. It focuses on two exemplary and leading shapers of their home country digital economies – Amazon and Alibaba. The strategies of these companies encompass much more than e-commerce: they leverage more systemic aspects of the digital economy such as platforms. The authors identify interaction effects between national systems and corporate strategies, especially with regard to controversial areas of national Internet ecosystem governance. Important interactions can be found in the realm of: (1) cybersecurity and national autonomy (in China related to the Great Fire Wall); (2) privacy and real-name verification; and (3) the Chinese policy to have a "special management share" in Internet corporations. As a consequence, important national differences appear between the United States and China, which – through the international operations of lead corporations such as Amazon and Alibaba – will likely have major implications on the global digital ecosystem.

Chiavesio and Romanello (Chapter 14) consider comparable developments from the perspective or a European country, Italy. They look at the consequences of the introduction of Industry 4.0 technologies for the internationalization of 16 manufacturing exporting companies. They find a much less straightforward relationship between industry 4.0 and internationalization than might be expected from the extant literature. For most of the companies adopting 4.0 technologies, it was a logical next step, following a long tradition of investments in technology and innovation. It can be concluded from this research that for established European companies, Industry 4.0 technologies are used primarily to sustain their existing position, but not necessarily to improve their position in new areas.

Götz and Jankowska (Chapter 15) further explore the role of clusters in the fourth industrial revolution. In a largely theoretical chapter, they argue that clusters provide mechanisms and functionalities that are well aligned with features of Industry 4.0 manufacturing. Clusters and Industry 4.0 are compatible, not contradictory. SMEs can implement Industry 4.0 manufacturing principles (and the related use of the Internet) better if they are embedded in a cluster. The authors argue that this also has consequences for the spatial distribution of activities. Industry 4.0 clusters create platforms of collaboration and alliances, but stripped from their geographical attributes, much in contrast with Michael Porter's outdated thinking. Industry 4.0 clusters need not be location-specific, nor geographically concentrated.

The final contribution in this fourth part (Chapter 16) considers another type of networking and ecosystem build-up, in support of Industry 4.0, namely the creation and internationalization of science parks. Tomelin, Amal, Zen, and Arrabito present an exploratory study of three science parks located in the south of Brazil. Science parks are an important component of national and regional innovation ecosystems. In particular, in developing countries, they are considered a distinct milieu, within which social and institutional processes emerge.

The authors apply (social) network theory, as well as an upgraded Uppsala internationalization approach, to take into account the relationships and synergy among the actors in the local ecosystem. They find that the internationalization of Brazilian science parks and their tenants has been based primarily on international partnerships with comparable ecosystems: other science parks, business incubators and international institutions and organizations that govern science parks around the world.

9. CONCLUSIONS: THE QUEST FOR AN UPGRADED IB DICTIONARY

The combined chapters of this volume – whether exploratory, conceptual, case-based, or data-based – demonstrate that we need to expand the "dictionary" of IB scholars. Some of the most pervasive and impactful trends related to the information and digital age require: (1) accounting for the novel international growth strategies of companies such as Amazon, Alibaba, and many still unnamed, start-up companies. These start-ups often utilize business models that provide the potential for becoming true "born globals" in the Internet age; (2) introducing new spheres of regulation and public policy, in general, not only to address the opportunities and challenges posed by bitcoins, blockchain technology, 3D printing, etc., but also to provide effective oversight in the realm of domain names and rights to security and privacy; (3) adopting new concepts in business model analysis, such as platforms, crowdsourcing, additive manufacturing; and (4) contributing to new, great societal debates; for instance, around intellectual property rights and privacy protection. The index of this volume provides some indication as to where the requisite, new dictionary is growing in substance. The volume also demonstrates that our journey into this new era – a new society, new business models, the need for new IB scholarship, has only just begun.

NOTE

1. The seven journals include: *Journal of International Business Studies, International Business Review (IBR), Journal of World Business/Columbia Journal of World Business, Critical Perspectives on International Business, Management International Review, Multinational Business Review*, and *Transnational Corporations*.

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CHAPTER 1

THE FOURTH INDUSTRIAL REVOLUTION: SEVEN LESSONS FROM THE PAST

Lorraine Eden

ABSTRACT

The digital economy, which heralds the start of the Fourth Industrial Revolution (IR4), is upon us. What can history teach international business scholars about how firms are likely to respond to this new form of technological change? Who are the likely winners or the likely losers? For 30 years, the author has lived through, studied, and written about the Third Industrial Revolution and other major environmental shocks, ranging from new entrants to academia to regional integration to outbreak of war, looking at the fundamental issues of how individuals, firms, communities, and countries respond to and are affected by life-changing events. In this chapter, the author tells seven brief stories about living through and studying "shocks and responses." Perhaps, some of these stories may provide useful lessons to the scholars of IR4.

Keywords: Fourth Industrial Revolution; Industry 4.0; digital economy; shocks and responses; insiders and outsiders; technological competition; political bargaining model; institutional distance; liability of foreignness

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1. INTRODUCTION

The global economy is going through a digital revolution, one that Schwab (2016a) refers to as the "Fourth Industrial Revolution" or "Industry 4.0." In this chapter, I offer some insights into the Fourth Industrial Revolution (IR4) based on having lived through the Third Industrial Revolution (IR3) and having researched the roles played by multinational enterprises (MNEs) in IR3.

The question of how individuals and firms are affected by and respond to major shocks, of course, is not solely the property of IR3. Many kinds of environmental shocks can blow through and disrupt the existing order of our lives. For example, Bob Dylan's song "The Times They Are a Changin" has been a theme song for my generation, who grew to adulthood during the turbulent times of the late 1960s (e.g., the Vietnam War, the assassinations of Martin Luther King and Robert F. Kennedy, the first man landing on the Moon). The "changing times" has also been a key research interest for me, studying how environmental shocks affect us and change the trajectories of our lives.

In this chapter, I want to share some reflections on shocks and responses, focusing mostly on IR3 but with the occasional addition of a personal story along the way. The *Oxford English Dictionary* defines a parable as "a simple story used to illustrate a moral or spiritual lesson." I write about my research and experiences as simple stories, which I hope may have lessons useful for other international business (IB) scholars studying IR4. We all see life through our own lenses, of course, so the reader is warned in advance that these stories are subjective and colored by the haze of history; they are not "transparent accounts of events" but rather "material for interpretation, inquiry, and engagement (Bocher, 2007, p. 206). I invite the reader to engage with these stories and think about their potential usefulness for research on multinationals, IB, and the digital economy. My chapter begins with a brief history of the first three industrial revolutions and then moves into a description of IR4. Seven short lessons follow. I conclude with some thoughts about next steps.

2. THE FIRST THREE INDUSTRIAL REVOLUTIONS

Industrial revolutions are caused by "new technologies and novel ways of perceiving the world [that] trigger a profound change in economic systems and social structures" (Schwab, 2016a, p. 11). Most scholars believe that there have been three industrial revolutions (Bell, 1987; Mytelka, 1987) and that the fourth is underway (Morrar, Arman and Mousa, 2017; Schwab, 2016a, b). The First Industrial Revolution lasted from about 1760 to 1840; this was the era of water and the steam engine, the shift from craft production in homes to simple machines in factories, and the rise of the iron and textile industries. The Second Industrial Revolution (IR2), from roughly 1850 through 1920, was sparked by new technologies (electric power, telephone, and internal combustion engine), the rise of the chemical, steel and petroleum industries, and the introduction of modern business management systems. The IR3 started with the introduction of semiconductors and integrated circuits (1950s), which were followed by mainframe computers

(1960s and 1970s), personal computers (1980s), and the Internet (1990s). In IR3, the introduction of electronics and information technologies was also accompanied by changes in business management systems as manufacturing shifted from mass to lean production techniques.

I have had a long-run interest in technology and its impacts on domestic and foreign firms going back as far as Eden (1989, 1991). My early work in this area was influenced by the writings of social scientists on the political economy of technological change and its impacts on the international division of labor. Bell (1987) and Mytelka (1987), for example, argued that the early industrial world was split into two types of economies: core and periphery. Around 1860, core economies such as England, Germany, and the United States began to use outward foreign direct investment as a way to extract natural resources and primary goods from the periphery economies, creating the Old International Division of Labor (OIDL) in which raw materials were shipped back to the core economies.

The OIDL lasted up to the 1950s when, in response to the rise of Japan and the newly industrializing economies in East Asia, MNEs in the core economies began to shift light, labor-intensive assembly operations (e.g., textiles) offshore to East Asia, pulled by lower unit labor costs and more attractive government policies such as the creation of export processing zones. The introduction of semiconductors in the 1950s and mainframe computers in the 1960s fueled the growth of the electronics industry and it, too, moved offshore. At the same time, manufacturers of mass-production, capital intensive products, such as steel and automobiles, also moved out of the core economies, attracted by large host-country markets and import-substitution policies that induced inward tariff-jumping FDI into Latin and South America. Bell (1987) and Mytelka (1987) refer to this time period (roughly from the 1950s to the 1980s) as the New Industrial Division of Labor (NIDL). In the NIDL, multinationals began creating global commodity chains, linked together by intrafirm flows of capital, technology, and intermediate and finished goods. Researchers – typically sociologists, labor economists, and political scientists – studied these global value chains in industries such as textiles, apparel, semiconductors, and electronics (see, e.g., Gereffi & Korzeniewicz, 1994).

The introduction of personal computers in the 1980s and the Internet and e-mail in the early 1990s spurred another round of technological change. The new information and communication technologies (ICT) were also accompanied by another shift in manufacturing processes, from mass production to lean production, as the US and European manufacturers began to adopt Japanese business practices. New industries emerged, not only in electronics, but also, for example, in biotechnology and advanced materials.

The automotive industry was the "old style" manufacturing industry where the shift from mass production to lean production was perhaps most pronounced and certainly most studied; the best-known study being the five-year MIT research project and book *The Machine that Changed the World* (Womack, Jones, & Roos, 1990). Other works with seminal case studies included Van Tulder and Junne (1988) and Kenney and Florida (2003).

The flat panel display (FPD) industry was perhaps the first "new economy" manufacturing industry to emerge in that time period. The definitive study by Murtha, Lenway, and Hart (2002), funded by the Sloan Foundation, saw FPDs as "the windows to the souls" of all the new machines that would follow, including wall-hanging TVs, wearable computers, and on-board automotive navigation systems – all of which we have today. Key insights in Murtha et al. (2002) – also borne out subsequently – were that the sources of competitive advantage in these new industries would be knowledge based, with short product life cycles where rival firms would engage in knowledge-driven competition based on learning, speed, and flexibility.

And now, we are witnessing what most social scientists believe is the birth of IR4.

3. IR4

3.1. Definitions

Schwab (2016a, 2016b) argues that IR4, also known as Industry 4.0 or the "digital economy," started around the millennium with the introduction and widespread adoption of digital technologies. (I use the three terms interchangeably in this chapter.) Schwab (2016b, p. 1) defines IR4 as "characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres." Schwab (2016b) believes that IR4 is distinct from IR3 due to its velocity (evolving at an exponential not linear rate), scope (disrupting almost all industries in all coun tries), and systems impact (transforming production systems, management, and governance).

Organisation for Economic Cooperation and Development (OECD) (2012, p. 5) views IR4 as "comprised of markets based on digital technologies that facilitate the trade of goods and services through e-commerce." A third, more detailed definition is provided by Global Trends (2013, p. 1):

> social and economic activities that demonstrate the following characteristics: are enabled by internet/mobile technology platforms and ubiquitous sensors, offer an information rich environment, are built on global, instant/real-time information flows, provide access 24/7, anywhere, support multiple, virtual, connected networks.

My own view (Eden, 2016) is that IR4 is one of the key "winds of change" that are shattering and replacing traditional forms of MNEs and FDI. IR4, like the industrial revolutions that preceded it, is generating a process of Schumpeterian creative destruction. IR4 is being fueled by several disruptive technologies that are transforming markets; these include the Internet (also in IR3), automation of knowledge-based work, the Internet of Things, cloud computing, advanced robotics, 3D printing, and advanced materials (McKinsey Global Institute, 2013).

IR4 has three key features, according to the European Commission (EC) (2014): mobility (velocity), network effects, and data usage. All three offer the potential to shake up domestic and international markets. In terms of mobility, once the fixed costs have been incurred of developing a blueprint for a digital product, the marginal cost of producing, replicating, and providing a digital product to consumers is minimal; thus, location can be placed wherever total costs (including tax payments) are the lowest.

Network effects are generated when the value of a product to its users increases with the number of other users of the product, creating economies of scale and scope. Network effects were very much evident in IR2 with the creation of telegraph and railroad networks and in IR3 with the Internet. In IR4, network effects are particularly pronounced because digital platforms not only attract users, but also other groups, such as advertisers and applications developers (OECD, 2012, pp. 8–9). Two-sided networks where both buyers and sellers interact on online platforms are common (e.g., Amazon, eBay, HomeAway, and Uber). In instances where small firms have firm-specific advantages with global reach, they can now "go global" from start-up, delivering online business services and digital products through e-commerce. Manufacturing firms that use digital technologies gain advantages in flexibility, small batch production, and customization. Network effects can lead to "winner take all" outcomes, but low replication costs suggest that the monopolies may not be long lasting if fast followers overtake the early movers.

The third feature of IR4, according to the EC (2014, p. 12) is the growing usage of data caused by information and communications technologies "continuously driving down the costs of collecting, storing and analyzing data." As the volume of data grows and the costs of generating and storing data fall, market-making costs (e.g., search, negotiations, monitoring, and enforcement) also decline, generating more opportunities for domestic and cross-border trade.[1]

3.2. Classifying Firms in IR4

Firms that are key participants in IR4 can be classified in different ways. One simple classification is to separate firms that are wholly digital from those that are partly digital. Wholly digital businesses are typically digital from inception, operate digitally, and have their products delivered digitally. They are truly "born digitals." Examples of born digital businesses include the Internet search engines (e.g., Google, Yahoo, Bing, ask.com, Baidu, and DuckDuckGo), the Internet social networks (e.g., NextDoor, Facebook, Instagram, LinkedIn, Twitter, WeChat, WhatsApp, and YouTube), and internet-based sharing platforms (e.g., Airbnb, Uber, Dropbox, Google Drive, and Khan Academy).

Born digitals are distinct from existing "brick-and-mortar" businesses that are adopting digital technologies into their existing production processes and product lines, which I refer to as "going digital" or partially digital businesses. Going Digitals can be either digital users (consumers) and digital producers, or both.

For traditional brick-and-mortar firms that are going digital, IR4 is expected to have significant effects on supply chains. World Economic Forum (2017, p. 5) estimates that the percentage impacts on gross profits could be huge in manufacturing (39.6%), logistics services (17.8%), and retail (33.3%). Not only will firms produce and manage their supply chains differently, but new value chains are also likely to emerge due to three developments: open innovation, distributed manufacturing, and new collaboration models. Open innovation platforms, whereby firms involve other firms and customers in their innovation and development processes, encourage crowdsourcing of ideas, designs, and problem-solving solutions. In distributed manufacturing, advanced manufacturing technologies such as 3D printing enable firms to move production closer to customers, engage in small-lot customized production, and integrate customers, designers and other firms into the value-creation process. Lastly, new forms of interfirm collaboration based on cloud computing and open-source platforms are likely to emerge. Vertical collaboration along the supply chain, a feature of IR3, may shift in IR4 to horizontal platform-based collaboration such as joint procurement and information gathering services and shared use of transportation and storage facilities. All of these disruptive changes will involve, of course, not only new revenue generating opportunities, but also short- and long-term costs.

A second classification method is to categorize businesses by their function or role in the digital economy. United Nations Conference on Trade and Development (UNCTAD) (2017), for example, provides a detailed classification of digital economy firms based on functions. First, digital economy firms are divided into two groups: ICT firms and digital firms. ITC firms provide the infrastructure and tools that underlie the digital economy, and their role is growing exponentially. Nineteen of the top 100 multinationals in the world based on size of foreign assets are ICT companies (UNCTAD, 2017, p. 161).

ICT firms are then further subdivided into tech and telecom. Tech MNEs are "by far the most dynamic players among the largest global multinationals" (UNCTAD, 2017, p. 161). Tech firms include manufacturers of information technology (IT) devices (e.g., Apple, Samsung Electronics, IBM, Sony, Dell Technologies, HP, Lenovo Group, Sharp, Nokia, and Acer) and components (e.g., Hon Hai Precision Industry, Toshiba, Taiwan Semiconductor Manufacturing, Flextronics, Nvidia, and ZTE). The tech firms grouping also includes IT software and services firms (e.g., Microsoft, Oracle, Accenture, Qualcomm, SAP, Tata Consultancy Services, Infosys, Adobe Systems, and Wipro). The second subgroup is telecom firms, that is, the providers of communication infrastructure and connectivity (e.g., AT&T, Nippon Telephone and Telegraph, Deutsche Telekom, Telefonica, BT Group, and Vodafone Group).

UNCTAD (2017) subdivides the digital firm category into four groups: the Internet platforms, digital solutions, e-commerce, and digital content producers. Internet platforms include search engines, social networks, and so on (e.g., Alphabet, Facebook, eBay, Yahoo, LinkedIn, and Twitter). Digital solutions include firms engaged in electronic payments and other digital solution providers (e.g., PayPal, Salesforce, VMware, NASDAQ, Citrix Systems, and GoDaddy). E-commerce firms include the Internet retailers and other e-commerce (e.g., Amazon, Alibaba Group, Priceline Group, Expedia, and Sabre). Lastly, digital content producers include firms that produce digital media, games, and information and data firms (e.g., Comcast, Time Warner, CBS, Viacom, Netflix, Moody's, and Thomson Reuters).

In reality, there is substantial overlap among these groupings, especially as mergers and acquisitions continue to blur the lines between industries. Moreover, as Adelson, Ledeen, and Lewis (2008) in *Blown to Bits* remind us, technological revolutions transform firms and industries and change the nature of competitive advantage in ways that we cannot predict; even the most established of the Fortune 500 firms can be vulnerable and not survive.

As scholars begin to study the digital economy and its likely impacts on these different categories of firms (and vice versa), a look back at the past may be useful. I turn now to seven lessons from the past and my past, which I believe may be helpful lenses through which to view "how the times they are a-changin'" in Industry 4.0.

4. LESSONS FROM THE PAST

4.1. Shocks and Responses

Like most of the students in my high school, I was the first in my family to go to a university. What differentiated me from my peers was that my father was at home while my mother went out to work. This was highly unusual; in the 1950s and 1960s, women were stay-at-home mothers and men went out to work. The reversal in my parents' work roles was necessitated by my father's being blinded in a car accident when I was eight years old. Before the accident, my father had been a successful refrigeration engineer with a well-paying job. My mother had been a traditional housewife: she had three children, received a weekly grocery allowance from my father, did not drive, and did not sign checks. The accident meant my father never worked fulltime again, which necessitated my family's role reversal: my mother learned to drive, balance a checkbook, and went to work outside the home as an insurance secretary.

My response to this family crisis was to promise myself to never be put in the situation that my mother had had to face. I would go to university, get an education, and find a career that paid me a really high salary. So, I graduated top of my high school class, went to university and got a PhD, and became a university professor … well, "two out of three ain't bad!" All jesting aside, being an academic now for nearly 50 years has been a wonderful career. I have traveled the world; worked with amazing students, colleagues, and coauthors; and have had a very rewarding personal and professional life filled with family and friends.

My first position in academia was as an untenured lecturer in Economics at Mount St. Vincent University (MSVU), a small Catholic women's university in Halifax, Nova Scotia. I started teaching at age 22 after 1 year of graduate studies at McGill University. My new husband, Ron Eden (we had been undergraduate classmates at Mount Allison University), had been admitted to the MBA program at St. Mary's University. I took a job at MSVU while he went back to school.

At MSVU, I discovered that I liked teaching and being a professor – but knew I needed a PhD to stay in academia. With my husband and I both now working in Halifax, I started taking graduate courses part-time at Dalhousie University, and then took a year off from teaching and entered the PhD program fulltime. At the time, the Dalhousie Economics department was home to four leading scholars in public finance (John Head, John Graham, Carl Shoup, and Cliff Walsh). As the sole PhD student in my cohort, I was treated very much as a junior colleague in the small seminars that comprised my training. After graduating from Dalhousie, I went back to MVSU, this time as the department head. My daughter, Jessica, was born the next spring. Life was good.

My earliest publications, not surprisingly, arose from my PhD dissertation on transfer pricing. Carl Shoup had just retired from the Economics department at Columbia University and agreed to take me on as his last doctoral student while he visited Dalhousie if I were willing to write on transfer pricing, a subject on which he had to write something for the Committee on Eminent Persons at the United Nations. I am a believer in "nothing ventured, nothing gained" and so yes. Looking back now, I realize how much of my subsequent activities were a result of that offer and acceptance. My career in transfer pricing is the most visible outcome, but Carl also kindled my longtime interest in MNEs, taxation, and developing countries, having spent much of his adult life advising developing country governments on their tax systems.[2] He was very much a believer that academics needed to engage with firms and governments in the real world and not just be bystanders in the "ivory tower of academia." On the substantive front, I believe in IR4 the issue of transfer pricing will be even more important than before, since governments and MNEs will have even more difficulty in assessing where value is created and how it should be taxed. Carl would have relished the challenge of writing a high-level white paper on the global challenges of taxing MNEs in the digital economy.

A few years later, my family and I moved to Ontario and I became an assistant professor at Brock University, teaching undergraduate economics. Ron worked first in Toronto and then went back to school to do his PhD in Accounting at the University of Buffalo. While I was at Brock, my early transfer pricing articles attracted the interest of Alan Rugman who invited me to co-organize a conference with him on MNEs and transfer pricing at Dalhousie University in 1983; we later co-edited the seminal book that came out of the conference (Rugman & Eden, 1985). A key insight for me from meeting the IB scholars Alan had invited to the conference was that while I knew a lot about the economics of transfer pricing, I did not know very much about MNEs. I, therefore, proceeded to learn all I could about MNEs and FDI by creating and teaching an undergraduate course on this subject.

In 1986, I was invited by the Paterson School of International Affairs at Carleton University in Ottawa to interview for an opening the School had for someone with an expertise on the political economy of MNEs and FDI. When the School made me the offer, my husband and I decided to move to Ottawa. I joined the faculty at the Paterson School and Ron joined the Accounting department at the University of Ottawa.

4.2. Multinationals as Agents of Change

Moving from teaching undergraduate economics at Brock to teaching masters-level courses in international affairs at the Paterson School was a big transition in both level and discipline. In the fall of 1987, I co-taught the core graduate seminar on International Political Economy with Maureen Appel Molot, a well-known Canadian political scientist. I had only one undergraduate course in political science, so each class was a learning experience. Despite my intellectual handicaps, Maureen and I discovered that not only did we enjoy teaching together, but we also shared common research interests in MNEs and FDI in the auto industry. Thus began a fruitful research partnership and a life-long friendship. Maureen and I co-authored 16 publications along with others on our own that built on our learning and working together, on MNEs, the auto industry, North American regional integration, and Canadian economic policies.

Residing in Ottawa, the capital city of Canada, I benefitted from having a window seat on observing the intricacies of government functioning. I was given an opportunity to provide policy advice to the Canadian government during one of Canada's most exciting time periods for economists and political scientists: the years spent negotiating and implementing the 1989 Canada–US Free Trade Agreement (CUSFTA) and the 1994 North American Free Trade Agreement (NAFTA). It was a busy and productive time for me. I ran an international trade and FDI research center, was promoted to full professor, and started working with Revenue Canada providing in-house training on transfer pricing.

Much of my research after moving to Carleton was focused on technological change and regional integration, and their effects on MNEs and FDI in North America. A key argument that I made was that MNEs, not domestic firms, were the core "agents of change" in this process (Eden, 1989, 1990a, 1990b, 1991b, 1994a, 1994b, 1994c, 1994d).

I began to focus on how technological change and government policies would affect not only the MNE as a whole, but more importantly the role of the individual plant within the MNE network of companies. For example, in Eden (1991b), I argued that a plant's role within the MNE group, whether for resource, cost, or market seeking, was a key factor influencing plant location. Plants at different stages of the value chain would have different levels of technological sophistication, which would vary with the nature of the plant activity and the age of the plant in the host country. My work on plant location suggests a lesson for IB scholars of IR4: not all MNE activities around the globe are equal in importance to the MNE. The easy mobility of goods, services, and intangibles in the global economy is unlikely to create a "level playing field" within the MNE, and it will be important to study how government policies affect particular value adding activities of "born digitals" and "going digitals."

4.3. Hub and Spokes: From Silent Integration to Strategic Alliance

In November 1990, I testified before the House of Commons Standing Committee on External Affairs and International Trade on the US–Mexico–Canada trade negotiations. My testimony revolved around how US multinationals with Canadian subsidiaries were responding to the shift from mass to lean production and the 1989 CUSFTA. I also expressed my views on what Canada's response should be to Mexico's request for a bilateral free trade agreement with the United States. In my testimony, I explained the different types of plants that

MNEs could establish and how knowledge-based production was likely to affect the MNE's plant location decision. I argued that trade and investment flows in North America should be viewed as the outcomes of a hub-and-spoke system; that is, North America consisted of one large "hub" economy (the United States) and two small "spoke" economies (Canada and Mexico). I argued that another bilateral trade agreement between the United States and Mexico would only accentuate the existing hub-and-spoke pattern, and that, therefore, Canada should choose a trilateral agreement (NAFTA) over three bilaterals.

In later publications, using statistics on trade and FDI patterns between the three countries, I showed that international trade and FDI were mediated, for each of the spokes, through the US hub (see, e.g., Eden & Molot, 1992a, 1992b, 1993b). I argued that Mexico and Canada had for many years been engaged in "silent integration" into the US economy, and that it was time for Canada and Mexico to move away from relying solely on these dyadic patterns, and to engage with a true strategic alliance among the three countries. Maureen and I also made these points in various meetings with government officials in Industry Canada and the Department of Foreign Affairs in the early 1990s, and, perhaps, we may claim some very small credit for trilateralizing the trade agreements.

At the same time, I was also working with Maureen on studying the Canadian side of the North American auto industry. In Eden and Molot (1993a, 1993c), I focused on how government regulation of the industry changed over time with the introduction of the 1965 Automotive Pact, the 1989 CUSFTA, and the 1994 NAFTA. These papers were both a study of the three sets of regulations and of their likely impacts on the strategies and structures of the auto assembly and auto parts firms, as viewed through the lens of "silent integration versus strategic alliance."

A fundamental building block for my later research on MNE location strategies was the sponsoring by Industry Canada of a conference I organized in 1993 on "Multinationals in North America," where I brought together all the leading scholars working on MNE strategies and structures to explore how regional integration and technological change would likely affect MNE and FDI activities and patterns in North America. Industry Canada subsequently published the edited book (Eden, 1994c). Although now out of print, it is viewed by many as one of the seminal works in the field on MNE responses to technological change and regional integration.

My own chapter (Eden, 1994d) explores the impacts of technological change and regional integration on MNE plant location strategies inside North America. The chapter draws together much of my earlier work into one definitive study of MNE strategic responses to NAFTA. In thinking about winners and losers from regional integration, I used the analogy of a chessboard with immovable blocks scattered around the board to explain why incumbent firms, having adjusted to the blocks, found it so difficult to develop new strategies once the blocks were removed. New players that were not handicapped by old learning were likely to be more flexible and successful. In the long run, the game would be faster and more efficient, but not all the old players would survive. Applied to the NAFTA, the question was whether the US multinationals would close their Canadian plants and shift their production to Mexico. I argued they would not, but that there would be significant rationalization across the continent, both in terms of horizontal and vertical specialization.

In the digital age, similar questions to those I posed in Eden (1994d) are still important. Can small open economies thrive as loci for investment and employment by born digital and going digital firms? What are the relative benefits and costs to small open economies of regional agreements on regulating digital economy activities as opposed to undergoing silent integration? Can local activities of incumbent firms that are late movers in IR4 be protected from the new digital entrants from abroad? Should they be protected?

4.4. Who Is Us? Insiders and Outsiders

A core piece in my work on regional integration has been the differential treatment of insiders and outsiders and how they respond to regional integration. Robert Reich had asked the question "Who Is Us?" (Reich, 1990, 1991), when looking at the US and foreign MNEs in the US economy. The question intrigued me and led to me to write several papers around the theme of "Who is us?" in the context of regional integration (see, e.g., Eden, 2002, 2007; Eden & Li, 2004; Eden & Monteils, 2000) and the auto industry (Eden & Molot, 1993a, 1996, 2002).

In this work, I model "us" as "insiders" and "them" as "outsiders," with the distinction being based initially on nationality (domestic vs foreign), but over time being determined increasingly by two other elements: the firm's activities and whether the firm achieved (what we now call) organizational legitimacy. At that time (the early 1990s), I was unfamiliar with the sociologist's concept of organizational legitimacy but do believe that I was using the concept correctly since my definition is consistent with the term. I defined "us" as "seen and treated as insiders by consumers, other producers and National Governments" (Eden & Molot, 1993a, p. 31).

In Eden and Molot (1993a), I focused on the economic and political strategies firms can use to influence how they are viewed by others. I argued that firms can use either economic or political strategies, or both. Economic strategies include methods of serving the market (exports vs FDI), purchasing of inputs (imports vs locally purchases), and contributing to the local economy. Political strategies include joining industry associations, advertising, donating to local charities, and putting prominent nationals on corporate boards. I then compared the US MNEs and foreign automotive transplants in the US market on the basis of these dimensions.

At this point in time, there has been relatively little study of economic versus political strategies used by firms in the digital economy. Given the lack of government policies addressing externalities created by IR4 (e.g., digital economy MNEs having access to worldwide data on consumers through their dispersed customer base), there is an urgent need for creative IB scholarship in this area.

4.5. Technological Competition

Three years later, my thinking had become much richer and more based on corporate strategy. In Eden and Molot (1996), I began to think about how MNEs might use technology as a form of competition. I called this the "technological competition model" and applied it to a case study of Japanese auto multinationals penetrating the US auto market. In the model, a new technology emerges in one country (e.g., Japan) that gives local firms using the new technology the ability (e.g., through lower costs) to enter an established market in another country (e.g., the USA) via exporting. Foreign entry is not viewed as a threat by the incumbents because import penetration is low; as a result, incumbent firms react slowly with short-term, uncoordinated responses. As import penetration rises and competition between the foreign entrants and incumbents grows more intense, the two groups begin to split into "insiders" and "outsiders," and the incumbents begin to develop strategies for dealing with the technological competition posed by the "outsiders."

I argued that the incumbents are likely to respond to technological competition in one of two ways, which I characterized as production strategies versus political strategies. In the model, three possible production strategies for the incumbents are discussed: (1) intensification (a short-run strategy focused on raising productivity by lowering unit labor cost, while holding the number of plants and technology fixed; (2) rationalization (a mid-term strategy based on reallocating capital among the firm's plants by closing existing plants and/or shifting product lines); or (3) technological upgrading (a long-run strategy based on investment in new product and/or process technologies.

The incumbents could also adopt one or more types of political strategies. I argued that the first political strategy is to focus on the "us (insiders)" versus "them (outsiders)" distinction, attempting to widen the gap and preventing the foreign entrants from being viewed by the host government, labor, and consumers as "insiders." The second political strategy is to seek policy changes that benefit the incumbents at the expense of the entrants. These policy changes could be pro- or anti-market. For example, they could involve pro-market lobbying for regional integration that would provide a larger market with greater economies of scale and scope. On the other hand, the incumbents could lobby for anti-market "shelter strategies" (Rugman & Verbeke, 1990) that would protect the incumbents from foreign competition through tariffs, non-tariff barriers, or market closure.

Whatever production and political strategies were adopted by the incumbents, I argued that these firms would typically fail to recognize the permanent nature of the technological change, and the need to adapt to the new technology, until the foreign firms actually moved onshore and began using the technology in the host country. After that point, when faced with the fact that foreign firms could be successful on the "same turf" as the incumbents, the demonstration effect would finally take hold and diffusion of the entrants' technology to the incumbents would start to occur. I also argued that incumbents, which continued with market-shelter strategies would continue to lose market share to the foreign entrants, unless they used the "window of opportunity" provided by the shelter to engage in restructuring operations. Here, incumbents that successfully engaged in technological upgrading (either on their own or through strategic alliances with the foreign firms) were more likely to succeed.

Maureen and I then applied the model to a case study of Japanese entry into the US automotive industry. The First Challenge, Japanese auto exports to the United States over 1955–1973, triggered two responses from the (at the time Big Four, later Big Three) auto MNEs. The first was an "intensification" production strategy based on increasing the number of platform sizes and corporate twins (e.g., Ford producing essentially the same car models under the Ford and Mercury brands). The second was a market-based political strategy (e.g., lobbying for specific regulations in the Canada–US Auto Pact).

During the Second Challenge (1973–1983), import penetration continued to grow. The US auto MNEs shifted from a production strategy based on intensification to one based on rationalization (e.g., downsizing the number of models, closing plants, and sourcing captive imports). The US firms also stepped up their political strategies, going primarily with shelter-based requests (e.g., the Chrysler bailout, the voluntary export restraint program, requests for special foreign trade zones within the United States). The Third Challenge (1983–1995) was triggered by the establishment of Japanese automotive factories in the United States. The Big Three responded with a mixed strategy: greater use of worldwide sourcing of parts and vehicles, downsizing and plant closures in North America, and (finally!) attempts that were mostly unsuccessful, to shift from mass to lean production techniques. The big changes came on the policy side. In both the CUSFTA and NAFTA, the US auto MNEs attempted to isolate the Japanese transplants as "outsiders," and were far more successful with the US administration than they were in Canada or Mexico.

During this entire time period, the Japanese transplants were not standing still; they continued to engage in technology upgrading and taking market share away from the US auto MNEs. Several key lessons emerge from this case study that might be useful in thinking about firm responses in IR4. First, incumbent firms typically misunderstand the nature of the challenge from the new entrants and therefore deploy temporary (and ill-conceived) solutions. Second, they are likely to continue doing so until the advantage of the innovation is demonstrated on the local firms' "home turf." Third, if the form of technological innovation is difficult to understand and duplicate, the incumbents and new entrants are likely to continue traveling along very different technological trajectories. Switching from one technological trajectory to another is difficult, making incumbents reluctant to switch and more likely to be trapped in second-best strategies. Fourth, government policies designed to shelter incumbents from foreign competition typically fail and end up costing more than allowing markets to work through the "fresh winds of competition." Fifth, government policies almost always have unintended consequences that create unexpected winners and losers. And, lastly, technological competition is here to stay: innovations happen and are not well understood; firms are on different technological trajectories; and incumbent firm strategies are biased toward short-term, partial responses.

4.6. The Political Bargaining Model

"Insiders, Outsiders and Host Country Bargains" (Eden & Molot, 2002) brought much of the earlier strands of my research together in a case study of iterated bargaining between one host-country government (Canada) and two sets of MNEs: incumbents (US firms) and foreign transplants (Japanese and European firms). The obsolescing bargain model is dyadic; it looks at bargaining between one host government and one foreign entrant. However, in Canada, there had been two waves of foreign entrants; US automotive firms early in the twentieth century, and (primarily) Japanese transplants in the 1980s and 1990s. The "first wave" transplants over time assumed the status of "favored insiders" in the Canadian market; the "second wave" transplants hoped to achieve the same status (which the "first wave" entrants actively lobbied to prevent).

In this chapter, I used the tools of the obsolescing bargain model (goals, resources, and constraints) to predict bargaining outcomes with respect to a series of government policies, ranging from the Auto Pact through NAFTA. Another innovative construct was to graph the Canadian demand for autos together with the US and Japanese supplies, and then predict how different government policies would affect demand and supply, and relative market shares.

Key insights in this chapter – which again may be useful for studies of the IR4 – are as follows: (1) early foreign entrants can achieve insider status and then behave like traditional incumbents; (2) the home country governments (in this case, the United States and Japan) for the two waves of foreign entrants can play important roles in affecting outcomes of policy decisions; (3) timing of entry matters because the longer the gap between the two entries the more time the first movers have to become entrenched; (4) nationality is much less important for outcomes than organizational legitimacy; and (5) the number of entrants in each wave and the type of industry also affect the results.

Thinking about multiple players and bargains in the automotive industry also led me to question whether the obsolescing bargaining model (Vernon, 1971, 1977, 1998) could be reconceptualized. Most IB scholars had abandoned the obsolescing bargain model, arguing that it has outlived its usefulness. Case studies attempting to test the model had shown that MNEs were able to retain relative bargaining power over the host country government so the bargains seldom obsolesced; in addition, few governments in the early 2000s restricted inward FDI. The question therefore was whether the model could be salvaged.

In Eden, Lenway, and Schuler (2005), I developed the concept of the *political bargaining model,* which was based on goals, resources, and constraints as in the obsolescing bargain model, but reconceptualized as iterative bargains played out over time with multiple parties (MNEs, domestic firms, and governments) in both home and host countries. The key question in the obsolescing bargain model – "What have you done for me lately?" (Vernon, 1998) – emerges as a special case of the full model. I, therefore, concluded that a richer, broader bargaining model, one that included multiple players and multiple negotiations over time and over public policies, could be a valuable theoretical lens for studying MNE–state relations. It will be fascinating to extend the political bargaining model to case studies of born digital and going digital firms. In IR4, firms might expand and contract rapidly across geographic space, partly as a function of evolving institutional quality and regulatory requirements in both home and host countries.

My interest in multiple players rather than dyads has persisted, most importantly in joint work with my former PhD student Dan Li on international, particularly R&D-based, strategic alliances (Li, Eden, Hitt, & Ireland, 2008, 2012; Miller, Li, Eden, & Hitt, 2008; Li, Eden, & Josefy, 2017). In this work, I argue there are fundamental differences between dyadic alliances (joint ventures) and multi-party alliances. These differences are particularly important in high-tech alliances where problems of knowledge creation (growing the pie) must be balanced against the difficulties of knowledge appropriation (sharing the pie) and the risks of opportunistic behavior (stealing the pie). I have also examined these issues in the context of technology transfers involving small and medium-sized enterprises (Eden, Levitas, & Martinez, 1997). Issues of knowledge creation, sharing, and dissipation are likely to be even more important – and more problematic – in the digital economy.

4.7. Distance, Borders, and the Liability of Foreignness

The last story that I want to share is about the role that distance and borders, and their implications for liability of foreignness (LOF), play in affecting all of the aforementioned issues I have identified. We all intuitively know that distance matters, that the further away a firm is from its customers and suppliers, the higher are the costs of doing business across that distance. We understand that distance is not only about geography, but also about other forms of distance such as language, culture, and differences in government policies.

We also know that borders matter because they create barriers that impede and sometimes stop flows across geographic space. In my first editorial as the new editor-in-chief of the *Journal of International Business Studies* (Eden, 2008, p. 1), I remarked that "international business is bread and butter to a border child." Growing up in Canada, a small open economy next door to the United States, the world's largest and most powerful country, "there was no question as to whether or not international business was important: it was reality." I saw it every day as people, goods, and cars were stopped and checked at the St. Stephen–Calais international border crossing, with occasional tariffs being levied or goods confiscated. Canadians, most of whom live within 100 miles of the 3,000-mile long US–Canada border, are keenly aware of distance and borders.

In 1995, I encountered both borders and distance as I moved with my new husband, Charles (Chuck) Hermann, to join the faculty at Texas A&M University. I had already spent time in the United States as a Fulbright Scholar at the Kennedy School, where I had co-taught with Raymond Vernon (and thoroughly enjoyed) a graduate seminar on MNEs and Public Policy while writing my book *Taxing Multinationals* (Eden, 1998).

Still, the move to Texas A&M was a big environment shock: from a small graduate School of International Affairs in the capital city of Canada to a huge business school in a small college town deep in the heart of Texas. Chuck had been hired to create and launch the Bush School of Government and Public Service as part of the Presidential Library Complex for George H. W. Bush, the 41st President of the United States. I joined, as a tenured associate professor, one of the largest and most well-known management departments in the United States. As in my earlier move from Brock to Carleton, I was faced with learning and teaching courses in a new department, joining a new professional association, and being expected to publish in new journals. Texas A&M was also my first academic department with a doctoral program, and my first opportunity to teach and work with doctoral students.

Much of my research on "shocks and responses" since arriving at Texas A&M has involved studies of the ways that distance and borders affect firm strategies. Several of these pieces have been written with Stewart Miller, who introduced me to the term "LOF" when we met at an IB workshop for doctoral students at Ohio State University where we were both panelists. I understood LOF intuitively, of course, and found the concept very useful.

Our first published piece, Eden and Miller (2004), was a conceptual paper looking at the ways in which various types of distance create costs for the firm when it ventures abroad. In the piece, I argued there are two types of costs of doing business abroad: hard costs (economic activity based, visible and quantifiable, such as transport costs and tariffs) and soft costs (sociopolitical costs, opaque, and difficult to measure, such as cultural differences).

The soft costs capture the LOF costs of being a "stranger in a strange land"; that is, not only does the firm go abroad to a strange land, but also local firms and customers view the new entrant as a stranger. I argued there are three distinct types of LOF – unfamiliarity hazards, relational hazards, and discriminatory hazards – and that these hazards increase with various types of institutional distance (regulatory, normative, and cognitive). Unfamiliarity hazards are the easiest to handle because they normally disappear over time as the firm becomes more familiar with the host country. Relational and discriminatory hazards, however, are more problematic, and depend on the form and intensity of the institutional distance. Two mixed dimensions of soft institutional distance (corruption and culture) and some possible ways for the foreign entrant to handle the resulting LOF are also explored in this chapter. I concluded that LOF is mostly driven by normative and cognitive institutional distance, suggesting that pursuing local partnerships can be important as a coping mechanism for LOF.

Much of my subsequent work with Stewart on this topic has focused on coping mechanisms for LOF, mostly but not always using panel data on foreign bank entries into the United States. We have examined, for example, local density (Miller & Eden, 2006; Zhu, Eden, Miller, Thomas, & Paige, 2012), experiential learning (Thomas, Eden, Hitt, & Miller, 2007; Zhu et al., 2012), organizational imitation (Li, Miller, & Eden, 2012), ethnic identity (Miller, Thomas, Eden, & Hitt, 2008), and corporate social responsibility (Campbell, Eden, & Miller, 2012). Eden and Miller (2010) also explored the LOF costs facing Chinese firms entering the US market, and possible coping mechanisms. In all of these studies, I found that foreign firms could reduce but not fully eliminate LOF through these mechanisms.

Most of the literature, to date, on IR4 has focused on cost reductions, new value creation, and, more generally, entrepreneurial opportunities in the new digital age. But LOF, as I and many other IB scholars have learned from our research, still matters in today's world. Unfamiliarity, relational and discriminatory hazards are likely to plague both born digital and going digital firms. The firms will need to develop their own coping mechanisms, which I suspect will continue to involve local partnerships.

My interest in LOF has led to other research that explores the LOF concept in a variety of ways. For example, in Perez Batres and Eden (2008), I argued that there are problems for local firms too; they can suffer from a liability of localness, making it difficult for them to adapt to shocks such as regional integration and technological change. In Dai, Eden, and Beamish (2013, 2017), I explored how foreign MNEs respond to shocks such as war breaking out in a host country, arguing that their response (stay or leave) depends on their vulnerability. Much like vulnerability to an earthquake, firms' responses depend on their distance from the shock, the size of the shock, how much the firms have at risk, and their coping mechanisms. These are all familiar concepts from my earlier work on how MNEs respond to the shocks of technological change and regional integration.

In my most recent work on LOF, I have looked at the ethical pitfalls that can haunt new entrants to academia (doctoral students and junior faculty). In Eden, Lund Dean, and Vaaler (2018), I argue that new entrants face the same three kinds of LOF identified in Eden and Miller (2004) but I now relate these hazards to specific forms of liability: (1) unfamiliarity hazards arising from liability of newness; (2) relational hazards arising from the liability of resource dependence; and (3) discriminatory hazards arising from the liability of outsider-ness.

Having been a new entrant to three different departments and disciplines over my career (Economics, International Affairs/International Political Economy, and Management/International Business) and their counterpart professional associations (the Canadian/American Economics Association, the International Studies Association, and the Academy of Management/Academy of International Business), I have incurred LOF costs, mostly start-up costs due to unfamiliarity, in all of these institutions. My publication outlets have shifted significantly over time also; the departments and disciplines all had their own preferred outlets for published research. I am here to report that it is possible not only to survive, thrive, and be successful, but also to have fun and a rewarding life while doing so.

The importance of local partners as a coping mechanism for LOF has been a theme not only in my research, but also in my professional and personal life. Being a new entrant, a "stranger in a strange land," has been made easier by a local senior faculty member several times in my career: Carl Shoup (Dalhousie), Roberta Robb (Brock), Maureen Molot (Carleton), Raymond Vernon (Harvard), and Kerry Cooper (Texas A&M). For their mentorship and friendship, and for the many others who have shared their research knowledge, experiences, and good will with me over the years, I am most grateful. On the personal side, none of us should go through life alone; a supportive, loving spouse, family, and friends are all critical ingredients for a happy life.

5. TAKEAWAYS – THE WAY AHEAD

In this chapter, I have outlined how technological revolutions change the landscape facing domestic and foreign firms. In any new landscape, I argue that old firms are often at a disadvantage, hampered by old ways of doing things. New, more nimble and flexible firms are the most likely to survive. However, new entrants often suffer from various liabilities too; particularly, where institutional distances are large. Who wins is often not that clear.

I have explored seven stories from my own experience that may provide useful lessons for IB researchers investigating how firms are likely to respond to IR4, who wins and who loses, and the strategies for success. My first story was about shocks, both external ones and shocks created by one's own choices, and how firms and individuals respond to shocks. My second lesson was that MNEs have been the key agents of change, both at home and abroad for the past 30 years. That the impacts of shocks as technological change and regional integration have different effects on hub and spoke economies was lesson three. My fourth story was about insiders and outsiders as winners and losers, which I explored further in the technological competition model (story five). My sixth lesson was about the need to move from the lens of dyadic one-time bargains to the richer but more complex world of multi-party iterated bargaining models. My last lesson was the importance of understanding distance, borders, and LOF.

I hope that you, the reader, have enjoyed this tour through my intellectual past and, perhaps, found some similarities with your own intellectual journey. More specifically, I hope that this brief chapter may, like the proverbial butterfly's wings, cause ripples in your own research trajectory and lead you into new paths that you might otherwise not have taken.

NOTES

1. With the cautionary warning from Alain Verbeke, that using big data and big datasets can reduce in-depth knowledge of what goes on "in the trenches," leading to costly mistakes including failure.
2. My father's views on how corporations, domestic and foreign, affected their employees and consumers were dinner table subjects when I was growing up. Like most in his generation, he favored small businesses and railed against multinationals. We were also experts in foreign exchange transactions (living on the Canada–US border) and smuggling (since my Dad preferred American cigarettes and my mother American margarine).

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CHAPTER 3

IB AND STRATEGY RESEARCH ON "NEW" INFORMATION AND COMMUNICATION TECHNOLOGIES: GUIDANCE FOR FUTURE RESEARCH

Christopher Hazlehurst and Keith D. Brouthers

ABSTRACT

In this chapter, the authors undertake a systematic review of the literature to identify research exploring the use of new information and communication technologies (ICT). New ICT include the use of the Internet, mobile communications, and social technologies. The authors find that while interest in the area is increasing, especially among marketing and information systems scholars, there seems to be far less research interest among international business (IB) and strategy scholars. This chapter provides a summary of the research that has been done and discusses some potential future research areas that IB and strategy researchers might wish to pursue. Among these projects are investigating the use of ICT as a tool to aid the internationalization process, improve location choice and entry mode decisions, and identify and create a sustainable competitive advantage. The use of ICT in business is pervasive; As research scholars, we need to build these technologies into our theories and research to help managers determine what works and where certain technologies can help create better performing firms.

Keywords: Digital economy; e-business; e-commerce; internet; internationalization; strategic management process; technology use

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1. INTRODUCTION

To read the popular press, one would imagine that new information and communication technologies (ICT) are a central part of our business and daily lives (McAfee, Bonnet, & Westerman, 2012). This seems to be especially true for social technologies like Facebook and Twitter (Divol, Edelman, & Sarrazin, 2012). To illustrate this point, research suggests that 85% of non-technology sector businesses make use of ICT and social technologies (Bughin, Chui, Harrysson, & Lijek, 2017). Survey data evoke an image of a highly technologized firm that uses ICT and social technologies for various tasks, such as research, information-gathering, and decision making (Harryson, Schoder, & Tavakoli, 2016). In this chapter, we follow Fox (1974) and define "new" ICT as all tangible and physical aspects such as cloud computing, mobile phones, and the Internet (but, exclude "old" ICT like computers and printers), while social technology includes more intangible elements such as systems, processes, communications, and platforms. ICT and social technologies now provide an ever more connected world of instant data transfers and real-time information available at our fingertips everywhere we are (Macer & Wilson, 2017).

The purpose of this chapter is to review what research has been undertaken and identify areas for future scholarly work that can make a contribution to our understanding of the use of ICT and social technologies in the international business (IB) and strategic management (strategy) process. More specifically, we focus on research that investigates the *use* of ICT and social technology in strategic management or IB-related contexts. Through a systematic review of the literature, we identify the research published to-date, and demonstrate how the IB and strategy literature is falling behind other areas, such as marketing and information systems. We also discuss reasons why IB and strategy research has yet to actively explore the impact of these technologies. Further, we argue that exploring the benefits and drawbacks of using ICT and social technologies in the IB and strategy process can lead to significant new insights.

Despite the apparent pervasive use of ICT and social technologies in the business world, the academic literature in IB and strategy has provided few insights about its use. While researchers in information systems and marketing have increasingly explored the use of ICT and social technologies in their areas, IB and strategy scholars have only begun to explore its impact (see, e.g., the 2016 special issue of the *Journal of International Business Studies*). We are not the first to note this dearth of research. Others like Brown, Dennis, and Venkatesh (2010) note that there is little research on the use of the unified theory of acceptance and use of technology in regard to social technologies in businesses. Leonardi and Vaast (2017) maintain that few scholars have explored the use of social media for collaborations in business, while Brouthers, Geisser, and Rothlauf (2016) suggest we know little about how Internet-technology-based businesses such as ibusinesses internationalize.

Although empirical research can be a time-consuming endeavor and cannot realistically produce results as fast as markets change (Buckley, 2002) an important question needs to be asked: why have "new" ICT and social technologies not received more research in the areas of IB and strategy, despite the fact that these technologies have been in use for 10–50 years? Emails started to be commercially used from the mid-1970s (Crocker, 2012) and the earliest use of a two-way videophone conversation took place in April 1930 (Borth, 2011). It was the late 1990s that Integrated Services Digital Networks (ISDN) and Internet-mediated video telephony became available to most businesses but even then this technology has been in use by businesses for over 20 years (Borth, 2011). Another technology that has been around in similar format since the 1960s and 1970s is what is now generally labeled as cloud computing and collaborative working on files (Carr, 2009). In comparison, social media are less established than these other technologies, but have been around for over 10 years. After such a long period of use, it is thus unclear why our understanding of ICT and social technology use in strategic management and IB is so limited.

A recent McKinsey survey reveals that social technologies are used in strategy "cocreation" (Harryson et al., 2016) and there are examples of companies, such as Daimler, implementing different approaches to their strategy development, which are facilitated by social technologies (Harryson et al., 2016). Despite numerous studies on information system and information technology strategies and debates about where these technologies can tribute as part of the business strategy process (e.g., Chen, Mocker, Preston, & Teubner, 2010) or implemented in a certain part of the business (e.g., Gunasekaran & Ngai, 2004), there is a gap when it comes to understanding *how* ICT and social technologies are used in the various stages of the strategic management and IB process and *where/when* businesses can benefit from its use. Notwithstanding all these technical advances and commercial interests, there has been little scholarly work in this area. Even though the popular press indicates that the use of ICT and social technology is widespread and can have a profound impact on businesses (La Torre & Moxon, 2001), IB and strategy scholars have tended to ignore its impact.

2. METHODOLOGY

To achieve the objectives of this study and provide insights about current knowledge in the field, we undertook a systematic review. While it is more common to conduct narrative reviews in management, we believe that a systematic review is a more effective way to understand what research exists in the area (Tranfield, Denyer, & Smart, 2003). A systematic review differs from a narrative review in that the former takes a systematic approach to reviewing literature in an attempt to reduce or eliminate reviewer bias, while the later approach relies on the reviewer's knowledge, insights, and choice of literature. Our systematic review followed an adapted three-stage approach as outlined by Tranfield et al. (2003). The first stage involves the plan – such as setting the search terms and scope; second, the literature search was executed and the results that were obtained for each search string were systematically recorded; and third, the results were systematically analyzed, assessed for relevance, and documented (Tranfield et al., 2003, p. 218).

This process enabled us to conduct a thorough investigation of previous studies and synthesize the advances made in the field, which helped us identify the gaps in the literature that future empirical research can fill (Webster & Watson, 2002).

Due to the heterogeneous nature of the strategic management and IB fields, the literature search was as broad as possible. We used an inclusive definition of IB and strategy and its associated processes (David, 2011; Hill & Hult, 2017). As it was our intention to find out if there were any studies on how, for instance, social technologies are used in the scanning and interpretation of the internal and external environment, or assessing internal competencies (Nag, Hambrick, & Chen, 2007), we did not limit our search to any specific theoretical understanding (Furrer, 2011), dimension (Aaker & McLoughlin, 2009), or stage (Johanson & Vahlne, 1990) of the strategy or IB process.

2.1. Protocol and Plan

The research protocol contained the search terms and scope of the search. The search terms used centered around six constructs that are outlined in the Appendix. Using various combinations, the search terms included at least one term related to strategy or IB to try to keep the results relevant. To avoid subjectivity at this stage, the terms were discussed and reviewed by both authors. The literature search was not limited to specific journals or publication types but focused predominantly on journal articles and conference proceedings, for the purpose of keeping the results manageable. The search was limited to English language documents, published from January 1970 to February 2018, in line with the emergence of the commercial use of ICT and social technologies such as emails. Because strategy and IB often overlap with other areas including sociology, finance, or economics, we did not limit the search to a specific subject area (Nag et al., 2007). To minimize potential biases and produce a pool of key contributions in the field, we used two scholarly databases: Google Scholar and EBSCO Business Source Complete (Pinho & Mendes, 2017; Zott, Amit, & Massa, 2011). We looked for the search terms in the title, keywords, abstract, and anywhere in the main body of the article.

2.2. Overall Results of Literature Search

The search was carried out between February and April 2018, through which we identified 1,759 different publications. These mostly included academic journal articles (90%), but we also captured conference papers (4%), textbooks (4%), book chapters (1%), and Internet documents (0.34%). A review of the publication dates revealed that the majority of papers (77%) were written after 2000 (Fig. 1). This reflects the time in which social technology started to be used more widely by businesses. After a peak in 2002, the number of publications decreased, possibly reflecting the Dot-Com bubble-burst in the early 2000s. However, more recent years (2016 and 2017) have seen a strong increase in publications. This trend is likely to continue as the number of 2018 publications is already at a similar level as the total for 2016.

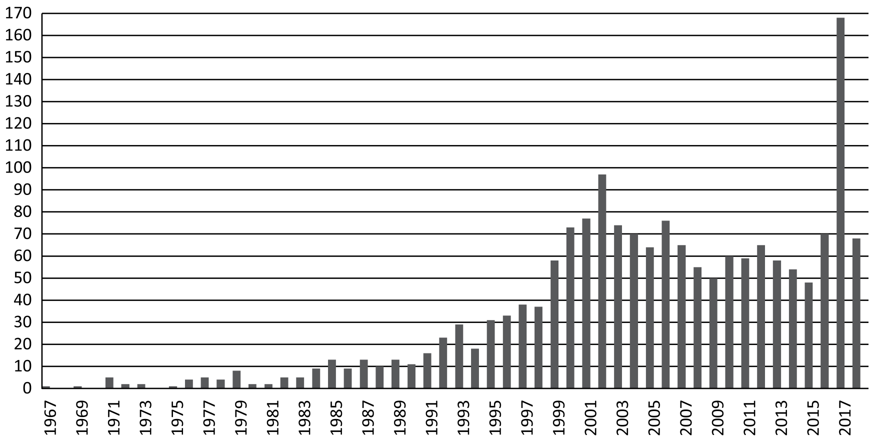

Fig. 1. Count of Publications Obtained by Year.

2.3. Classification of Results

Once the search was complete, we read each abstract and classified all the articles into broad themes (Neuendorf, 2002), regardless of their relevance to the IB and strategy field. The authors identified 15 themes and classified research accordingly (Table 1). The choice of themes did not follow any preset scale and the themes were inductively set by the authors after an initial review of the first 250 articles (Drisko & Maschi, 2016). Each theme was set as a heading under which existing research was gathered to obtain an overview of the general subject areas. Studies were assigned to a theme even if there was no clear indication that the use of ICT and social technologies was the key focus of the research. The following contains a brief description of each theme and summarizes the direction of the research within each theme.

Marketing strategy and communications: This theme included all marketing-related publications, predominately from the marketing literature. The size of this category demonstrates the level of interest in the subject of ICT and social technology in the area with 10% of all identified publications being classified under this theme. The most common subjects include research on ICT and social media use for consumer-level marketing purposes (e.g., Wood & Burkhalter, 2014), in business-to-business Internet marketing (Eid, Elbeltagi, & Zairi, 2006), and how marketing-related research can be undertaken using ICT and social technology (Bakopoulos, Baronello, & Briggs, 2017). Generally, the marketing literature focuses on the use of ICT and social technologies, in particular social media, by companies in the creation and capturing of value from customers.

Education and research: With a percentage share of 3.5%, this is one of the smaller themes. It includes publications that address the use of technology at any level of education, academic or university-based research, and the pedagogic use of ICT and social technologies. Common themes in this area range from using ICT and social technologies for scientific research (Robinson, 2000) to how

Table 1. Publication Count Per Theme.

Items Per Theme	Total
Marketing strategy and communications	177
Education and Research	62
Medicine, health care, and natural science specific use	80
Individual user behavior	139
Adoption of (social) technology	57
Organizational structure and behavior	154
Macro and market focus	98
Tourism and leisure specific use	12
Business, management, strategy, and internationalization	311
Entrepreneurial management and behavior	27
Supply chain, manufacturing, and logistics	66
(Social) Technology company perspective	58
e-Commerce and online trading	55
Technology and computer science	129
Unrelated content	334
Total	1,759

universities need to use ICT and social technologies either as part of the curriculum (McCorkle & Payan, 2017) or in teaching (Barn, 2016).

Medicine, health care, and natural sciences specific use: ICT and social technologies are not only of interest in the social sciences, but also in the field of natural science as the number of publications in this theme (4.5% share) reveals. These papers were concerned with the potential use of ICT and social technology to provide remote patient treatment (Bates et al., 2001) as well as with the risks and ethical considerations of increasing interconnectivity in health care (Greengard, 2017).

Individual user behavior: This theme encapsulates publications which focus more on the use of ICT and social technology by individuals rather than how it is used in a firm. It also includes the use of ICT and social technologies in a private or professional context (Xiang & Gretzel, 2010) and how individuals within an organization are using (Stronge, Rogers, & Fisk, 2006) and interpreting ICT and social technologies (Fulk & Connie Yuan, 2017). With an 8% share of identified research, this was one of the larger themes that emerged from our search results. Publications are based in a variety of sectors with most research being published in the major information technology journals (*MIS Quarterly* and *Communications of the ACM*).

Adoption of social technology: In a related theme, there appears to be a growing body of research (3.2% share) focusing on the adoption of ICT and social technologies by either individuals or companies. ICT and social technologies have changed the way business is undertaken. Papers in this theme explore the adoption of technology within and outside the business itself. This research focuses on individuals in businesses or other organizations (Thong & Yap, 1995), technology adoption for the entire organization (Mergel, 2013), or adoption outside businesses, mostly by consumers (Venkatesh, Thong, & Xu, 2012).

Organizational structure and behavior: With 8.7% of all the publications that were found in the search, this is one of the larger themes. Publications in this area draw on the organizational behavior literature to describe the use of ICT and social technologies by businesses. We distinguish the papers in this theme from the *Adoption of Social Technology* theme by including only studies that describe things that are already in use and focus on the actual usage and its associated impact, rather than on adoption and implementation. Dominant streams include studies trying to measure the impact of social and information technology on organizational performance (Mukhopadhyay, Kekre, & Kalathur, 1995) or the role of technology as a mediator between different business processes within an organization (Zhuang, 1995). Another stream that emerged is concerned with the management of knowledge, innovation, and resources through or with the aid of ICT and social technology (Hester, 2010).

Macro and market focus: We found some studies, which examined the use of either social or information technology from a more macroeconomic or market sector angle. These studies represent about 5.5% of the articles identified. Studies classified into this theme largely focused on either the use of information or social technology across a specific part of the economy (Eng & Unza, 2016) or in specific sectors within a country (Vajjhala & Thandekkattu, 2017). Some of this research also explored the markets of certain social technologies such as cloud computing (Alsarhan, Itradat, Al-Dubai, Zomaya, & Min, 2018) or how social technologies contribute to shrinking geographic and cultural distance (Fey, Koning, & Delios, 2006).

Tourism and leisure specific use: Despite representing only 0.7% of the articles identified, publications in this area have a distinct application of ICT and social technologies to the tourism and hospitality industries. The content of these publications may overlap with other themes such as marketing (Standing & Vasudavan, 1999) or e-commerce (Morrison & King, 2002), but these papers are published in tourism-related journals.

Business, management, strategy, and internationalization: With a share of about 18% of identified publications, this is the largest theme of studies that research the use of ICT and social technologies. This theme not only contains studies from the relevant literature (IB and strategy), but also studies from the IS, IT, organizational behavior, and marketing literatures. We assigned publications to this category if there was a clear link to business strategy or the internationalization processes. We will examine this theme in more depth in Section 3.2.

Entrepreneurial management and behavior: Studies with an entrepreneurial focus represent 1.5% of the articles we found. Here, we included all publications that examined the use of ICT and social technologies by entrepreneurs or their businesses. We also included studies on entrepreneurial education and development (McGowan, Durkin, Allen, Dougan, & Nixon, 2001) and those looking at how ICT and social technologies are used for the formation of inter-business networks (Vasilchenko & Morrish, 2011).

Supply chain, manufacturing, and logistics: Studies (3.7% of the total) examining the use of technology in supply chains, logistics, and manufacturing were included in this theme. Research in this area spans across various stages of the supply chain such as the use of ICT and social technologies in manufacturing and supply chain management (Cagliano, Caniato, & Spina, 2003), the impact of e-business on manufacturing (Cagliano et al., 2005), and the use of technology in inter-supply chain communications (Prahinski & Benton, 2004).

(Social) Technology company perspective: Not all the publications we identified focused on the use of ICT and social technology by third-party organizations or individuals. In this category (3.3% of articles), we classified those studies looking at social technology or information technology businesses. These studies explore diverse issues such as the future potential of advanced cloud computing (Goutas, Sutanto, & Aldarbesti, 2015), the internationalization of high-tech companies (Jones, 1999), and the development of certain technology-based companies (Vise, 2007).

e-Commerce and online trading: The increase in private-home Internet connections has supported the growth of e-commerce providers (Wang & Zhang, 2012). Publications allocated to this theme (3.3% share) investigate the use of ICT and social technologies by businesses with an e-business or ibusiness model (Mahadevan, 2000). This includes online traders and providers of services via the Internet. To distinguish this theme from the aforementioned one, we included only those publications that look at consumer interactions with e-businesses, or transactions between two or more e-businesses. Specifically, these studies examine the use of ICT and social technologies by e-businesses (La Torre & Moxon, 2001) or explore the link between a specific social technology, social media, for instance, and consumer behavior (Pilik, Klimek, Jurickova, & Palka, 2016).

Technology and computer science: With a 7.3% share of identified research, this theme comprises all publications that had more of a technological and computer scientific angle. Most of these publications stem from technology and IS journals and related conferences. These publications are concerned with technology-related hardware (Raghunathan & Madey, 1999), aspects such as coding (Moore, Shannon, Voelker, & Savage, 2003), issues regarding cybersecurity (Samtani, Chinn, Chen, & Nunamaker, 2017), or data mining (Kohavi, 2001).

Unrelated content: By far, the largest theme (19.2% share) included studies we could not easily classify into any of our other groups. This theme contains all articles, which did not appear to research the use of ICT and social technology in businesses or were from unrelated disciplines such as law or public policy. We also included papers, which have an outdated technological perspective (e.g., adoption of computers).

3. IB AND STRATEGY RESULTS

Once our initial search was over, we continued to refine the results by identifying all the articles that were published in IB or strategy journals. This left us with a sample of 73 articles in 29 journals (see Table 2, for a list of the top journals). Thus, it appears that IB and strategy research in the area lags behind other areas and represents only a fraction of the work undertaken so far. To learn more, the final list of relevant papers from the IB and strategy literature underwent a more detailed analysis to identify the areas of investigation and highlight where there are gaps in the field.

Table 2. Top IB and Strategy Journals.

Journal Name	Papers
Strategic Management Journal	7
California Management Review	6
Business Horizons	5
International Business Research	5
Journal of International Business Studies	5
Management Science	5
Thunderbird International Business Review	5
International Business Review	4
Journal of Knowledge Management	3

3.1. An Overview of IB and Strategy Research

While there are a relatively small number of studies in the IB and strategy area, there appears to be a diffusion of topics based on the aims and objectives of the authors. Many of the studies focus on delineating or defining the place of technology in a business model (12.3%) or determining ways in which technology can be used to capture business value or manage customer and business relationships (12.3%). Others were concerned with the management of knowledge or other resource-based view (RBV) conceptualizations of technology use (11%) or identifying factors influencing technology acceptance (11%), strategy development (6.8%), or the facilitation of the internationalization process (9.6%).

About half of the studies in our list of IB and strategy research (52.1%) did not mention or include a specific type of technology; to the extent of how it was used within a business for strategy- or for IB-related processes. Of those that did discuss specific technologies, the largest group of papers explored social media (13.7%) followed by communication technology (12.3%). About 5.5% of the studies in our sample conceptualized technology more broadly as IT without referring to any specific features. Additionally, 4.1% of the articles we extracted dealt with Web 2.0 or other Internet-based technology. Finally, almost 4.2% of this research took a more general stance to technology and did not limit (or discuss) any specific format or included a variety of different manifestations of technology. Thus, the fact that just under half of the studies we found, or just 2% of the total number of studies we originally identified, focus on the use of specific technologies in the IB or strategy process further demonstrates that there is currently a lack of research in the area.

Looking at the industries covered, the majority of IB and strategy studies did not connect their sample or theoretical conceptualization to a specific business or industry sector (34.2%). The second largest group (23.3%) included multiple sectors, numerous studies included businesses or organizations from a variety of industries and sectors in their empirical sample (e.g., Daniel, Wilson, & Myers, 2002; Gabrielsson & Gabrielsson, 2011). The largest group of studies focusing on only one sector was the retail and e-commerce sector with 9.6% of all papers in our list (Guzzo, Ferri, & Grifoni, 2014). Other specific industries on which studies concentrate include: the ICT and IT industry itself (6.8%); health care; science & energy; and manufacturing (4.1% each); ibusiness; banking; logistics; and governmental offices (1.4% each).

Methodologically, we noted that about one-third of the IB and strategy studies (34.7%) were theoretical or conceptual in nature (e.g., Berthon, Pitt, Plangger, & Shapiro, 2012; Rowley, 2002). For the empirical papers, about one-third (33.3%) used quantitative methods, which were predominantly surveys (e.g., Grover, 1993; Powell & Dent-Micallef, 1997) and had a mean sample size of about 218 people/firms. A further 19.4% used qualitative methods with interviews being the most frequently chosen method (e.g., Kane, Fichman, Gallaugher, & Glaser, 2009; Toubiana & Zietsma, 2017) and included on average 21 participants. The remaining 12.5% of articles used secondary data or took a mixed-method approach (e.g., Chen & Kamal, 2016; Chen, Qian, & Narayanan, 2017).

3.2. Analysis by Theme

Next, we take a more detailed look at the 73 papers published in IB and strategy journals. Table 3 shows the number of papers by theme to highlight the diffusion of research on technology use by strategy and IB scholars. The number of papers published in these journals is in stark contrast to the number of overall articles detailed in Table 1 and indicates the lack of research on ICT and social technologies in the IB and strategy areas.

Marketing strategy and communications: Of the five papers in this category, four deal with social media. This specific type of social technology has found increasing use and adaption by marketers due to the ease of which it allows companies to communicate with consumers, especially mobile social media (Kaplan, 2012). Kaplan and Haenlein (2010) highlight the cost and efficiency benefits of using social media in marketing. Only one of the studies contained empirical data, conducting interviews within organizations to determine the sources on which managers decide their choice of sales channel, such as the perception of the need for marketing communication with their customers (Karamehmedovic & Bredmar, 2013).

Table 3. Count of IB/Strategy Articles by Theme.

Items Per Theme	Total
Marketing strategy and communications	5
Education and research	1
Medicine, health care, and natural science specific use	0
Individual user behavior	8
Adoption of (social) technology	2
Organizational structure and behavior	10
Macro and market focus	3
Tourism and leisure specific use	1
Business, management, strategy and internationalization	35
Entrepreneurial management and behavior	1
Supply chain, manufacturing, and logistics	2
(Social) Technology company perspective	2
e-Commerce and online trading	2
Technology and computer science	1
Unrelated content	0
Total	73

Education and research: Ghemawat's (2017) study on using online technologies, such as an open online course, to provide education was the only study in this category in an IB/strategy journal. Using secondary data, Ghemawat describes how higher education establishments need to address the opportunities that stem from using technology.

Medicine, health care, and natural sciences specific use: We identified no studies published in IB or strategy journals addressing this issue.

Individual user behavior: There are a small number of empirical studies ($n = 6$) in this theme focusing on social media, general communication technology, and cloud computing. Several studies in this theme focus on user behavior of social technology inside a business (Fulk & Connie Yuan, 2017; Trainor, Andzulis, Rapp, & Agnihotri, 2014). Other studies delineate the adoption of social technologies by consumers and what businesses need to be aware of to increase use and interaction with the technologies they plan to use.

Adoption of technology: There were two studies in IB journals that empirically investigate the adoption of e-commerce by small and medium-sized enterprises (SMEs). These studies contribute to the wider understanding of technology adoption, something that is related to technology in different contexts (Belkhamza & Azizi Wafa, 2014; Daniel et al., 2002).

Organizational structure and behavior: With 10 papers, this area represents the second largest theme for IB and strategy research. Four papers were theoretical conceptualizations without empirical data. These studies vary in their contribution from critiquing the epistemological view of studies researching the impact of IT use, to the management of knowledge through knowledge management tools (Cormican & O'Sullivan, 2003; Markus & Robey, 1988). The other six papers used a variety of different empirical research methodologies such as interpretative case studies (Boudreau & Robey, 2005) to cross-sectional–large-scale surveys (Grover, 1993). Brews and Tucci (2004) explore the effects of Internet-working on the organizational structure and collaboration behavior of multinational businesses. The authors find evidence that the greater the use of Internet-working within a business, the more internal hierarchies are reduced. Using a health system network as an example, Devaraj and Kohli (2003) suggested and found that the impact of IT on the firm is contingent on the usage of IT, not the amount of investment into IT.

Macro and market focus: We obtained three articles from strategy journals and one from an IB journal that use secondary market or financial data in their analysis (Bharadwaj, Bharadwaj, & Konsynski, 1999; Dewan & Kraemer, 2000). The strategy articles focus on the causal relationship between IT investments and firm or market performance. In the IB paper, Tang and Trevino (2010) examined the influence of ICT on the spatial distribution of FDI based on a sample of 35 different countries.

Tourism and leisure specific use: The sole article in this category presents a case study in order to evaluate the effectiveness of using web-based technology to advertise tourism in Ho Chi Minh City (Bui, Le, & Jones, 2006). The authors argue that in developing countries, hotels which are engaged in e-commerce activities outperform rivals that do not offer their accommodation services online. The focus thus lies more on the marketing-related use of technology rather than using technology as a means to develop strategy or decide on the appropriate option for internationalization.

Business, management, strategy, and internationalization: With 35 papers, this theme is the largest, and is the key focus of our chapter. In 19 articles, we found evidence of research around some form of technology. However, in six of these papers references to technology were kept to a generic level such as IT or communication technology with no mention of any specific technology (Larkin, 2014). The focus of one paper was on the Internet use by businesses, it uncovered that business relationships are highly relevant when Internet-mediated transaction channels are utilized (Gabrielsson & Gabrielsson, 2011). Another study's focus was on technical terminology, namely throughput technology, and found that throughput technology can moderate the entry-mode choice by service companies (Domke-Damonte, 2000). Studies that focus on particular social technologies such as Twitter (Kaplan & Haenlein, 2011) or Social Media (Sashi, 2012) examine the development of relationship creation with stakeholders outside the company, such as customers or business partners, rather than using the technology internally for strategy or IB purposes. In line with this approach to technology use, one article proposed and developed a search tool for organizations looking for innovation partners outside their local network. This tool can help businesses to expand the scope of their search (Meulman, Reymen, Podoynitsyna, & Romme, 2018). Similarly, Alarcón-del-Amo, Rialp-Criado, and Rialp-Criado (2018) found that new technologies, such as Social Media, can benefit the overall performance of companies; especially, when there is some degree of managerial performance. Another stream of research within this theme investigates organizational creativity and how ICT use can negatively moderate the relationship between the collection of knowledge and organizational creativity (Giustiniano, Lombardi, & Cavaliere, 2016).

We also identified several papers that investigate various aspects around technology use and the internationalization processes. For example, Pogrebnyakov (2017) describes the internationalization process of businesses through Facebook. Rangan and Sengul (2009) demonstrated that internationalization and internalization of US-manufacturing businesses are increasingly intertwined and coupled with the use of ICT. Also focusing on ICT, in this case mediated via the Internet, Chen and Kamal (2016) assessed the impact of such a technology on the business decision to reconstruct their supply chain across borders. Furthermore, there are a few studies concerned with how technology facilities the internationalization process for high-tech startups or Internet portal providers (Chen et al., 2017; Gabrielsson & Gabrielsson, 2004; Robles, 2002).

The remaining 16 articles range from theoretical papers that develop or expand existing IB or strategy process models (Kano & Verbeke, 2015; Tassabehji & Isherwood, 2014) to articles focusing on the strategic development or internationalization of technology-based companies (Brouthers et al., 2016) or investigate the impact of IT in general on corporate strategy (Morton, 1988). Others explore theoretically the business competencies that are required to successfully use IT and IS systems (Feeny & Willcocks, 1998) or understand the process through which users in a business make sense of a certain technology feature within the business (Griffith, 1999).

Entrepreneurial management and behavior: The sole paper in this theme contributes more to the entrepreneurial marketing field by highlighting relevant factors, such as e-business development and the establishment of competitive advantages, while delineating attitudinal barriers of individuals toward gaining required business skills (Fillis, 2005). Therefore, it has more of a learning focus.

Supply chain, manufacturing, and logistics: The one paper in this category provides an assessment of collective firm behavior through a case study of an industrial park in Oahu, Hawaii (Chertow & Miyata, 2011). The paper did not mention any specific technology use in this collaboration process.

(Social) Technology company perspective: The two articles in this theme place the focus of their research not on how companies use technology, but on technology providers. One of the papers explored the factors that impact the internationalization decision made by a high-tech startup (Cannone & Ughetto, 2014). The second paper provides some potential strategies for traditional retail banks that face competition from online-only banks (Wright, 2002).

e-Commerce and online trading: The two studies we identified in this theme look at business models and how traditional physical stores can extend their business to the online realm (Cho & Tansuhaj, 2013; Mahadevan, 2000).

Technology and computer science: Taking a more technical stance, the one paper in this area tries to ascertain whether multinational enterprises (MNEs) can use knowledge-management technologies to influence their performance which stems from the multinationality of the business (Andersen & Foss, 2005). Building on ideas and concept from knowledge management, the focus of this paper was more widely on ICT.

Unrelated content: We identified no studies published in IB or strategy journals that we could not include in one of the themes above. Therefore, there are no unclassified articles.

4. DISCUSSION AND FUTURE RESEARCH

Our review of the literature tends to indicate that research examining "new" ICT and social technologies is rather scarce in the IB and strategy fields. While areas like marketing and information systems have found the impact of these new technologies to be important components of their research agendas, presently IB and strategy scholars have shown limited interest in exploring this area. While some anecdotal evidence indicates that businesses have been using these technologies to assist with IB and strategy issues (Bughin et al., 2017), more systematic investigations of what is going on, what works and what does not, and theoretical exploration of potential uses of these new technologies are yet to emerge. We did identify a few studies looking at some specific issues and/or technologies. These papers will help provide a starting point as IB and strategy scholars begin to embrace the many potential uses technology now plays and will play in the future in the business world.

We believe there are three key reasons why ICT and social technology research in the IB and strategy fields is limited. First, there appears to be a lack of appropriate theory that helps explain the impact of these new technologies. The IB and strategy literatures tend to share many common theories to explain the processes that firms undertake and the way a firm can improve performance. Among the most widely used are transaction cost analysis (TCA) (Williamson, 1985), the RBV (Barney, 1991), and institutional theory (North, 1990). While these theories help us gain a better understanding of how firms interact with each other and with other stakeholders, it is unclear where and how these new technologies fit. Most existing IB and strategy theories were developed for more traditional industries that faced very different restrictions (such as high travel costs and communications issues). New technologies have altered many of the foundations on which these theories were developed (how we do business and what a business looks like) and therefore require changes. For example, asset specificity and uncertainty are core concepts in TCA (Williamson, 1985). Yet, it is unclear whether, for example, mobile technologies are transaction specific (especially, for firms outside the mobile phone industry) or whether these technologies impact uncertainty or stand outside the TCA framework. From a RBV perspective, many of these technologies are common goods and, therefore, need to be combined with other firm-specific resources to provide an advantage. Yet, current theory does not explain how, and in what circumstances, these technologies help firms generate a RBV advantage and when/where such technologies reduce advantages. Porter (2001) suggests that these new technologies (the Internet) may not impact advantage at all but simply represent a different channel to undertake the same transactions. Have we moved on from this perspective or is Porter's stance correct? Finally, institutional theory helps explain the impact of the external environment on firms, yet it is unclear how these new technologies impact the regulative, normative, and cognitive environment. This seems to apply both to the domestic setting (institutional voids) as well as to cross-national concepts (institutional distance). New technologies might influence all three aspects of the external environment creating new challenges and opportunities for businesses.

Adaptation of current theories is one way forward but development of new theory or adoption of theories from other areas might also help. When Brouthers et al. (2016) wanted to examine the internationalization process of ibusinesses (platform businesses on the Internet), they realized that existing theory needed to be rethought and thus they developed a new theory, borrowing from the IB, strategy, and marketing literatures. Alternatively, the information system and marketing disciplines have already developed theories to explain how these new technologies might be used in business. Among these theories are Venkatesh et al.'s (2003) "Unified Theory of Technology Acceptance," and Watson, Pitt, Berthon, and Zinkhan's (2002) "U-commerce theory." Thus, we suggest that one reason for the limited inclusion of new technologies in IB and strategy research is the lack of clear theory to help explain its impact.

Second, despite the growing interest in ICT and social technologies, scholarly coverage of the topic may be hampered by a lack of data. There appears to be a lot of market data for the use of ICT and social technology adoption and diffusion; yet, to our knowledge, there is little data available on which technologies firms use or what they are using these technologies for. While the popular press may present some examples of businesses using social technologies in their strategy formulation process, there does not appear to be a large-scale secondary data-base that researchers can utilize. Consequently, the inclusion of ICT and social technologies in IB and strategy research might involve more complex research methods since it will require the sourcing of primary data from firms. At this time, it is unclear which technologies firms have adopted and how they are using them in the IB and strategy process. This means that scholars need to undertake both case and survey data collection methods to gain a greater understanding of the current situation and how new technologies are (if at all) being used in today's businesses. Of course, to undertake this task, we need both some theoretical understanding of what to expect, as well as reliable measures. Fortunately, the information systems literature, for example, has a wide array of scales and indices, at its disposal, that have been frequently used in empirical research. These scales range from measures of the perceived usefulness of technology to more macro-level factors such as the amount of IT investment (Davis, Bagozzi, & Warshaw, 1989; Goh & Kauffman, 2013) Equally, the marketing literature has made use of new measures such as customer sentiment in social media posts, online click-through rates, and basket value that allows scholars to investigate the various aspects of consumer behavior or engagement with certain types of technology formats (e.g., Kumar, Bezawada, Rishika, Janakiraman, & Kannan, 2016; Mallapragada, Sandeep, & Qing, 2016).

Consequently, a second way forward for research in IB and strategy is to begin to produce some empirical work, developing new ideas and measures that can gain wider acceptance. There are important contributions to be made from both qualitative and quantitative research studies. Qualitative studies would be able to explore the use of technology in the IB and strategy process in-depth and explain it from an interpretative angle. Such research would allow us to detect potential challenges and perceived usefulness of these new technologies that can inform our theoretical approach. Quantitative studies could be used to test the ideas noted in qualitative research, develop new measures, and test adaptations to existing theories. This could provide a foundation of insights, which would allow others to identify further areas of research and help managers to gain a better understanding of what technologies can help create better performance, and what technologies create barriers to success. One key issue that remains, however, is the difficulty in gaining access to managers or firms so that a researcher can obtain the data required to investigate the use of social technology or ICT.

Our third explanation for the lack of research looking at the impact of new ICT and social technologies in the IB and strategy area reflects the suggestions for future research found in existing papers. Often, researchers look for new ideas in both research papers and papers devoted to new research ideas. Examples of the former include Newbert (2007) while the later include papers like Buckley, Doh, and Benischke (2017) and Delios (2017). These papers contend that IB and strategy scholars tend to stick with existing theories and explore well-defined phenomena (Newbert, 2007). Yet, when something new arises (e.g., the grand challenges in Buckley et al., 2017), we as researchers are slow to respond. This seems to be especially true for the rise of ICT and social technologies where few scholars have yet to trod (for exceptions, see Brouthers et al., 2016; Chen & Kamal, 2016). Instead, scholars appear to rely on the more established IB/strategy theories, as discussed above. Most of these theories were developed at a time when social technology and ICT use by businesses was non-existent or in its infancy and, therefore, do not fully capture the added level or dimensions that are brought in by these new technologies (Buckley et al., 2017). As social technologies and ICT provide a novel aspect to IB and strategy, it requires a degree of academic curiosity; to go beyond existing theories and not simply look for one additional independent variable, moderator, or mediator (Delios, 2017; Newbert, 2007). Instead, Delios (2017) advocates a more collaborative and embedded approach to studying these new phenomena so that "real learning can occur" (p. 395). We think therefore that an over-reliance on existing theories and well-researched ideas inhibits the advancement of IB and strategy scholarship.

Despite these three potential obstacles, there are many areas of research that can be explored to further our knowledge of how ICT and social technologies have changed the business landscape and provide both opportunities and challenges to firms and managers. To begin with, IB scholars could look at how technology influences the internationalization decision. Research in this area previously explored why some firms expand abroad while others do not (Ah Keng & Soo Jiuan, 1989). It also looks at how governments can intervene to try and improve the rate of international expansion (Wilkinson & Brouthers, 2000). Now that businesses have access to far more information, ways of communicating, and new ways to process big data, research could explore how technology is changing, or could be used to change the rate of internationalization. Questions to be addressed might include: Are there online programs and web-based tools that governments could provide to support or improve the rate at which firms internationalize? Does having access to all this new information help firms make better internationalization decisions, or does it lead to "paralysis by analysis"? What can be done to improve the conversion rate and success of internationalizing firms, especially SME?

Looking at the internationalization process itself, scholars could explore which technologies can be used to improve the process of internationalization. While Brouthers et al. (2016) developed some theoretical ideas about the internationalization process for ibusinesses (also called network industries or platform businesses), these ideas have not been tested. Nor may this theory apply to more traditional businesses. How can firms use this new technology to improve the internationalization process? Being on the Internet, for example, gives a firm the ability to be in international markets, but how does one deliver products, services, and customer support when such a vast geographic area is being considered? Do technologies reduce or increase liabilities of foreignness, distance, and other important factors impacting international process success? Are some of the new technologies the answer (Twitter or podcasts)? Which combination of technologies leads to greater internationalization success?

Simply deciding where to expand to (location choice) might be easier with this new technology. Location choice concerns identifying markets where existing products can be sold and new capabilities developed. With the information exchanges available through new technologies, webcasts, email, and skype, firms could access more information and obtain more precision in identifying locations, which will provide the best location combination. The use of big data analysis might facilitate this process. Research looking at these issues could help firms to make better location decisions.

Other areas of IB could also benefit from exploring the impact that these new technologies could have. For example, distance might be eliminated or reduced as a consequence of new technologies. Everything from customer service to repairs could be undertaken through technology, meaning that firms might have few physical locations but service a rather extensive geographic area. This is especially true given the strides made in robotics research. Technology is also changing the way firms access financing. Researchers might look at how this impacts internationalization. Finally, one important aspect of IB is learning. Some technologies make learning easier, make transfer of knowledge more effective, and could potentially improve management and control of foreign subsidiary units. Determining which technologies help, and which hinder, learning could add to our knowledge and improve firm performance.

For strategy scholars, including the impact of these new technologies in both theory and practice could improve our understanding of the strategy process. Scanning the environment looking for opportunities and threats can help firms improve strategy development. Important research questions include: How do new technologies create opportunities or threaten existing advantages? Are certain technologies useful for following or identifying trends in the external environment? For example, recent research has shown the importance of competitor identification (Yu, Wang, & Brouthers, 2015). Can firms use technology to do a better job of identifying and tracking competitors? Would this information improve the response to competitor actions or the identification of competitive weaknesses? Can technology be used to create a sustainable competitive advantage or destroy a competitor's advantage?

Since technology varies in its manifestation, platforms such as cloud technology and collaborative working might be worthy subjects for empirical research. This could vary from trying to determine how and why firms adopt cloud technology and collaborative working to identifying how these technologies are used in the strategy process. Do firms using these technologies perform better?

Finally, there could be new or yet undiscovered uses of mobile technology. As the use of smartphones allows remote working and begins to blur the lines between traditional work boundaries, areas for future research could expand on the impact of remote and instantaneous working in the strategy process, especially, for strategy implementation. Questions could range from the impact of mobile technology on the speed of strategic change to the ability to access relevant information independent of location. Closely related to this area is the use of the Internet and how it is used to assess and access the resources and opportunities of an organization. While we uncovered some studies that investigate the use of the Internet as a search function, there is a gap in terms of the potential value managers and decision makers place on the Internet as a resource.

It would, therefore, be an area worth pursuing to find out how relevant information obtained through the Internet are used in the actual decisions that are made regarding IB and strategy.

5. CONCLUSION

In this chapter, we explored the level and extent of research regarding the use of "new" ICT and social technologies in the IB and strategy literature. New technologies include the Internet and mobile-based technology such as clouds, communication platforms, or enterprise social networks. By conducting a systematic review of the literature, we discovered that there is only a limited body of research in the IB and strategy areas looking at the use of these technologies in business. Many of the existing studies either take a more general stance toward technology or do not focus on specific internal processes of IB or strategy. We argue that IB and strategy scholarship needs to keep pace with the use and adaptation of technologies so that we can help businesses identify what works and what does not. This will help inform managers as they wrestle with the proliferation of new technologies and try to implement them in their businesses. While we identified a number of reasons why scholars may not have undertaken this research, we hope the suggestions outlined in this chapter will begin to stimulate more research. Since businesses continue to adopt and integrate these new technologies, it is important to fill these research gaps and provide evidence that can enhance business performance. We outline a range of important research topics that IB and strategy scholars can purse to help managers make better decisions. In a world of growing interconnectivity and technological advancement, it is fundamental for managers to understand the impact of technology use in order to reap its benefits, while maximizing its potential and mitigating its downside effects.

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APPENDIX: SEARCH CONSTRUCTS AND TERMS

1. ICT and Social Technologies (General)	2. ICT and Social Technologies (Specific)	3. IB/Strategy (General)
"information technolog*" OR "communication technolog*" OR "social technolog*"	"social media" OR collaborative OR "decision technolog*" OR digital OR online OR electronic OR sharing OR resources OR exchange OR cloud OR survey OR edi OR email	strateg* OR internationli?ation OR expansion OR diversification OR dematerili?ation OR branding OR positioning
4. IB/Strategy Process (Specific)	5. Context	6. Internet
"development" OR "external analysis" OR "internal analysis" OR "environmen* analysis" OR "long?term plan*" OR "generat*" OR ideas OR cho* OR strateg* OR implement* OR evaluat* OR goal?	E?business OR e?commerce OR m?business OR m?commerce OR i?business	Internet OR web OR internationali?ation OR multinational OR technology OR digital OR e?commerce OR e?business OR "internet?enabled" OR "Web 2.0" OR strategic OR strategy OR international OR business OR online

CHAPTER 4

THE CHANGING FACE OF INTERNATIONAL BUSINESS IN THE INFORMATION AGE

Jakob Müllner and Igor Filatotchev

ABSTRACT

In this chapter, the authors review emerging literature on multidimensional, information age-related phenomena across different disciplines to derive common themes and topics. The authors then proceed to analyse recent developments in these fields to provide an interdisciplinary overview of the most disruptive challenges for multinational companies (MNCs) competing in the modern information age. These challenges include more efficient peer-to-peer communication between stakeholders, crowd-organisation, globalisation of value chains and the need to organise knowledge resources. The aim of the chapter is not to review all age research, but to identify fundamental uncertainties for MNCs and discuss strategies of tackling such information age phenomena from an international business perspective.

Keywords: Information age; literature review; corporate communication; corporate social responsibility; stakeholder management; international business research

1. INTRODUCTION

Information technologies have altered the competitive landscape. These technological developments affect many areas of international business (IB) from marketing to HR and from finance to strategy. Often, these changes

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are subsumed under the broad term 'information age' but there is little clarity about the specific phenomena that characterise this epoch. In this review, we seek to identify, map and discuss such distinguishable phenomena related to the information age in specialised disciplines (Management, Finance, HR, Accounting, Strategy, Governance and Marketing). We then discuss these phenomena from an IB perspective, deriving interdisciplinary implications for research and theory. Since its early beginnings, IB has transcended specialised disciplines, borrowing from them and contextualising these theories and phenomena in the context of multinational enterprises (Buckley, 2002; Cheng, Henisz, Roth, & Swaminathan, 2009; Dunning, 1989). In this chapter, we seek to do the same with information age-related literature. Thus, we understand and use the term information age as an umbrella term that describes a number of societal, economic and business-related changes brought about by the proliferation of information technology.

Information processing and information management capabilities have become major sources of competitive advantage in many industries. As a result, new business models (e.g. e-commerce and sharing economy) and innovative forms of organisation have evolved (e.g. open-source and crowd organisations). On the one hand, information age champions like Google, Amazon, Airbnb or Uber are prospering. Increasingly, these players disrupt traditional business models of incumbent firms. Media announcements of retail giant Amazon, for example, can affect stock prices of whole industry sectors (Ovide, 2018).[1] Companies that fail to adapt to the information age, on the other hand, risk their survival (Porter & Millar, 1985) in an increasingly competitive marketplace (e.g. Toys 'R' Us).

Between 2005 and 2015, global connectedness increased by 8% (Ghemawat & Altman, 2017).[2] Whilst trade and capital flows remained largely stable over this period, personal cross-border mobility and exchange of information increased substantially. Thus, economic exchange in goods and capital has not kept pace with increasing connectedness of the world in terms of people and information. For MNCs, this has created additional non-market challenges to an already more competitive business environment. Companies failing to meet increasing corporate social responsibility (CSR) standards risk global stakeholder reactions, loss of reputation and costly lawsuits, as the recent developments at Volkswagen clearly illustrate.

Neither of these information age trends has escaped academic interest in IB and beyond. However, different disciplines have developed different understandings, definitions and research foci. This fragmentation has created a pressing need to systematically categorise the various interrelated phenomena related to that jointly make up information age (Castells, 1996). In order to reflect on the theoretical implications of the information age on IB, a more fine-grained conceptualisation of the underlying mechanisms and dynamics is necessary. This chapter seeks to provide a first step towards such a systematic reflection by mapping modern information age threats and opportunities for MNCs.

Scholarship in various disciplines referring to the information age traces back to the advances in information technology in the early 1980s. We start our literature review by reviewing this early interdisciplinary academic work. We systematically categorise the literature and identify dominant themes, stakeholders, and theories. Our analysis shows, somewhat surprisingly, that studies explicitly referring to the phenomenon of the information age have declined over the past 15 years. However, this decline does not indicate a decrease in economic importance of the phenomenon or scholarly ignorance. Rather, our subsequent review of recent literature reveals that information age scholarship has evolved from a buzzword to a more detailed analysis of several, distinguishable phenomena, which we discuss in detail.

The goal of this review is not to provide an exhaustive account of detailed research findings but to analyse how the information age literature has evolved into distinguishable but interconnected lines of inquiry. Therein, we seek to identify common themes and phenomena in different disciplines to develop a nuanced view of the most important changes brought about by the information age. Such a more nuanced view allows us to inductively derive firm-level implications and discuss them in the broader context of IB research (for a similar attempt, see Alcacer, Cantwell, & Piscitello, 2016). More specifically, we identify, categorise and discuss emerging trends and strategies of MNCs in the modern information age.[3] We reflect on the theoretical challenges that arise from these developments. Fig. 1 represents the conceptual idea underlying our systematic analysis of the information age literature across disciplines.

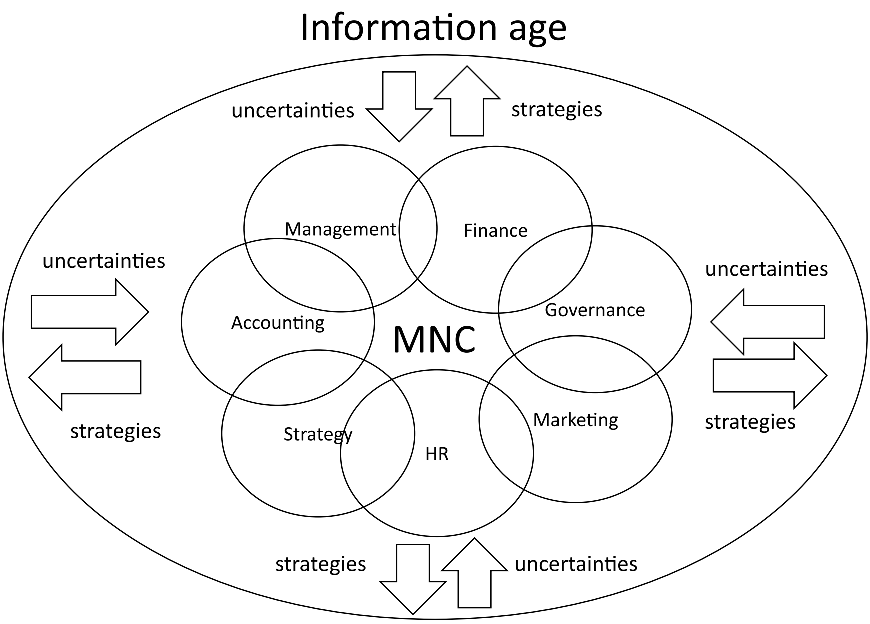

Fig. 1. The Information Age, External Uncertainties and Strategies in International Business.

2. INTERDISCIPLINARY REVIEW OF EARLY INFORMATION AGE SCHOLARSHIP

In a first step, we screened Web of Science for publications explicitly referring to the information age, either amongst keywords or in the title. We focussed on papers that were assigned to the disciplines management, finance and business[4] and published in, at least, three-star journals according to the ABS Journal Ranking 2015. We also included publications with 30 or more cites since their publication. Our first search yielded 68 published articles explicitly referring to the information age. We then manually screened all articles for their suitability and excluded papers that were not business related (e.g. education and statistics). The final sample amounted to 63 published articles.

Explicit information age literature originated in the late twentieth century (Alcacer et al., 2016, p. 499) and reached its peak during the dot.com bubble between 2000 and 2001. After 2001, the number of publications subsided to a rather low level of one or two academic papers per year. However, as we will show in our subsequent review, this decrease does not reflect lower relevance or academic interest. Rather, information age literature has evolved into more nuanced lines of inquiry addressing several interrelated phenomena.

Table A1 in the Appendix illustrates the distribution of papers across journals. It highlights a dominance of ethics-related publications. More importantly, Table A1 illustrates the fragmented, interdisciplinary nature of early information age scholarship, with publications in management, human resources, strategy, marketing and finance.

The following Table 1 summarises the most widely cited papers,[5] their respective disciplines, as well as methodology and data sources. Table 1 shows that, despite a lower absolute output, strategy scholarship has provided several highly cited contributions to the early information age literature, in particular regarding the effect of the information age on industry-level competition (Globerman, Roehl, & Standifird, 2001; Sampler, 1998) and firm-level commercial strategies such as e-commerce (Amit & Zott, 2001).

In terms of methodology, Table 1 also indicates a dearth of early quantitative research on the information age.[6] Despite one decade of research, most academic papers in the early information age literature remained on a conceptual level, seeking to theorise the information age phenomena within their specific disciplines. Existing attempts of empirical investigation were predominantly based on case studies, interviews and surveys that are difficult to replicate or problematic to generalise from. Amongst the few attempts to create replicable firm-level measures for information age-related capabilities, the survey-based approach to measuring organisational IQ by Mendelson (2000) stands out.[7]

Table 1 also shows the dominant topics in early information age literature.[8] Along with Table A2 in the Appendix, which tabulates author-supplied keywords of all publications, the overview shows that topics of consumer ethics and information privacy dominated in numbers. Strategy literature concentrated on industry-level effects, e-business models and, to some extent, on information-related dynamic capabilities. Within the management and HR domain, studies focussing on issues of employees' knowledge productivity or management dominated.

Table 1. Top 22 Most Cited Publications, Disciplines, Topics, Methodology and Data.

Author	Total Citations	Citations Per Year	Discipline	Topics	Method	Data
Amit and Zott (2001)	5,737	337	Strategy	E-business and innovation	Qualitative	Case studies
Spender and Grant (1996)	1,908	87	Strategy	Knowledge management and the theory of the firm	Editorial	Literature review
Smith, Milberg, and Burke (1996)	1,632	74	Ethics	Information privacy concerns and measurement	Quantitative	Interviews
Keohane (1998)	1,177	59	Political Science	Globalisation, interdependence and national sovereignty	Conceptual	n.a.
Venkatraman and Henderson (1998)	1,135	57	Management	Virtual organisation and IT strategy	Qualitative	Case studies
Mason (1986)	1,049	33	Ethics	Information privacy	Conceptual	n.a.
Leamer and Storper (2001)	975	57	International Business	Internet and economic geography	Conceptual	Secondary macrodata
Dewett and Jones (2001)	871	51	Management	Information technology and knowledge management	Conceptual	n.a.
Eighmey and McCord (1998)	783	39	Consumer Research and Marketing	Consumer web behaviour	Quantitative	Survey
Stewart and Segars (2002)	636	40	Consumer Research and Marketing	Information privacy concerns and measurement	Quantitative	Survey
Shapiro and Varian (1999)	634	33	Strategy	Technology standard strategies and industry dynamism	Qualitative	Case studies
Balasubramanian and Mahajan (2001)	630	37	Consumer Research and Marketing	Virtual communities, consumer activism and e-marketing	Theoretical	n.a.
Stock, Greis, and Kasadra (2000)	553	31	Supply Chain Management	Supply chain management and cooperative IT strategies	Quantitative	Survey
Oxley and Yeung (2001)	391	23	International Business	E-commerce proliferation and host country institutions	Quantitative	Secondary macrodata
Sampler (1998)	379	19	Strategy	Information characteristics and industry dynamism	Conceptual	n.a.

Table 1. (*Continued*)

Author	Total Citations	Citations Per Year	Discipline	Topics	Method	Data
Acquisti, Brandimarte, and Loewenstein (2015)	308	103	Consumer Behaviour	Information privacy, social media and public policy	n.a.	n.a.
Sullivan (1985)	294	9	Information Technology	Technology adaptation and leadership	Qualitative	n.a.
Mendelson (2000)	283	16	Information Technology	Organisational architecture, IQ and performance	Quantitative	Survey
Clarke (1998)	277	14	Ethics	Stakeholder activism and management	Conceptual	n.a.
Esty (2004	253	18	Law	Environmental activism and legislation	Conceptual	n.a.
McAfee (2006)	251	21	Information Technology	Technology adoption and integration	Conceptual	n.a.
Teng, Grover, and Fiedler (1994)	232	10	Process Management	Information technology and process management	Conceptual	n.a.
Lee and Maurer (1997)	221	11	HR	Knowledge retention, employee turnover and HR	Qualitative	Case studies
Prahalad and Krishnan (1999)	218	11	Information Technology	Software integration and sustainability	Conceptual	n.a.
Robson, Khalifa, and Jones (2007)	207	19	Accounting	Business risk auditing, legitimacy and technology	Qualitative	Interviews

In addition to disciplinary fragmentation, early information age scholarship applied different levels of analysis on information age phenomena.[9] Amongst quantitative research contributions, 55% of studies were carried out on a company-level and 35% used data on individuals (e.g. managers, consumers or employees). Within the qualitative and conceptual domains, 61% of studies were on a company-level, 29% on an individual level and the remainder addressed broader societal issues. Because of disciplinary and analytical fragmentation, early information age literature has failed to converge on a shared understanding of the phenomenon and its consequences. It has also failed to establish recognised measures and theories.

Another interesting perspective of analysis relates to the stakeholders addressed in early information age literature. Table 2 tabulates these stakeholder relationships. Some papers focussed on stakeholders within the firm such as individual managers (22%) and employees (16%). However, the vast majority of papers analysed the effects of the information age on external stakeholders. Most prominently, 25% focussed on consumer behaviour and the resulting consequences for firm-level marketing, ethics and strategy. Other studies addressed relationships with alliance partners, governments, auditors, suppliers, and competitors.

Fig. 2 plots the literature explicitly referring to the information age over time (x-axis) and citation index (y-axis). The size of the bubble indicates journal ranking (large bubbles are published in ABS four-star journals). Strategy and IB papers are marked with shaded bubbles, whilst Management and HR publications are marked with plain bubbles. Contributions from other disciplines are depicted in dashed bubbles.

Within the strategy discipline, early information age literature was defined by the contributions on e-business models (Amit & Zott, 2001), the conceptual work on knowledge and the firm by Spender and Grant (1996), the contributions of Sampler (1998) on industry structure and the works of Shapiro (1999) on the role of industry standards. Research has made interesting theoretical advances, highlighting that the boundaries of industries, their profitability, competition and the need for firms to diversify are increasingly defined by the nature of

Table 2. Stakeholder Relationships Analysed.

Stakeholder Category	No.
Consumers	17
Society	15
Managers	15
Employees	10
Government	2
Auditors	1
Competitors	1
Alliance partners	1
Suppliers	1
Not applicable	4
Total	63

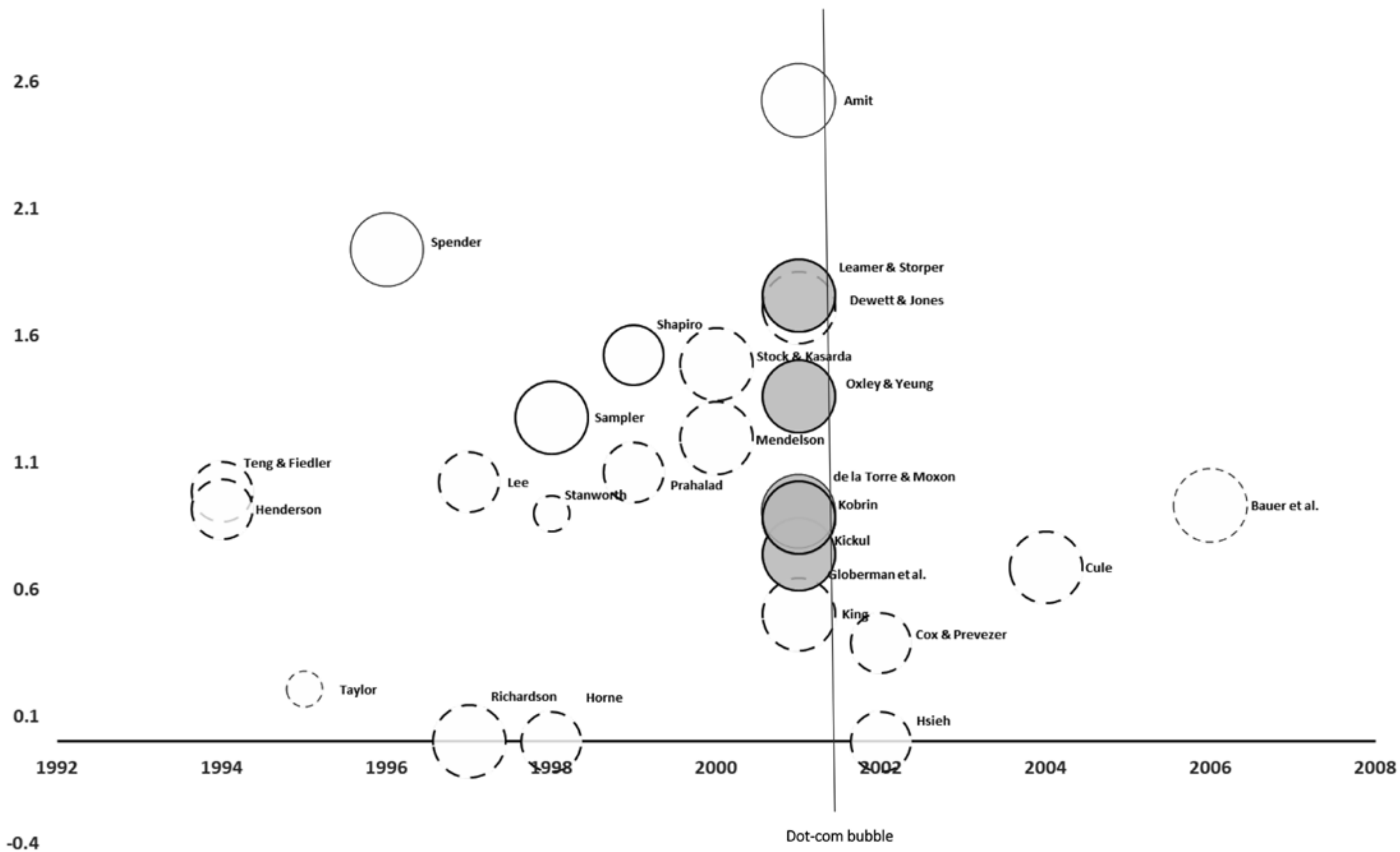

Fig. 2. Research Landscape of Information Age Publications in Top-tier Journals.

information itself. Whilst previous theories, such as transaction cost economics, have focussed on the nature of assets, these strategy scholars proposed that information specificity and separability are becoming defining competitive forces (Sampler, 1998), which facilitate disagglomeration of value creation on the one hand, but, under certain circumstances, also increase the value of agglomeration on the other hand (Leamer & Storper, 2001). The theoretical implication drawn from this research is that the information age provides opportunities for MNCs to dissect their value chain activities, where the information process can be separated and protected. However, processes that require strong interaction and cooperation between complementary knowledge providers are increasingly collocated within organisational units or local clusters of cooperative organisations.

IB made some important advances analysing the effects of the information age on firm-level internationalisation. De la Torre and Moxon (2001) discuss the effects of new information technologies on ownership, location and internalisation advantages (OLI). The internationalisation benefits of e-commerce, in particular, received extensive attention. Kobrin (2001), for example, linked the feasibility of e-commerce with the institutional regulation of cyberspace, whilst Oxley and Yeung (2001) empirically tested the proliferation of e-commerce in host countries as a function of the rule of law and the availability of reliable payment mechanisms. Therein, IB scholarship contributed an institutional perspective to early information age literature. In particular, it shed light on contingencies and trade-offs involved in the organisation of global value chains. In addition, it addressed the effects of the information age on firm-level internationalisation per se.

In summary, early information age literature puts more focus on the opportunities of the information age (e.g. e-commerce, e-marketing and disintegration of global value chains), but studies explicitly referring to the information age have subsided somewhat after the dot-com bubble. In the second section of the literature analysis, we seek to link this historical map of the information age literature with more recent research. Drawing on the functional dimensions of the early information age literature, we selectively discuss the recent literature, which has built on these topics.

3. INTERDISCIPLINARY REVIEW OF RECENT CONTRIBUTIONS TO INFORMATION AGE PHENOMENA

In this section, we seek to track and summarise recent research on information age-related phenomena, identified in our review of early literature. We first cover disciplines such as marketing, HR, finance, governance and accounting, before focussing on disciplines that are closer to core IB scholarship, such as management and strategy. As disciplines naturally overlap, we refer only to topics in detail that were not thoroughly covered in previous subchapters. Subsequently, we discuss the findings of various disciplines and their implications for IB literature as a transversal, interdisciplinary field that covers international elements from all these specialised disciplines.

3.1. Marketing

Marketing research has been the most productive discipline with regard to modern information age topics. Early marketing research on the information age focussed mainly on the emerging opportunities of companies to connect to customers (e.g. e-commerce). Since then, researchers have made progress regarding the identification of concrete communication channels. A substantial body of research focusses on means of online advertising (Culotta & Cutler, 2016; Dinner, Van Heerde, & Neslin, 2014; Goldstein, Suri, McAfee, Ekstrand-Abueg, & Diaz, 2014; Seamans & Zhu, 2014; Urban, Liberali, MacDonald, Bordley, & Hauser, 2014; Xu, Duan, & Whinston, 2014), social media advertising (e.g. Facebook and Twitter) (Culotta & Cutler, 2016; Ma, Sun, & Kekre, 2015; Schweidel & Moe, 2014), or more specialised commercial platforms such as Craigslist (Seamans & Zhu, 2014).

Recent information age advertising research has also studied novel channels of advertising like online banners (Urban, Liberali, MacDonald, Bordley, & Hauser, 2014), geo-positioned advertising (Golrezaei, Nazerzadeh, & Rusmevichientong, 2014), and personalised customer advertising algorithms based on artificial intelligence (e.g. Netflix and Amazon) (Petersen & Kumar, 2015). Finally, internet search engines like Google (Ghose, Ipeirotis, & Li, 2014; Jerath, Ma, & Park, 2014; Joo, Wilbur, Cowgill, & Zhu, 2014) have received extensive attention. In contrast to early marketing research, however, recent publications have focussed more closely on ethical and commercial concerns of modern marketing strategies in the information age. These threats include the loss of control in advertising and potential pitfalls related to customer data protection.

Another interesting development and emerging field relates to the growing importance of online retailers such as Amazon, Alibaba and eBay (Abhishek, Jerath, & Zhang, 2016; Einav, Knoepfle, Levin, & Sundaresan, 2014; Gallino & Moreno, 2014; Gallino, Moreno, & Stamatopoulos, 2017; Lanzolla & Frankort, 2016). On the one hand, retailing giants offer quick and easy access to a large number of customers. On the other hand, they are powerful actors in the distribution of products that can potentially undermine profits and reduce the efficiency of traditional channels of distribution (Abhishek, Jerath, & Zhang, 2016; Gallino & Moreno, 2014; Gallino, Moreno, & Stamatopoulos, 2017).

The dominant novelty in more recent marketing research has been a growing recognition of customer-to-customer or *peer-to-peer communication* (Bapna & Umyarov, 2015; Rosario, Sotgiu, De Valck, & Bijmolt, 2016; Tirunillai & Tellis, 2014) brought about by increasing global information connectivity. It includes online customer reviews on retailer websites (e.g. Amazon, Alibaba and eBay) (Anderson & Simester, 2014; De Langhe, Fernbach, & Lichtenstein, 2016), or specialised consumer platforms (e.g. Tripadvisor, Yelp and Foursquare) (Kovacs, Carroll, & Lehman, 2014; Lee, Hosanagar, & Tan, 2015; Luca & Zervas, 2016; Mayzlin, Dover, & Chevalier, 2014; Orlikowski & Scott, 2014; Proserpio & Zervas, 2017; Wang, Wezel, & Forgues, 2016; Wu, Che, Chan, & Lu, 2015). All of these information age agents provide means of peer-to-peer communication, not only with possible benefits, but also with possible threats to companies.

Some specialised peer-to-peer platforms such as Groupon go beyond peer-to-peer communication and consolidate consumer power through *crowd* purchasing (Wu, Shi, & Hu, 2015). Other platforms capitalise on high industry competition and provide automated price-comparison algorithms (e.g. Expedia and Booking.com). Marketing research has found that such price comparison sites can foster strategic purchasing behaviour of customers and put pressure on selling prices (Cavallo, 2017; Li, Granados, & Netessine, 2014; Papanastasiou & Savva, 2017).

Firm-customer communication has changed to a lesser degree than peer-to-peer communication. Much of this change is caused by an increasing willingness of consumers to share information, and firms' ability to use this information for marketing purposes. However, increased willingness to provide information has not undermined the importance of information privacy highlighted in early marketing research (Casadesus-Masanell & Hervas-Drane, 2015; Tucker, 2014). On the contrary, as hacking activity has increased, several large companies, including Sony, Ebay, Home Depot and Yahoo, have suffered from breaches or thefts of customer data (McGoogan, 2016). Most recently, Facebook – arguably the epitome of the information age – has come under intense scrutiny for breaches of information privacy. In the information age, peer-to-peer communication between stakeholders exacerbates breaches of customer trust and can have serious economic repercussions on MNCs.

In the early years of the information age, the dominant trend of service intensive MNCs was to outsource firm–customer communication to locations with lower labour costs. Modern technologies and artificial intelligence may reverse this trend, with more and more companies outsourcing customer communication to automated software programmes (BOTs). As with online advertising, such technologies have the potential to reduce costs but little research has addressed possible downsides.

On the positive side, the information age has provided unforeseen opportunities for advertising, retailing and marketing, allowing entrepreneurs and small and medium enterprises (SMEs) to grow at an unprecedented pace. At the extreme, *viral products* (Goel, Anderson, Hofman, & Watts, 2016) can conquer the globe in less than a year from initial commercialisation. For example, the fidget spinner toy rose globally to the most sold toy on Amazon in a matter of just five months. In *The Economist*, Andrew Moulsher describes the fidget spinner as a 'watershed moment for the business' (*Economist*, 2017). The statement highlights both the vast marketing opportunities and the potential threats to established business in the information age.

Summarising, marketing literature has evolved into a more balanced and less optimistic view of the information age, recognising in particular possible threats from peer-to-peer communication between customers, information privacy concerns and loss of control of distribution channels.

3.2. Human Resource Management

The information age has changed our way of working and the management of human resources in MNCs. Contemporary human resource (HR) literature has made some advances in addressing these fundamental changes.

Online job boards such as Monster.com have a long history. Modern career platforms, such as LinkedIn, have made available much more information on possible job candidates providing unprecedented opportunities for global hiring. Today, specialised *e-hiring* providers, such as Ziprecruiter, go beyond the dissemination of candidate information and use artificial intelligence algorithms to match companies and applicants (Burbano, 2016; Pallais, 2014; Tambe & Hitt, 2014). However, similar to peer-to-peer communication in marketing, information age hiring poses threats to MNCs. Job-rating sites, such as GlassDoor, equal employment activist groups and a generally more mobile job market have increased the importance of employer branding, especially with regard to knowledge workers. In a particularly interesting interdisciplinary study, Toubiana and Zietsma (2017) analyse how managers and employees respond to a disruptive event that contradicts their expectations of their firm's behaviour. They find that, in such situations, social media can become a conduit of emotional escalation that leads to destabilisation.

The number of employees in knowledge-intensive jobs has increased (Tambe & Hitt, 2014). Besides hiring highly skilled employees, companies are increasingly dependent on *knowledge retention*. Improvements in communication have allowed companies to offer more flexible working arrangements (Daniel, Di Domenico, & Nunan, 2018) but have burdened companies with providing adequate information infrastructure for such work schemes.

Again, *crowd technologies* have played a major role in changing knowledge management. Companies use crowd technology to facilitate knowledge exchange between their employees, and sometimes their users (Huang, Singh, & Ghose, 2015; Hwang, Singh, & Argote, 2015; Neeley & Leonardi, 2018). Unlike traditional, centralised and one-to-many approaches to knowledge management, such technologies offer extensive opportunities by allowing for many-to-many interactions. On the downside, crowd content is more difficult to monitor and control for knowledge MNCs. Yet, little is known about these possible downsides and the contingencies that allow MNCs to create value from crowd-based knowledge management technologies.

The information age has also changed the organisation of work itself. At the extreme, companies outsource single tasks to loosely organised self-employed crowds on online workplaces such as oDesk, Amazon Mechanical Turk or TaskRabbit (Kokkodis & Ipeirotis, 2016). On the one hand, this allows companies to focus on their core business. On the other hand, companies jeopardise control over important knowledge resources.

Overall, the information age poses both opportunities and threats to HR. It has put more emphasis on employer branding, supportive information infrastructure and efficient and sustainable knowledge management.

3.3. Finance

Whilst many of the effects of the information age on marketing and HR management have prompted public debates, the effects on the financial management of companies have received little to no public attention. Nevertheless, there have been some interesting advances in modern finance research linked to the information age.

Similar to marketing and HR, crowd approaches have opened up new ways of finance, in particular for smaller enterprises. *Crowdfunding* sites such as Kickstarter, GoFundMe or Indiegogo provide easy access to equity capital. A recent proliferation of crowdlending platforms such as Lending Club, Prosper, Upstart or Funding Circle (Iyer, Khwaja, Luttmer, & Shue, 2016; Lin & Viswanathan, 2016; Wei & Lin, 2017) complement crowdfinancing business models. Crowdfinancing technologies reduce entry barriers for innovative products and increase innovation pressures on incumbent players.

At the same time, global serviced payment systems, such as PayPal, provide an easily accessible and cheap cash-management infrastructure to smaller companies, which allows for rapid global commercialisation of products. The aforementioned fidget spinner toy, for example, obtained initial finance from Kickstarter. Small manufacturers of fidget spinners, such as the New York City high-school students behind Fidget360 – one of the early beneficiaries of the fidget spinner pandemic – have relied heavily on serviced online payment infrastructures (Rashid, 2017). Financial innovations (and marketing) allowed them to become a born global company not, as commonly defined in born global literature, within three years (McDougall, Shane, & Oviatt, 1994), but within three months.

Whilst such cases provide interesting insights, academic finance research has mostly focussed on fundamental changes of market and price mechanisms brought about by the information age and its new powerful actors. Studies have analysed the effect of online retailing on market prices (Gorodnichenko & Talavera, 2017; Overby & Forman, 2015). They have shown that prices on external online retailing platforms and prices in proprietary distribution channels may diverge, thus creating opportunities for arbitration and a possible loss of pricing sovereignty for manufacturing firms. For example, online retailing can limit a company's ability to pass detrimental exchange rate changes through to international customers.

A similar trend towards more efficient markets was observed in the stock markets. Whilst product prices relate more to customers, share prices represent investor confidence in a company. Studies have, for example, found that companies' share prices and analysts' recommendations have become more responsive to social media activism (Chen, De, Hu, & Hwang, 2014; Kim & Youm, 2017) and negative media coverage (Leung & Ton, 2015; Renault, 2017; Sun, Najand, & Shen, 2016). This is of particular importance since *stakeholder activism* has shown to have a strong impact on a company's financial performance. Cahan, Chen, Chen, and Nguyen (2015), for example, show that media coverage of CSR issues affects firms cost of capital.[10] Similarly, Ioannis and George (2015) and Kim and Youm (2017) have recently found related evidence that stock analysts are influenced by firms' CSR ratings.[11]

A final and particularly interesting recent information age-related development in finance research is the emergence of the bitcoin as a possible, decentralised alternative currency. In one of the few academic discussions, Bohme, Christin, Edelman and Moore (2015) reflect on some possible future applications of bitcoins (or, more specifically, the underlying *blockchain* technology) that go beyond its use for general-purpose payments. There is strong agreement that the underlying blockchain technology can revolutionise many aspects of corporate finance; in particular, the governance of financial markets, which we discuss later, in this chapter.

Summing up, the information age offers unprecedented financial opportunities (e.g. crowdfinancing) for small innovative enterprises. For established companies, it has increased competitive pressure and the financial vulnerability to stakeholder activism.

3.4. Accounting

Some contemporary research on information age topics acknowledges fundamental changes in accounting and auditing. Increasing availability of company information and the emancipation of stakeholder activism extend the scope of auditing, from traditional tax-based approaches, to more inclusive, social accounting practices. *Social accounting* has become a key requirement in the information age to mitigate risks resulting from increasing stakeholder activism.

Within large accounting and auditing firms, the implementation of artificial intelligence allows for continuous client auditing (Baldwin, Brown, & Trinkle, 2006; Chan & Vasarhelyi, 2011). Firms like EY, Deloitte and PwC, for example, are experimenting with artificial intelligence (Zhou, 2017). In his discussion of bitcoin applications in firms' governance, Yermack (2017) proposes to combine artificial intelligence and blockchain technologies to create real-time accounting systems in firms. The blockchain technology would allow firms to record all business transactions in a decentralised ledger that can be audited using artificial intelligence algorithms in real-time.

Summarising, the information age has firmly established CSR accounting as both an opportunity and a threat to companies. The technological developments related to artificial intelligence and blockchain, however, are not sufficiently developed to foresee their effects on MNCs.

3.5. Governance

Availability of information has also had profound effects on corporate governance. As firms come under increased scrutiny from activists and stakeholders, managerial behaviour and firm governance comes into focus. Firms are facing higher stake- and shareholder expectations regarding their *transparency* and *information disclosure.*[12] This is reinforced by more stringent reporting requirements.

Bednar, Love, and Kraatz (2015), for example, find that reputational risks for managers resulting from stock-analysts and peer executives have increased. Most recently, Volkswagen's CEO Martin Winterkorn has joined the ranks of high-level executives indicted for corporate misconduct, not only in his domestic jurisdiction in Germany, but also in the United States (Henning, 2018). This illustrates a contemporaneous trend towards more international CSR enforcement, in which firms and managers are held accountable for their actions across multiple jurisdictions.

Interdisciplinary research from finance and governance has opened up the discussion on a novel application of information age technology in the information age. In a groundbreaking paper, Yermack (2017) discusses possible applications of the blockchain for firm governance and their consequences. The transparency of *blockchains*, for example, would allow firms, regulators and activists to keep transparent and decentralised ledgers of stockholders. As such, a publicly accessible blockchain has the potential to revolutionise financial governance, financial market regulation and efficiency.

> Perhaps most importantly, blockchains could provide unprecedented transparency to allow investors to identify the ownership positions of debt and equity investors (including the firms' managers) and reduce the opportunity for rent-seeking or corrupt behavior by regulators, exchanges, and listed companies. (Yermack, 2017, p. 8)

Whilst the application of blockchain technology in financial markets still has a long way to go, both politically and technologically, the effects of fully transparent financial markets could fundamentally alter firms' governance and the functioning of financial markets for all stakeholders (firms, managers, investors, shareholders, creditors, activists and auditors).

The information age is altering corporate governance both in terms of transparency of information and enforcement. Non-compliance with such governance standards has become increasingly costly. At the same time, an increase in reputational risks associated with new information technologies has imposed new demands on the board members' ability and skills required to evaluate and handle these risks.

3.6. Management

In addition to various aforementioned topics that we have already discussed, scholars in management have analysed the corporate use of online *open collaboration* communities. Their main characteristic is that users act not only as recipients of knowledge, but also as contributors. Some researchers have analysed the acceptance and success of open collaboration communities within organisations (Kane, Johnson, & Majchrzak, 2014; Kane & Ransbotham, 2016). Levine and Prietula (2014) show that the performance of online collaboration platforms is determined by the cooperativeness of participants, the diversity of their needs, and the degree to which the goods or knowledge are rival. Haas, Criscuolo, and George (2015) argue that communities are restricted by the users' attention allocation and find that open collaboration communities are more efficient if knowledge providers are matched to problems rather than knowledge seekers.

In some cases, companies have extended collaboration networks to customers or users of their products. Thus, they capitalise on consumer crowds using proprietary online customer communities that improve customer experience of a product (Manchanda, Packard, & Pattabhiramaiah, 2015). Another important application of crowd platforms in management research relates to innovation communities like Quirky.com. These communities allow firms to assess ideas and inventions using the wisdom of crowds (Boudreau & Lakhani, 2013). A study by Kornish and Ulrich (2014), for example, finds that crowd assessments of innovations are better at predicting commercial success than expert ratings.

The information age certainly provides new opportunities for management; in particular, regarding innovation management. Most prominently, these opportunities relate to the outsourcing of value creation activities like innovation and knowledge management to open communities. The papers sampled in our analysis have given less attention to possible threats of open communities, such as possible loss of control and protection of intellectual property.

3.7. Strategy

Within recent strategy research, the dominating information age topic related to increasing *stakeholder activism* and its effects on firm performance. Online activism sites such as Avvaz, Glocal Co-op, Change.org, Countable.us and the Action Network have increased activists' ability to initiate boycotts and reveal corporate irresponsibility (Eesley, Decelles, & Lenox, 2016; McDonnell & Werner, 2016). As such, activists are more capable than ever of affecting a firm's bottom line.[13]

Companies have responded with active stakeholder management programmes and strategy research has provided some empirical evidence of firm-level benefits of stakeholder management (Henisz, Dorobantu, & Nartey, 2014; Kolbel, Busch, & Jancso, 2017). Henisz et al. (2014), for example, developed a media-based, firm-level index of stakeholder conflict/cooperation and showed that stakeholder cooperation boosts firm valuations.

Strategy research has also shed light on some important contingencies of the stakeholder activism – performance link. Kolbel et al. (2017) showed that media outreach moderates the adverse effect of negative media coverage on financial risk. In a similar vein, Dorobantu et al. (2017) have studied the dynamism of share- and stakeholder reactions to negative media CSR coverage. They show that loosely connected stakeholders escalate or appease public reactions to critical CSR events, based on their prior perceptions of the company. From an IB perspective, Crilly, Ni, and Jiang (2016) find that stakeholder reactions differ if a company suffers from liability of foreignness. Thus, foreign companies may be at a disadvantage in preventing stakeholder disputes.

Whilst this body of research focusses strongly on the negative effects of stakeholder pressure, some strategy researchers have identified ways in which companies can use stakeholders to gain a competitive advantage. Castello, Etter, and Nielsen (2016) develop a framework of firm-stakeholder interaction based on the non-hierarchical use of social media that ultimately creates legitimacy. Their work suggests that social media is not only a threat in stakeholder management, but also, to an equal extent, a strategic communication tool.

A second emerging topic in research in the strategy domain focusses on possible opportunities that emanate from *crowd-based value co-creation*. Similar to approaches in other domains, the underlying idea is that companies can use crowds to gain a sustainable competitive advantage. Empowerment of customers as complementors, for example, can allow a firm to establish industry standards, which serve as entry barriers for possible competitors. Crowd complementors are often unrelated to the focal firm but provide value to the customers, free of cost (Boudreau & Jeppesen, 2015). Thus, collaborative communities can shape industry structures but are difficult to establish, control and govern.

In sum, strategy research has affirmed the importance of CSR for MNCs and provided interesting insights into antecedents, mechanisms and effects of CSR management. It has also shed light on some industry-level consequences of the information age, highlighting that collaborative information and knowledge-generating strategies can shape a company's competitive landscape to the better (or worse).

3.8. International Business

Finally, we turn to recent information age research in the IB domain. IB literature has picked up many of topics from other disciplines, which we will not discuss in detail in this review. Rather, we will focus on three lines of research that are specific to IB.

First, IB researchers have made advances in addressing the role of the country-level institutional context in many of the information age phenomena discussed in other disciplines. Such contributions have identified interesting, country-level boundary conditions on the proliferation and effects of information age phenomena. Kshetri (2018), for instance, combines institutional and financial perspectives and explains variations in equity crowd funding across countries based on informal institutions.

Second, modern information age technologies have created new opportunities and patterns of firm-level internationalisation. IB research has made some advances in explaining such information age internationalisation strategies. Parente, Geleilate, and Rong (2018), for example, theorise on how sharing economy firms internationalise and how the use of non-proprietary resources affects internationalisation behaviour. In a similar vein, Tran, Yonatany, and Mahnke (2016) document how Facebook sourced translation services from its user crowd to support rapid internationalisation. In their study on i-business firms, Brouthers, Geisser, and Rothlauf (2016) combine liability of foreignness and online internationalisation. They find that foreign i-business firms suffer from liability of outsidership when internationalising to foreign markets. However, the inclusion and adoption of local user crowds can help to overcome liability of foreignness.

Third, the information age has changed the way in which internationalised companies organise and configure their *global value chain*. In 2016, a special issue of the *Journal of International Business Studies* was devoted to global value chains in the information age (contributions included Alcacer et al., 2016; Brouthers, et al., 2016; Chen & Kamal, 2016; Gooris & Peeters, 2016; Lew, Sinkovics, Yamin, & Khan, 2016). In the editorial, Alcacer et al. (2016) identify several trends. First, information age technology enables more international fragmentation of value creation. It reduces the internal, technical need of collocation of activities. Therefore, MNCs can more effectively harvest location-based advantages (Alcacer et al., 2016; Chen & Kamal, 2016; Gooris & Peeters, 2016). In addition, fragmentation of the value chain may also serve as a mechanism of intellectual property protection, since no single location or organisational unit can fully capture the entire value creation (Gooris & Peeters, 2016).

Interestingly, however, the lower need to collocate value creation within a firm has been somewhat balanced by an increased need to collocate knowledge intensive activities within localised clusters of coopetition. Specialised knowledge clusters around regional centres of highly interconnected firms. In order to access such external resources, firms need to collocate such activities, not within their own value chain, but within the broader knowledge context of their industry. The configuration and management of the value chain are of particular importance in innovative industries, where the information age has altered the competitive landscape towards more loosely organised networks of cooperative entities.

Attempts in IB research to tackle some of the more technical phenomena of the information age have been limited. In a recent paper, Strange and Zucchella (2017) theorise the possible implications of digital technologies, often summarised under the umbrella term industry 4.0 (Internet of things, big data analytics, robotic systems and additive manufacturing). Unlike finance and governance literatures, IB has not addressed possible effects of blockchain technologies for international trade and/or global value chains. This is surprising since one of the most promising applications of blockchain technology lies in *smart contracts* (i.e. a decentralised 'computerized protocol that executes the terms of a contract'). Smart contracts could potentially revolutionize international trade by substituting traditional documentation in shipping and payment (e.g. letters of credit and shipping documents) (Yermack, 2017). Equally, blockchain technologies could potentially provide new and more efficient means of coordinating international activities within a firm's global operations. As such, they provide an interesting research question for IB scholarship.

In sum, IB research has picked up and integrated many of the information age phenomena from other disciplines. In addition, IB research has also generated some important proprietary contributions related to the role of the country-level institutional context, the accelerating patterns of firm internationalisation in the information age and the disintegration versus localisation trade-off in global value chains.

4. IMPLICATIONS FOR IB THEORY

After summarising recent developments in information age-related research across different disciplines, we now discuss and contextualise these findings from an IB perspective, pointing out important trends for future IB research. Six dominant, interdisciplinary themes have emerged from the review of recent information age literature. Each of these interrelated phenomena poses both opportunities and threats for companies' IB operations.

First, the technological advances in information age have increased the means of *peer-to-peer communication* between stakeholders. This external connectivity results in fundamental changes of firms' internationalisation behaviour. On a sales side, firms can more easily reach customers across borders. In the extreme case, companies may mobilise stakeholders as engines of rapid internationalisation. Such internationalisation patterns are at odds with traditional IB theories like the incremental internationalisation theory, according to which firms gradually increase their internationalisation through learning within the organisation. In cases like the fidget spinner, born globals can use peer-to-peer communication and crowd technologies to conquer global markets in less than a year.

However, peer-to-peer communication may also pose threats for firms. At the extreme, peer-to-peer communication can undermine a firm's strategy and competitiveness. Because peer-to-peer communication is beyond the control of the company, it can quickly turn into a liability if the company fails to live up to stakeholders' expectations (i.e. customers, employees, activists and analysts).

The trend towards increasing peer-to-peer information connectivity is unlikely to be reversed in the future (Ghemawat & Altman, 2017) and there is no realistic means for companies to fully internalise communication and regain control. Thus, future IB research should more closely study threats from peer-to-peer communication and possible strategies for firms to turn peers into complementors of their international strategy.

Amongst these complementary strategies, CSR and corporate diplomacy stand out, both in practical relevance and academic interest (Henisz, 2014, 2016). Peer-to-peer connectivity has created strategic challenges for internationalising firms by creating powerful institutional players. Highly interconnected stakeholder and activist networks have turned CSR from a risk-mitigation strategy into a possible source of global competitive advantage.[14] Active stakeholder management and a reputation for corporate responsibility can enhance a firm's access to vital resources such as financial capital, human resources and customer loyalty. For internationalising firms, CSR can provide a legitimacy bonus that facilitates access to critical markets and locations (Müllner & Puck, 2017).

With the globalisation of stakeholder networks, the geographical outreach of CSR expectations and enforcement has internationalised. Increasingly, firms are held accountable for irresponsible behaviour in third countries. Traditional IB research has often put more emphasis on foreign companies' local license to operate in the host-country. As such, it has somewhat underscored the ability of domestic or international stakeholder networks to escalate ethical violations in a host country in which implicit or explicit CSR requirements may be much more lenient. Nowadays, MNCs must respond not only to a local host country's institutional context, but also balance the ethical norms enforced by their international stakeholder network. In some industries, this 'institutional duality' (Kostova & Roth, 2002) may translate into a liability, where some MNCs are held to higher standards than others.[15] From a theoretical point of view, increasing peer-to-peer connectivity of customers and stakeholders across borders challenges some of the institutional assumptions common in IB. In particular, that institutions are somewhat confined within national borders and can be reliably proxied with country-level metrics.

A second shared theme of the contemporary information age literature relates to *crowd-based organisations*. The notion of the crowd itself poses a theoretical conundrum, since, in many cases, it is governed neither by organisational hierarchy, nor by contracts. It does not follow a market-based price mechanism but functions purely on norms of reciprocity and the value of pooled knowledge for each participating individual. As such, crowd organisation challenges existing theories on the boundaries of the firm in IB. In crowds, information itself, rather than contracts or organisational hierarchy, serves as a means of coordinating a community of independent agents. For MNCs, the establishment of a crowd (both internally or externally) can provide substantial benefits that manifest in lower costs of managing knowledge, better knowledge-sharing, enhanced customer value and entry barriers for competitors. Similar to peer-to-peer communities, however, crowd organisations defy direct corporate control and thus pose serious threats to MNCs. Since crowd-based competitive advantages are not fully internalised, they can be elusive. In the worst case, crowd organisations expose themselves to possible espionage, sabotage and knowledge misappropriation, as evidenced in the recent Cambridge Analytica scandal surrounding Facebook.

Third, information age technologies have increased *industry dynamics*. Small innovative firms can obtain funding from crowds to finance rapid growth. Other firms, base their whole business models on crowd organisation. Uber and Airbnb are examples of disruptive crowd competitors that have challenged traditional business models, not without extensive legal and societal controversy. Globally, traditional industries like phone network providers or postal services are redefining their business models to maintain their competitive advantage vis-à-vis information age communication technologies. Similarly, commercial providers of statistical software are under competitive pressure from open-source solutions such as R (Muenchen, 2017).[16]

Thus, despite possible dangers, information age technologies have reduced entry barriers for innovative competitors and the value of economies of scale for established MNCs. In the most dynamic of industries, economies of scale may turn into diseconomies of scale, if they lead to organisational inertia and inflexibility. Established MNCs must adapt to a more dynamic competitive environment in which static competitive advantages, based on internalised transaction costs and proprietary resources, can quickly become obsolete. Rather, established companies need to adapt to dynamic environments by harnessing real options, cooperation and developing dynamic capabilities (Eisenhardt & Martin, 2000; Teece, 2007; Tong & Reuer, 2007). IB theories would benefit from incorporating such dynamic perspectives into their traditional theoretical frameworks to encourage more long-term, sustainable managerial strategies.

Fourth, and as a direct result of competitive dynamics, *collaborative strategies, alliances* and *networks* are increasing in importance. As with crowd organisations, the boundaries of firms are increasingly blurred. Competitive and cooperative elements coexisting within the corporate environment (Tsai, 2002). Ideally, coopetition creates a value for both parties. However, IB research still has a long way to go to understand the dynamics of cooperation in an international context and the reasons why so many cooperative strategies fail to create value for the participants.

Fifth, the information age changes the shape of MNCs. Information connectivity allows companies to disperse value-creation activities more efficiently across geographic and cultural distances (Gooris & Peeters, 2016). However, the *strategic configuration of the value chain* is the result of a complex tradeoff. Whilst advances in manufacturing technology (e.g. digital manufacturing and advances in 3D printing) have, in theory, reduced the need for collocation of activities in specific locations (Laplume, Petersen, & Pearce, 2016), the clustering of specialised knowledge in certain geographic regions or global cities (Belderbos, Du, & Goerzen, 2017; Goerzen, Asmussen, & Nielsen, 2013) has created incentives to collocate certain knowledge-based activities, not within the firm, but within specialised regional clusters. In knowledge intensive-industries, tapping into such regionalised knowledge pools can create positive collocation externalities (Alcacer et al., 2016). In the information age, MNCs must balance the need to access such external knowledge and network resources with the possible costs associated with them (e.g. loss of control, outsourcing of key value chain activities and possible opportunism).

Finally, the introduction of *artificial intelligence* and *blockchain technologies* in some areas of IB has the potential to disrupt traditional MNC business models. Nonetheless, applications of these technologies (e.g. smart contracts, financial market governance and real-time accounting) are still limited to conceptual ideas and their implementation remains uncertain (Yermack, 2017). However, because of its interdisciplinary nature, IB research would be uniquely qualified to address some of these grand issues with high potential impact on business practice.

Fig. 3 attempts to fulfil the initial promise made in this chapter by organising the dominant topics identified in our systematic review of contemporary information age literature along four dimensions: organisation, communication, competition and knowledge.

Concluding, we briefly discuss the implications for the IB research landscape. IB research has been comparatively slow to adapt to the information age. One reason is, undoubtedly, that the scholarly landscape too often rewards narrow contributions to traditional theories, whilst rejecting more fundamental, phenomenon-driven research, which may not align as well with past methodologies, data and theories.

If the information age is changing IB practice in fundamental ways, more qualitative and conceptual work is necessary to bring classic IB theories into the

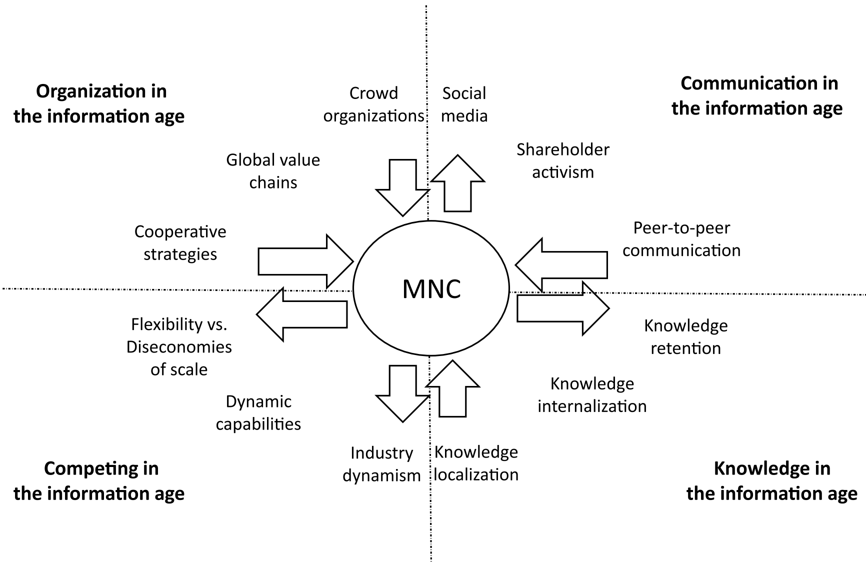

Fig. 3. Uncertainties and Strategies for MNCs in the Information Age.

information age and develop new theories (e.g. research case studies and exploratory content analysis). Editors and reviewers should be cognizant of the uncertainties and opportunities that the information age has imposed on corporate practice and should actively encourage research on these topics. Such qualitative research could provide a groundwork for quantitative empirical inquiry.

Naturally, any such quantitative attempts to study information age phenomena will require reviewers' openness to of novel sources of data (e.g. peer-to-peer data from social media or search engine data provided by Google Trends). At times, it will also require acceptance of less rigorous and robust empirics, since many of the phenomena are difficult to measure, especially in large samples. Nevertheless, initial measurement weaknesses should not hinder scientific progress on a theoretically and practically phenomenon. When necessary, editors and reviewers should prioritise relevance over rigor, novelty over conformism, and practical over theoretical implications. Responsiveness to a changing environment brought about by the information age will be a key competitive advantage, not only for MNCs, but ultimately also for IB scholarship.

NOTES

1. On 16 June 2017, Amazon announced its acquisition of Whole Foods Supermarkets causing immediate revaluations of competitors of up to 26% (United Natural Foods). On 29 January 2018, Amazon announced the creation of a health-care joint venture with JPMorgan and Berkshire Hathaway causing healthcare stocks' downturn across the industry. Ovide (2018) provides several further examples of such announcement effects.

2. The index is updated annually and available for download. More recent data were not available at the time of submission of the chapter.

3. An era that was coined as the 'techno-economic paradigm' by Alcacer et al. (2016, p. 499).

4. We excluded the discipline of economics to focus closely on micro- or firm-level implications of the information age.

5. Total citation count was extracted from Google Scholar on 14 January 2018.

6. Table A3 in the Appendix provides the distribution of the full sample of papers across disciplines. Table A4 in the Appendix provides information on the types of data used and Table A5 in the Appendix tabulates papers according to their methodology.

7. The measure is rooted in the information-processing view of the firm (Cyert & March, 1963; March & Simon, 1958) and measures an organisation's ability to process information and make decisions quickly and effectively. As such, it captures a firm's ability to reap the benefits of the information age and develop an information-based competitive advantage.

8. Topics were assigned by the authors of this chapter and not necessarily identical to the author-supplied keywords to facilitate interpretation.

9. Table A6 in the Appendix tabulates the distribution of papers across levels of analysis.

10. Most recently, when media reported carbon dioxide testing on monkeys by German car manufacturer Volkswagen, share prices fell substantially. According to Google Trends, on 22nd and 23rd January, Google searches for animal testing by Volkswagen exceeded the global search volume for Volkswagen shares. This pattern was particularly pronounced in developed countries in Europe, Canada and the United States.

11. Some research has analysed the persistence of negative CSR events in stakeholders' perception (Love & Kraatz, 2017; Mena, Rintamaki, Fleming, & Spicer, 2016).

12. Mas (2017), for example, provides evidence that increasing information disclosure regarding executive salaries leads to a generally lower level of remuneration.

13. After news outlets such as BuzzFeed had revealed a recent series of CSR scandals in the Australian banking industry, Bloomberg declared an end to the 'good times' for Australia's banks. The article quotes activist institutional investors acknowledging that 'companies that fail to grasp the importance of managing non-financial risks learn the hard way that these factors lie at the heart of their sustainability' (Cadman, 2018).
14. Most recently, oil firms have recognised this possibility and initiated massive diversification programmes towards more renewable energy sources. In addition, they have initiated CSR branding campaigns, in extreme cases even renaming their company, like Statoil (Norway) which is rebranding to 'Equinor' to reflect a more sustainable business model (IJGlobal, 2018).
15. Canadian mining companies, for example, are required to adhere to domestic CSR standards in their foreign operations. The implementation of such standards in certain countries with weak institutional environments is both costly and challenging.
16. The R statistical software is predicted to overtake SPSS as the market leader in academic publications in late 2018 (Muenchen, 2017).

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APPENDIX

Table A1. Distribution of Information Age Publications across Top-tier Academic Journals.

Journal	No.
Journal of Business Ethics	8
Journal of International Business Studies	5
Harvard Business Review	4
Journal of Management	4
International Journal of Human Resource Management	3
Sloan Management Review	3
Strategic Management Journal	3
MIS Quarterly	2
Organization Studies	2
New Technology Work and Employment	2
Journal of Advertising Research	2
California Management Review	2
Long Range Planning	2
Journal of Strategic Information Systems	2
Others	22
Total	66

Table A2. Most Prominent Author-supplied Keywords.

Keyword	No.
Ethics	12
Information privacy	9
Firm performance	8
Knowledge	6
Organisation	6
Management	6
Industry structure and competition	5
Strategy	5
Communication	5
Technology	5
Competitive advantage	4
Networks	4
Attitudes	4
Systems	4
Information technology	4
Risk	4
Employee behaviour	4
Dynamic capabilities	4
Total	99

Table A3. Distribution of Papers across Disciplines.

Discipline	No.
Ethics	11
Information Technology	8
HR	8
Marketing	6
International Business	5
Strategy	4
Knowledge Management	4
Philosophy	2
Process Management	2
Political Science	2
Consumer Research	2
Cognitive Psychology	2
Organisation	2
Supply Chain Management	1
Sociology	1
Public Policy	1
Economic Geography	1
Finance	1
Law	1
Consumer Behaviour	1
Computer Science	1
Ethics	11
Total	66

Table A4. Data Sources Used in Selected Papers.

Data Sources	No.
Survey	13
Case studies	6
Secondary (macro)	6
Anecdotal	4
Interviews	3
Not applicable	31
Total	66

Table A5. Distribution of Papers According to Type.

Type of Paper	No.
Empirical	27
Conceptual	10
Popular	10
Literature Review	3
Formal	2
Methodological	1
Total	53

Table A6. Distribution of Publications across Levels of Analysis.

Level of Analysis	No.
Company	35
Individual	13
Country policy	8
Society	3
Management	2
Industry	2
Stakeholders	1
Total	66

CHAPTER 5

THE EFFECTS OF GLOBAL CONNECTIVITY ON KNOWLEDGE COMPLEXITY IN THE INFORMATION AGE

John Cantwell and Jessica Salmon

ABSTRACT

Scholars have examined, in various ways, the complexity of knowledge in innovation. Recently, research has begun to focus on the role of a continuous process of knowledge recombination in our understanding of a changing structure of knowledge complexity and knowledge accumulation. Furthermore, we also claim that this process may reflect changes in the underlying innovation paradigm, or in other words the arrival of the information age. Yet, little is known about how knowledge complexity is increasing in the broader context of globalization, in which the influence of a rising diversity of locational sources may feature more prominently. We consider how knowledge recombination that relies upon the global spread of innovation activities will affect our theory of the relationship through which earlier contributions to knowledge become inputs to subsequent knowledge building that generates more (or less) complex knowledge artifacts. We propose that knowledge complexity rises when recombined elements are sourced across two dimensions of distance simultaneously, namely when sources which are derived from (i) disparate knowledge fields and (ii) distinct geographic locations are combined. We thereby develop an international business perspective on knowledge complexity through recombination by better appreciating the processes that may be necessary when knowledge is combined along global value

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chains. We also suggest some implications for changing organizational forms by highlighting the value of connecting previously unconnected geographically distant elements, which suggests a greater potential for more informal and indirectly diffused knowledge-based connections.

Keywords: Global and local knowledge; knowledge sourcing; knowledge structures; knowledge complexity; innovation; complexity theory

1. INTRODUCTION

Changes in the degree of knowledge complexity during the course of innovation have been studied through the lens of recombining fields of technological knowledge (cf. Fleming & Sorenson, 2001; Ganco, 2013; Vagnani, 2012). However, this does not take into account that the tacit nature of specialized knowledge often binds it to the specific geographic space in which it is utilized (Marshall, 1920; Saxenian, 1994). Based on this location-specificity of the knowledge developed in innovation, Cantwell (1989) had argued that by transferring technologies across countries, multinational enterprises (MNEs) can create international networks for innovation in which they, as actors, intentionally connect and combine experimentation in different knowledge settings. Indeed, recent research has come to emphasize the scope for global value creation by connecting distant knowledge sources for innovation (Antonelli, Krafft, & Quatraro, 2010; Cano-Kollmann, Cantwell, Hannigan, Mudambi, & Song, 2016; Cantwell & Noonan, 2004; Yayavasram & Chen, 2015) where these technologically distant knowledge recombinations can produce complex, value-creating innovations through which future rents may be derived (Fleming & Sorenson, 2001; Ganco, 2013; Vagnani, 2012). Yet, there has been little research to address the implications of the knowledge complexity of recombining knowledge taken from distant geographic locations. As specialized fields of knowledge and industry-types cluster in specific geographic locations, this suggests that when accessing technology fields external to the core knowledge base of the firm, it is necessary to reach into different geographic clusters. This process may result in a systemic increase in the complexity of the knowledge system. Here, we argue that the recombination of technology fields and geographic locations should be examined in tandem when thinking about structures of knowledge complexity.

Considered a vital source of value creation and competitive advantage, scholars have long studied innovation through the lens of new knowledge creation (Celo, Nebus, & Wang, 2015; Fleming & Sorenson, 2001; Frenken, 2006; Nightingale, 1998; Trajtenberg, Henderson, & Jaffe, 1997). It is commonly understood how novel knowledge can emerge through recombinatorial knowledge building (Antonelli, 2009; Arthur, 2009; Fleming, 2001; Ganco, 2015). In the present context of globalization, we must also consider the additional element of geographic complexity entailed by traversing physical distances in some capacity to achieve such recombinations. To assist in facilitating value creation and capture by firms, it is important to jointly understand the contributions of these two dimensions of knowledge-building processes through which global innovation connections are made. Yet, in much of the innovation strategy literature, distant knowledge has commonly been considered to be defined solely through the lens of distant technology knowledge fields, meaning simply in terms of cognitive distance rather than geographic distance. What is missing is a treatment of distance that incorporates geographic distance; by addressing this, we hope to explain the nature of the conditions for changing knowledge complexity.

Innovation is a socially intensive, recursive problem-solving endeavor whereby functional solutions are sought piecemeal from core and supporting technologies on the basis of the fluid and recipe-like combinatorial nature of knowledge (Arthur, 2007; Nahapiet & Ghoshal, 1998; Nelson & Winter, 1982; Rugman & Verbeke, 2001). We define complex knowledge as knowledge configured in a structure that requires its development to have relied upon numerous interactions and uncertain interdependences (Ganco, 2015; Kauffman, 1993; Simon, 1962). To clarify, complexity is an incidental outcome of a knowledge artifact rather than an intent or goal of innovation. The complexity of any knowledge artifact has been examined by several non-competing measures, which commonly account for the dispersed characteristics and development of knowledge building in this context (cf. Antonelli et al., 2010; Breschi, Lissoni, & Malerba, 2004; Cantwell & Noonan, 2004; Engelsman & van Raan, 1991, 1994; Fleming & Sorenson, 2001; Trajtenberg et al., 1997; Zhang, Jiang, & Cantwell, 2015). This literature suggests that the act of knowledge recombination is a process through which novel knowledge may be created. In this process, knowledge grows in part through the blending of antecedent knowledge streams in novel forms through trial-and-error processes, which may result in an artifact with greater complexity (Arthur, 2007; Olsson & Frey, 2002; Weitzman, 1998). The recombination literature provides a useful lens through which to examine complex knowledge building because this framework accounts for both the cross-field and cross-border (as well as cross-actor) characteristics and historical development of knowledge building (Celo et al., 2015; Fleming, 2001; Ganco, 2015; Olsson & Frey, 2002; Weitzman, 1996, 1998). The structure of complex knowledge building is considered to reflect (1) the pattern of the knowledge domains utilized and (2) the commonality of sources accessed (Antonelli, 2009; Fleming, 2001; Katila & Ahuja, 2002; Sorenson et al., 2006). Knowledge is a complex system, and a complex system is one that cannot be easily broken down into the contributory building blocks because each piece interacts with others in a non-additive and nonlinear manner (Ganco, 2013, 2015; Simon, 1962). As such, we focus here on one aspect of the factors underlying the complexity of knowledge – that of both geographic and technological distance. We expect that recombinations of distant knowledge are more likely to lead to more complex knowledge artifacts, and that processes forging distant connections are a means of value creation for firms, since they also suggest greater novelty in an otherwise typically path-dependent and localized process of knowledge search (Nelson & Winter, 1982).

The underlying structure of knowledge building may shift and change as new innovation paths are developed (Frenken, 2006; Kuhn, 1962; Olsson, 2000), and thus it is important to understand the pattern through which these connections are made. To address this, we have stressed the effects of informal ties in facilitating these distant connections between historically relatively unconnected knowledge fields (Cantwell & Salmon, 2018). We argue that the information and communications technology (ICT) era has encouraged the connection of more distant knowledge fields during this period of globalization, partially by facilitating more informal ties.

In constructing our argument, we explore the factors and processes supporting increasing knowledge complexity, before considering a framework for knowledge building through the lens of distance. First, in Section 2, we recapitulate on the vital role of location in innovation. Then, in Section 3, we articulate how knowledge recombination contributes to the role of innovation and its continuous development. Next, in Section 4, we establish a two-fold definition of distant knowledge in which knowledge distance can be thought of as either technological distance or geographic distance, related to knowledge artifact complexity, and location complexity respectively. In Section 5, we turn to the effects of societal transformations associated with a change in paradigm though globalization (global knowledge connectivity), the diffusion phase of the information age (via digitalization), and shifts in the nature of organizational ties, which facilitate knowledge recombination across previously little connected knowledge fields. Finally Section 6 concludes.

2. LOCATION IN INNOVATION

Any innovation is likely to draw on multiple areas of expertise (Arthur, 2007; Henderson & Clark, 1990; Nahapiet & Ghoshal, 1998; Schumpeter, 1950; Simon, 1962). Some of these may be core to a firm's knowledge base while other knowledge relied upon may be supporting or periphery. So, the geography of innovation depends upon the spread of expertise that can be found within a given vicinity. The importance of geography has continually recurred in the innovation literature among scholars interested in topics such as clusters (Marshall, 1920; Porter, 1990), economic geography (Krugman, 1991; Lorenzen & Mudambi, 2013), knowledge tacitness (Nightingale, 1998; Searle, 1995), and knowledge spillovers (Griliches, 1992, 1995; Mansfield, 1988, 1991). Knowledge has a degree of tacitness to it that gives it a tendency toward stickiness in a geographic context (Nightingale, 1998; Searle, 1995). Specialized forms of knowledge congregate in specific areas and industries agglomerate in these specific geographic regions (Marshall, 1920; Porter, 1990). For example, Bangalore, India is known for its IT and nanotechnology, London is known as a financial center, and the lavender cluster has a long-established presence in the South of France. Co-locating often brings firms strategic advantages, based on local features such as a targeted labor pool, contact with knowledge spillovers, and the availability of suppliers and complementary services nearby (Krugman, 1991; Porter, 1990). Firms initially search for new knowledge locally, then search more distantly by forging connections when the knowledge sought is not found locally (Ethiraj & Levinthal, 2004;

Gavetti & Levinthal, 2000). To innovate using some locally specific knowledge, some form of interaction is generally necessary with the target location. Such interactions across space may enable a combination of knowledge from different locations to form new knowledge artifacts (as represented, e.g., by patents). This act of recombination has a two-fold character, since disparate technology fields may be linked thereby, as are the associated locations.

Most often, a search for solutions to problems with products and production processes begins in the firm's immediate geographic area but if an adequate solution is not discovered there, the search gradually extends outside the neighborhood of its industry cluster and likely reaches outside its immediate geographic area (Ethiraj & Levinthal, 2004; Gavetti & Levinthal, 2000). International businesses, in particular, are better positioned to search outside their immediate geographic vicinity because they already have access to other subsidiary units, partners, transactional relationships, international research centers, university ties in R&D programs, and access to diaspora-established contacts elsewhere in the world (Lorenzen & Mudambi, 2013; Thomas, 2016).

Commonly, international business studies incorporate distance between locations, as measured in a variety of ways including geographic miles, knowledge or institutional relatedness, or cultural affinity, as indicators of spatial variation (cf. Dunning & Lundan, 2008; Rugman, 1981, 2005). These measures of spatial variety may refer to differences in administration, culture, economy, institutions, language, and religion (cf. Berry, Guillén, & Zhou, 2010; Zaheer, Schomaker, & Nachum, 2012) as drivers of business location decisions (Berry et al., 2010), or the destination of exports (Beugelsdijk, Hennart, & Slangen, 2011). Yet, little has been done to incorporate the role of geographic distance into our understanding of the complexity of any given recombined knowledge artifact and the underlying geographic structure of the origins of knowledge to which it relates. Here, we suggest investigating the geographic origins of knowledge sources in order to trace the knowledge-building process that led up to a new knowledge artifact, with the aim of discovering how the locational complexity of the sources for each artifact may contribute to our understanding of any resultant knowledge complexity.

Any component of technological knowledge will be associated with elements of context-specificity according to the conditions under which it was developed (Nelson & Winter, 1982). These contextual elements include tacit, social and institutional aspects in the practice of how the knowledge is interpreted, understood and operationalized. Therefore, combining knowledge components, which derive from different institutional and social contexts, is not a purely technical matter, but one that in itself contains an implicit adaptation of the sources used that tends to accentuate the complexity of the resultant knowledge.

3. INNOVATION, SEARCH, AND RECOMBINATION

Innovating firms engage in complex problem solving, often requiring novel combinations of knowledge. Because of its amorphous nature (Nelson & Winter, 1982; Rugman & Verbeke, 2001), knowledge can be partially used and re-incorporated into a selection of further knowledge creation activities. The opportunity for novelty is greater when recombining previously unconnected or more technologically distant antecedent knowledge streams, even if this also implies greater unpredictability. It has been argued that when notably distant prior knowledge streams are recombined, the outcomes may include both numerous failures and a few radical innovations (Arthur, 2007; Fleming, 2001; Weitzman, 1998). Stated alternatively, the merging of two or more different technology fields or knowledge from different locations of origin is likely to necessitate a more complex knowledge stream than if each technology field were to continue to develop solely locally, under its own steam without merging, and remaining unaffected by others.

Some research on knowledge complexity (cf. Arthur, 2007; Fleming, 2001; Frenken, 2006; Ganco, 2015; Sorenson et al., 2006) proposes that the development of more complex knowledge is supported by a much wider knowledge base – that is, eventually used across a broader range in later iterations, as knowledge building follows a series of experimental attempts. This implies that recombining selected elements of knowledge in some novel construction tends to be associated with an increase in the complexity of a resulting knowledge artifact. Although armchair speculation might suggest that a wide variety of forms of recombinant knowledge may potentially be envisaged (Weitzman, 1996, 1998), what becomes critical is the process through which particular combinations can be realized and brought to fruition within a given time frame. This process of recombination is by and large designed to address problem solving in ways that are deliverable and achievable. Feasible solutions often depend upon having an awareness of and access to a substantial body of supporting and complementary functional technological knowledge (Brusoni, Prencipe, & Pavitt, 2001; Kapoor & Adner, 2012).

Even though reliability may decrease and uncertainty increases during knowledge recombination, more distant combinations may also be associated with a greater scope for novelty (Ahuja & Lampert, 2001; Grant, 1996; Katila & Ahuja, 2002). During periods in which innovation patterns are changing, new forms of knowledge and accompanying organizational routines are sought through problem solving and experimenting with new potential solutions across formerly separate technological fields. Earlier innovation patterns are normally, or at least partially, integrated into whatever subsequently becomes the newly prevailing pattern following successful recombinatorial efforts. The distances between newly related knowledge fields are steadily reduced over time via mutual learning during problem solving. For example, the intellectual distance between the chemical field and the field of life sciences was shortened by the establishment of the intermediate field of biochemistry, which shared antecedent knowledge from both chemistry and biology (Schreiber & Nicolaou, 1994a, 1994b). In developing such intermediate fields, as time passes there is less distinction and separation between the now more connected fields of study. This suggests an increase in knowledge complexity at an aggregate level as knowledge field crossovers, used jointly, are creating recombined knowledge and exhibiting greater cross-field associations.

Quite often, a mix of problems emerge in the supporting technologies on which a complex device or piece of equipment relies, rather than merely as a result of an initial issue addressed in whatever are the primary core technologies (Arthur, 2007; Simon, 1962). Solving this hierarchy of problems implies that firms often have to extend beyond their standard range and tap into assorted forms of specialized knowledge within and beyond their own conventional borders in an innovation system (Rothaermel & Alexandre, 2009; Weigelt & Miller, 2013) and quite possibly they need to call upon innovation methods and patterns in different knowledge fields altogether. From the perspective of the development of any innovation system that follows some established paradigm, organic limits to knowledge building eventually emerge – commonly the process can become increasingly expensive exhibiting increasing costs, diminishing levels of productive creativity, decreasing growth rates, technical imbalances, reverse salients, and intra-contextual frictions (Hughes, 1987; Olsson, 2000; Rosenberg, 1976; Weitzman, 1998). Should the scope for innovation become confined to any or all of the aforementioned reasons, this may encourage the discovery and development of alternative paths to achieve usable answers to problems. As the prevailing innovation patterns become naturally hindered, at some point less expensive alternatives emerge, which may give rise to an emergent new paradigm for innovation (Freeman, 1991; Kuhn, 1962; Olsson, 2000; Von Tunzelmann, Malerba, Nightingale, & Metcalfe, 2008).

Firms operating in a single industry may sometimes co-locate in a geographically proximate area, which may over time develop into a cluster reflecting the characteristics of local knowledge specialization (Krugman, 1991; Porter, 1998). Agglomeration economies may emerge when related firms specialize in some industry or value chain segment (Marshall, 1920; Porter, 1990). Learning the uncodified aspects of knowledge may be facilitated through informal ties that grow up in an area (Miller, Zhao, & Calantone, 2006). Operating in such zones may augment the competitive advantages of firms in clusters. However, partially because of this local specialization, no one geographic area can sustain the entire range of expertise that has come to be needed in the information age.

Commonly search is localized up until a point at which it is determined that a satisfactory answer cannot be found, at which stage search extends more distantly to find potential solutions to problems (March, 1991; Nelson & Winter, 1982; Vernon, 1966). Knowledge applications that are derived from incremental and localized search are better able to find lower hanging fruit and, therefore, tend to be associated with more competition, and are less likely to be the basis for competitive advantage (Ethiraj & Levinthal, 2004; Fleming, 2001; Gavetti & Levinthal, 2000). Instead, when recombining knowledge in more novel and challenging ways, search must typically be mounted over a diverse assortment of distant fields. This novelty, however, potentially leads to a greater competitive advantage. Access to a different knowledge domain from a firm's core knowledge field(s) is likely to be enhanced by the intentional establishment of cross-field associations. Cross-field ties are often also geographically, and likely internationally, dispersed connections, and thus international networks for innovation also tend to promote a potential for more complex forms of new knowledge combinations.

Firms can also source knowledge indirectly from non-immediate and community-based pools that pass to areas in which a firm is present. It has been suggested that these informal and indirect networks critically enhance knowledge building transition processes as they help identify good ideas by providing early access to a spectrum of potentially useful knowledge fragments (Winter, 1984), offer diverse and contradictory knowledge (Burt, 2004), and alert an actor to relevant previous efforts (Arthur, 2007). Informal channels have become relatively more significant, owing in part to the establishment of international epistemic communities. Compared to formal channels within which firms have contractually enforceable obligations to one another (see Lincoln, 1982, for a review), the composition of informal channels may change more liberally over time. In an informal network, the structure of membership comes to reflect the degree of involvement of each participant, which may vary with the frequency and nature of commitments they make to common projects. An informal network relies on a system of reciprocity between those who hold complementary bodies of knowledge (Baldwin & von Hippel, 2011; Miller et al., 2006; Pavitt, 2002; Whitley, 2006). In sum, an informal channel does not generally require an overarching, legally binding contract. The mutual informal exchange of knowledge between parties can assist in a trial-and-error search for functional answers to problems. Opportunities engendered by regular informal and indirect exchanges may develop into a growing openness in the collaborative knowledge-seeking networks of firms (Brusoni et al., 2001; Grigoriou & Rothaermel, 2014; Langlois, 2003). During the more innovative stages of development, the relative role played by informal and indirect sourcing of problem-solving ideas is greater as they serve the purposes of experimentation under fundamental uncertainty. Informal networks also tend to be broader in composition. Informal and indirect ties may be especially helpful in synthesizing and welding together knowledge recombinations that derive from different paradigms of development, such as at times of a transition from one knowledge paradigm to another.

This opening of a knowledge structure network tends to be associated with a search for viable knowledge recombinations that had not previously been successfully connected. Looser indirect and informal linkages may complement existing formal organizational ties in an ambiguous field of innovation and a nebulous paradigm. Such looser connections bring an organization closer into contact with what initially is a peripheral knowledge stream that has unknown value and a greater degree of uncertainty associated with it. Yet, when an organization is beginning to explore an area peripheral to its own core skill set, these looser connections can be readily used to facilitate knowledge sourcing.

4. TWO ASPECTS OF KNOWLEDGE COMPLEXITY

In the present context of globalization in the information age, in which connectivity between areas is systematically rising, the interaction between technological distance and geographic distance in knowledge sourcing has become a central concern. Technological knowledge may be complex either if a knowledge artifact has itself a complex architecture of characteristics, or if the structure of recombined knowledge streams relied upon (sourced) to arrive at a knowledge artifact is complex. This gives rise to two forms of knowledge complexity: knowledge artifact complexity, and knowledge sourcing complexity. Considerations of location complexity are bound up with the second of these dimensions, namely complexity associated with a pattern of further reaching interdependencies between otherwise distinct knowledge sources. Technological knowledge complexity is commonly calculated through the use of patents, essentially because of the kinds of research question(s) addressed in this context, which reference the spread of knowledge fields and locations of origin, and due to the consistency of the patent coding system over time. From an empirical perspective, several potential definitions of technological knowledge complexity have been proposed to identify the complexity of combinations of knowledge with varying characteristics (cf. Breschi et al., 2004; Cantwell & Noonan, 2004; Engelsman & van Raan, 1991; Fleming & Sorenson, 2001; Trajtenberg et al., 1997).

Knowledge sourcing may be considered distant when the antecedent knowledge drawn upon stems from distinct and unconnected technology fields or distant geographic places of origin (Antonelli et al., 2010; Cano-Kollmann et al., 2016; Fleming & Sorenson, 2001; Kodama, 1992; Trajtenberg et al., 1997). One way to think about knowledge complexity across fields relates to the structure of characteristics or sources across core, niche, background, and marginal knowledge fields (Patel & Pavitt, 1997).

The knowledge base is becoming more interconnected as more complex structures of technological knowledge come about, drawing upon multiple domains of expertise. Because knowledge is always to some degree socially constructed, it has a degree of tacitness that embeds and ties it to the geographic region in which it was originally developed or learned (Nightingale, 1998; Searle, 1995). As specialized knowledge congregates or resonates especially in corresponding areas or clusters, accessing a knowledge domain outside the strengths of an area may require associations that reach across both knowledge fields and geographic locations. The systematic trend toward globalization, as illustrated by the internationalization of epistemic communities, is extending the scope of knowledge-based connections as people travel and move more often. Through skilled migration indigenous knowledge may be taken to new geographic locations and as migrant communities from a common country of origin emerge and develop, their new country of residence acquires greater knowledge recombinatorial capabilities in innovation (Bäker, 2015; Scellato, Franzoni, & Stephan, 2015; Shukla & Cantwell, 2018). Blending geographically dispersed sources of knowledge (more complex patterns of knowledge sourcing) tends to also result in a more complex knowledge artifact.

5. THE INFORMATION AGE AS A KNOWLEDGE-BASED PARADIGM

Rising knowledge complexity has been associated with the successive sequences of three predominant structural paradigms through which we have passed since the first industrial revolution in the eighteenth century (Andersen, 2001;

Cantwell, 2014; Kuhn, 1962). A structural paradigm provides an encompassing framework for most industry innovation paths in an era, through some elements of a common direction exhibited in a degree of industry convergence within a system of innovation (Andersen, 2001). Opportunities for knowledge field convergences first arose in the era of the mechanization paradigm (see, e.g., Rosenberg, 1976). Machine-based technologies in factories established a common ground on which to automate scale-based and initially labor-intensive activities that began in sectors such as textiles and agricultural equipment, and later spread to other industries. From the late nineteenth century the rise of the science-based electrical equipment and chemical industries during the science-based-mass-production paradigm depended on oil as the primary energy source, economies of scale, mass production, as well as highly specialized intra-corporate R&D activities, especially in the largest firms. Now since the late twentieth century, we have moved into the current information age, the goal of innovation has become increasingly to bring together different branches of knowledge through a wider diversity in the search for new applications across fields, organizations, and places. The emphasis has shifted to economies of scope or interrelatedness in R&D drawing upon interactions between flexible and linked production facilities. Through this sequence of paradigms, each of which encompasses and builds upon those that preceded it, knowledge has become progressively more connected across fields and more complex in character.

The ability of a firm to recombine knowledge for innovation in a suitable manner relies upon the growing significance of fusing together technologies by creating new forms of interrelatedness. The increase in knowledge complexity through the development of combinatorial capabilities is a key feature of the contemporary innovation pattern (Dosi, 1984; Perez, 1985; Freeman, 1987; Freeman & Louça, 2001; Freeman & Perez, 1988) in that ICT facilitates novel technological combinations, particularly through digitization. Exercising combinatorial capabilities relies on accessing, connecting, and utilizing geographically distant innovation clusters. ICT itself makes connections between areas of knowledge that were previously quite separate from one another, and thus its cross-border application offers a classic example of an effect of globalization (Andersen, 2001). Globalization has enabled firms to access and source distant knowledge with comparatively greater ease than previously. Through globalization, the world has become more interdependent, interconnected, and, yet, spread out across distinct political and institutional territories (Berry et al., 2014; Fernandes, 2011; Goerzen, Asmussen, & Nielsen, 2013). In doing so, globalization has been playing a critical role in the development of a more complex structure for technological knowledge building. In searching for novel innovation solutions, it becomes more likely that firms explore outside their geographic area and thus firms extend beyond their immediate vicinity.

ICT has also encouraged the rapid codification of knowledge and facilitated its diffusion across knowledge fields and across geographic space. Global value chains have encouraged the development of ICT applications relevant to the specific specialization of activity in each location (Chopra & Meindl, 2012; Kumar, 2001). Therefore, globalization has facilitated the increased complexity of knowledge, and, in particular, the complexity and diversity of knowledge recombinations. The links forged between previously rarely connected locations have been facilitated by decreases in the cost of connecting and decreases in the cost of transferring information. Although complex knowledge remains difficult to transfer across great distances, ties to distant collaborators can still facilitate the development of complex knowledge artifacts through the spatial diffusion of knowledge (Bell & Zaheer, 2007; Whittington, Owen-Smith, & Powell, 2009).

6. CONCLUSIONS

Due to rising knowledge connectivity across space through a variety of channels, relatively informal sources can be utilized to help generate knowledge for applications in a different industry. It is unlikely that an actor has direct contractual ties with many organizations outside its own primary market segments or industry. For example, a firm might learn informally from a potential supplier whose expertise does not align at the present but may do so in the future. Or, a general purpose technology (cf. Helpman, 1998; Trajtenberg et al., 1997) may have implications for a variety of downstream applications in other industries, and ICT is now the leading form of such a general purpose technology that is comprehensively diffused across every manufacturing or service activity.

When a firm is beginning to explore an area of potential but as yet undetermined value for future development, it may need informal access to a wider variety of supporting knowledge to ensure functionality of the novel technology or methodology. When firms begin to explore in any area experimentally, we would expect to see a greater degree of informality in their relationships with other actors or partners. We can expect an increase in knowledge complexity may quite often result from this process-oriented and open-ended informality. For reasons such as these, innovation that reaches out across technological field and geographic boundaries, and is associated with greater uncertainty over outcomes (compared to a localized technological change within a given field and in a specific place), tends to increase reliance on informal networks (Cantwell & Salmon, 2018).

Future research could add depth to the conceptual understanding of complexity we have suggested here by aligning this framework with empirical investigation. The two dimensions of distance, over technological fields and geographic locations, can be analyzed to ascertain their relative impact on knowledge complexity. The degree of knowledge connectivity across fields or over space can also be measured in order to assess their relative impact on knowledge complexity. The same two dimensions can also be compared in terms of their relative effects on the organizational form of ties that firms hold during innovation processes. A shift in knowledge complexity likely implies a shift in the structure of knowledge-based network relationships. Recombining previously unconnected knowledge streams is likely to be associated with a higher degree of flux in organizational networks, and in innovation networks becoming looser, more open, and more fluid. Through further empirical research of this kind, we may hope to improve our understanding of knowledge complexity, locational complexity, and the association between formal governance structures and informal networks.

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PART I

IB TRENDS AND THEORY IN THE INFORMATION AGE

CHAPTER 2

INTERNATIONAL PRODUCTION AND THE DIGITAL ECONOMY*

Richard Bolwijn, Bruno Casella and James Zhan

ABSTRACT

Digitalisation has become a central theme in the current economic and policy debate. Large digital and tech multinational enterprises (MNEs) are gaining an outsized role in the global economy. Also, the adoption of advanced digital technologies across all industries is fundamentally changing production processes. Both these (interrelated) phenomena have profound implications for economic structures, employment, inequality and development and industrialisation opportunities. This chapter analyses the international production and investment (i.e., foreign direct investment [FDI]) implications of the digital economy. First, it empirically documents significant differences in internationalisation patterns between the largest digital MNEs and traditional MNEs; particularly, the tendency of digital MNEs to exhibit an asset-light international footprint. Second, it argues that the powerful transformational forces related to digital adoption and the new industrial revolution have the potential to change international production more broadly, favouring a shift towards internationalisation models characterised by decentralised production, accelerated servicification and extended disintermediation. The chapter concludes with investment policy implications and a number of questions for future research.

Keywords: FDI; digital economy; international production; new industrial revolution; industry 4.0; MNEs

* This chapter builds on research carried out for *World Investment Report 2017 (WIR17)* on Investment and the Digital Economy, as well as various other editions.

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1. INTRODUCTION

1.1. The Pervasiveness of the Digital Economy

The digital economy – the application of internet-based digital technologies to the production and trade of goods and services – is becoming an ever more important part of the global economy (Schwab, 2016).

- It is affecting the lives of growing numbers of people: according to the International Telecommunication Union, three quarters of the population in most developed and emerging economies use the internet, and the penetration rate is approaching 50 per cent across developing countries — exceeding 25 per cent in Africa.
- It is a growing part of people's economic lives: in developed countries and emerging economies, up to two-thirds of people now shop online.
- It is pervasive in doing business: business-to-business transactions are worth a multiple of business-to-consumer (B2C) transactions; even considering only web-based sales (excluding closed digital networks between firms), they are still about a third higher (UNCTAD, 2015).
- It is encompassing an ever-greater part of the global economy: the value of B2C transactions has tripled from 0.5 per cent of global gross domestic product (GDP) in 2010 to 1.5 per cent today, and the internet industry contributes almost 4 per cent points to GDP in the largest economies, those that generate 70 per cent of global GDP.
- It is increasingly used by governments to interact with citizens and deliver services: according to the UN's e-Government Development Index, 90 countries now offer one or more one-stop portals for public information or online services, and 148 countries provide at least one form of online transactional services.

With the rapid growth of the digital economy, the importance of multinational enterprises (MNEs) in digital and technology sectors in international production has increased dramatically. The rapid rise of tech MNEs represents one of the most noteworthy trends in the world of global megacorporations in recent years. This phenomenon has attracted increasing attention not only at the research and policy levels, but also in the broader public. In 2010, the relevance of tech companies in the top 100 MNE ranking compiled by UNCTAD was still limited and not significantly different than 10 years earlier. From 2010 to 2015, in contrast, the number of tech companies in the ranking more than doubled, from 4 to 10, and their share in total assets and operating revenues followed a similar, and even more pronounced, trend. It has not stopped there; in the last two years, five more digital MNEs entered the top 100, signalling a further acceleration of the trend (Fig. 1).

This growing weight results from a group of tech MNEs, mainly from the United States, entering the ranking. Some of these companies, such as Alphabet (Google) and Microsoft, are leading the digital revolution; others, such as Oracle, heavily rely on and benefit from the acceleration of the internet to deliver their

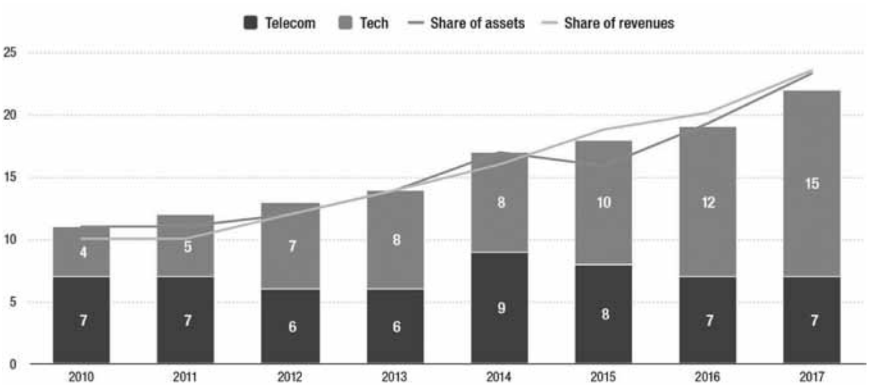


Fig. 1. Evolution of the Number of ICT MNEs in the Top 100 MNEs.
Source: Based on UNCTAD *World Investment Report* (2018).

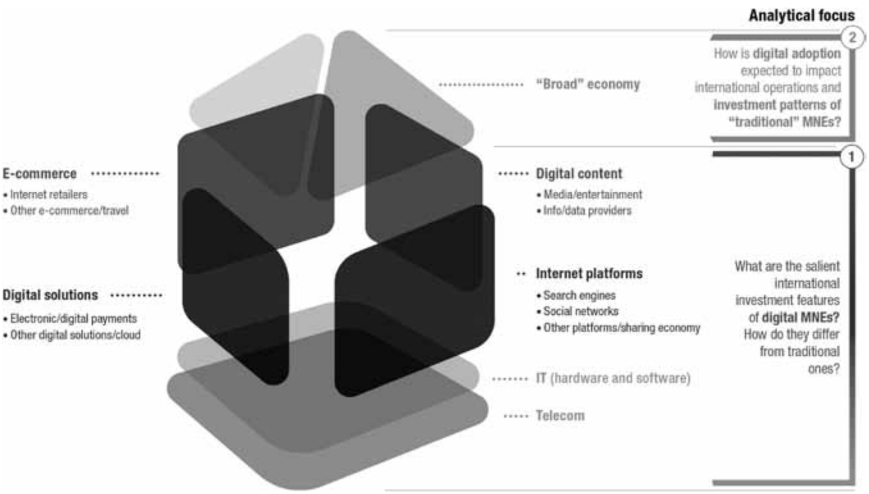


Fig. 2. Mapping the Digital Economy: Analytical Framework.
Source: Based on UNCTAD *World Investment Report* (2017).

value proposition. When including telecom MNEs, other important enablers of the digital economy, 22 MNEs in the top 100 are information and communication technology (ICT) companies — a sizeable portion of megacorporations.

1.2. The Analytical Framework and Scope of the Chapter

The digital economy is characterised by three building blocks (Fig. 2). At its foundation are firms in the IT and telecom industries that provide the infrastructure and tools that make the internet accessible to individuals and businesses. Its core is represented by digital firms, characterised by the central role of the internet in their operating and delivery model. Finally, the broad economy rests on digital infrastructure and digital content in the process of the digitalisation of traditional activities.

This analytical framework approaches the analysis of the relationship between digitalisation and international production at two levels. The first level (item 1 in figure 2) deals with the changes in international production patterns and behaviours brought by the players at the frontiers of the digital revolution, ICT and digital MNEs. The second level (item 2) expands the scope to include the broader impact of the adoption of digital technologies on the internationalisation of traditional players . These two levels are addressed (respectively) in Sections 2 and 3, the analytical core of this chapter. Section 4 elaborates on the policy challenges resulting from the fundamental changes in international production patterns described in Sections 2 and 3. Section 5 sets out an ambitious (and provocative) agenda for future research. It questions some of the common ways of thinking about the relationship between globalisation and digitalisation and argues that deep re-thinking of the MNE internationalisation theory is needed to explain the transformations at work in international production.

2. DIGITAL MNEs: CHALLENGING TRADITIONAL INVESTMENT PATTERNS

2.1. Mapping Digital MNEs: The Internet Intensity Matrix

To assess the potential impact of digitalisation on international production more broadly, that is, on international investment patterns of all MNEs, it is useful to re-think the analytical framework above more explicitly in terms of exposure to the internet. As illustrated in Fig. 3, the framework of Fig. 2 can be mapped into a conceptual matrix positioning digital categories on the basis of their internet intensity (the internet intensity matrix), along two dimensions: production and operations (vertical axis) and commercialisation and sales (horizontal axis).

At the top end of the matrix are the purely digital MNEs, the group of internet platforms and providers of digital solutions, where both operations and sales are digital. At the lower end of the matrix is the heterogeneous group of non-ICT and non-digital firms, some of which are gradually moving towards digital adoption in operations and sales, as confirmed, for example, by the growing importance of e-commerce in traditional business. An intermediate position is covered by digital MNEs with mixed models (digital content and e-commerce) and the group of ICT MNEs (IT and telecom), whose core business activities combine physical and digital elements.

Specifically, internet platforms (search engines, social networks and other platforms) are companies providing digital services through internet and cloud-based platforms; for example, search engines and social networks. ‘Other platforms’ includes sharing economy platforms; for example, transaction platforms

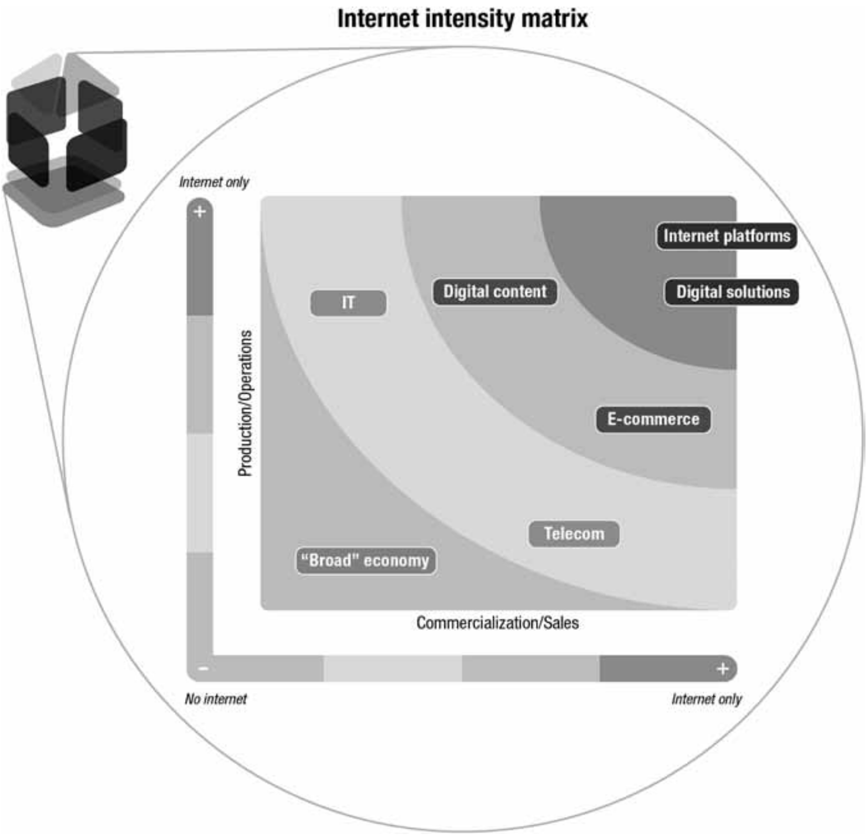


Fig. 3. The Internet Intensity Matrix.
Source: Based on UNCTAD World Investment Report (2017).

(eBay) and open-source platforms (Red Hat). The category digital solutions describes a variety of players with core activities based on, or strictly linked to, internet technologies. Among them: cloud hosting and computing, web hosting and email services, electronic and online payments and digital solutions for business management and for financial applications (fintech).

Among the mixed players, e-commerce (internet retailers and other e-commerce) consists of specialised and non-specialised online stores and online travel and booking agencies, focussing on fully online and online-born retailers. It also includes agencies specialised in online marketing and advertising. The last category in the scope of digital MNEs, digital content (digital media and entertainment, information and data providers) includes producers and providers of digital content, such as media (music, video, e-books and online magazines and online courses) and games ('classic' video games, online games, mobile games and multiplayer interactive games). It also captures 'big data' providers, and providers of marketing and customer intelligence, as well as economic, business and credit information.

The second macrocategory, ICT firms, includes IT companies producing hardware and software, as well as telecommunication firms. IT hardware and software cover the broad categories of manufacturers of ICT hardware (computer brands) and components (e.g., the semiconductor industry) as well as software developers, providers of assistance and IT consultancy and major software houses. Telecom players are owners of the telecommunication infrastructure on which internet data are carried.

Based on this classification, UNCTAD built a database of top 100 digital and top 100 ICT MNEs, selected as the globally largest (in terms of revenues) listed multinationals in their category. For details on the construction of the database, see Casella & Formenti (2018); the full list of MNEs can be found in the Technical Annex to the World Investment Report, 2017 (UNCTAD, 2017b).

The databases allow systematic profiling and ranking of digital and ICT MNEs across all main digital areas. It is currently the most extensive effort of its kind. These new data sets complement the established UNCTAD top 100 MNEs database, ranking non-financial MNEs, including digital and non-digital industries, based on their international presence. The combination of the 'traditional' top 100 database with the new databases of the top 100 digital and ICT MNEs provides a powerful data bank for analyses to compare and contrast investment patterns and international footprints.

2.2. The Lightning-Speed Growth of Digital MNEs

Digital MNEs are enjoying exceptional growth momentum. Fig. 4 describes the recent evolution of operating revenues for the groups of top 100 MNEs (traditional, ICT and digital). The growth pattern revealed by the matrix highlights the rapid expansion of digital MNEs and the role of the internet as a growth engine. In the last five years, the largest digital MNEs have outpaced traditional MNEs and ICT companies, with operating revenues growing by more than 10 per cent annually, compared with an essentially flat or slightly negative trend for the other two groups.

These figures confirm that digital MNEs represent by far the most dynamic players among the largest global multinationals. Their fast growth is a result of multiple and interrelated factors, including strong technological and market momentum prompted by the digital revolution, financial solidity and spending capacity due to very large margins and liquidity, as well as a managerial culture oriented towards investment and innovation. As a result, not only have digital MNEs gained market dominance in their core segments, but they have also successfully expanded in neighbouring digital areas. In just a few years, some have become *digital hubs* operating across the full spectrum of the digital economy.

2.3. FDI by Digital MNEs: Asset-Lightness

Operating and delivery models relying on high levels of digitalisation tend to result in lighter international footprints (Eden, 2016; McKinsey Global Institute, 2016).

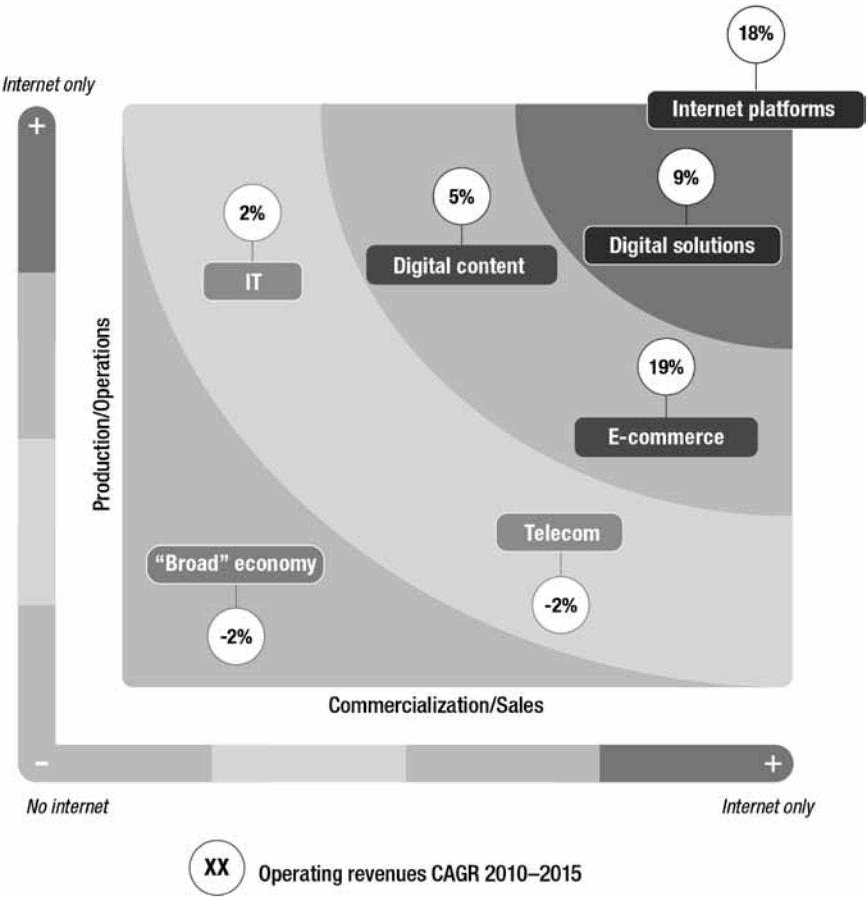


Fig. 4. The Internet Intensity Matrix and the Growth of Digital MNEs.
Source: Based on UNCTAD *World Investment Report* (2017).

This feature is described by the *FDI lightness ratio*, an indicator of the extent to which a company is able to generate sales abroad given its stock of foreign assets. Specifically, it is defined at the level of the individual MNE, as the ratio between the share of sales generated by foreign affiliates and the corresponding share of foreign assets. It is low (between 0 and 1) when the share of foreign assets is higher than the share of foreign sales (a 'heavy' footprint); it equals 1 when the two shares are the same; it is high (above 1) when the share of foreign assets is lower than the share of foreign sales (a 'light' footprint).

The more MNEs rely on the internet, the better they can leverage their foreign assets, obtaining a higher share of foreign sales with relatively fewer foreign assets (Fig. 5). This pattern is not driven by a few large companies, but rather applies across the board: the results are consistent when replacing categories' weighted averages with median values.

The foreign asset configuration of *digital MNEs* reflects the different degrees of exposure to, and usage of, internet and digital technologies.

- *Purely digital MNEs,* including *internet platforms* and providers of *digital solutions*, show the highest gap between (low) foreign assets and (high) foreign sales. These are companies that operate almost entirely in a virtual environment, characterised by limited physical ties with their markets. Tangible foreign assets in foreign markets are often limited to corporate offices and data centre hubs.
- *Digital MNEs with mixed models*, including providers of *digital content* and *e-commerce*, also exhibit lighter foreign asset footprint than traditional MNEs, but the gap is significantly reduced. Both groups combine a digital core business with a physical component instrumental to the delivery of their value proposition.
    - *Internet retailers* consist mainly of e-commerce multinationals, such as Amazon or Rakuten, where marketing and commercial activities are online, but delivery requires logistic assets and operations.
    - *Digital content providers* include large media companies, such as Twenty-First Century or Sky. These companies operate in an inherently digital environment with digital products and digital technologies. However, they still reach their mass customer base in traditional ways, for example, through cable or satellite television. With some notable exceptions such as Netflix, their online distribution segment, although growing rapidly, is still smaller than their traditional distribution segments.

MNE business models more suited to online operations and delivery, such as online travel agencies (in the e-commerce category) and information and data providers (in the digital content category), are characterised by lighter foreign asset footprint.

The group of *ICT MNEs* is highly polarised between IT MNEs (hardware and software) and telecom MNEs.

- *IT MNEs* exhibit a light foreign asset footprint overall, with a ratio between the share of foreign sales and the share of foreign assets almost equivalent to that of purely digital players. However, this group is quite heterogeneous, and reasons other than digitalisation may contribute to a light foreign asset configuration. The leading IT companies, such as Apple and Samsung, and the leading software companies, such as Microsoft and Oracle, have strong digital footprints. Conversely, smaller and specialised IT manufacturers have more limited digital exposure. Several of these MNEs are suppliers of IT components from East and South-East Asia. These companies tend to locate their production facilities at home, where production costs are lower, and then to export. This clearly contributes to a high ratio between the share of foreign sales and the share of foreign assets.

- *Telecom MNEs* exhibit a high share of foreign assets relative to foreign share. They tend to establish a heavy, tangible presence in the foreign countries where they operate. This is intrinsic to their business and operating model, which requires telecommunication infrastructure to achieve capillary coverage.

Finally, non-digital MNEs exhibit on average the same share of foreign assets and foreign sales (FDI lightness indicator equal to 1). However, there is significant variability across industries. MNEs in automotive and aircraft, a highly technological industrial sector, are comparatively lighter, typically resorting to contract manufacturing for more asset and labour intensive operations (average FDI lightness indicator at 1.3). At the other extreme, are industries that rely either on local infrastructure (utilities) or natural resources (mining and petroleum refining), with FDI lightness indicator below 1.

Not only do highly digital MNEs tend to realise more foreign sales with fewer foreign assets, but there is also little correlation between the two, suggesting that commercial presence in foreign markets has no apparent bearing on international

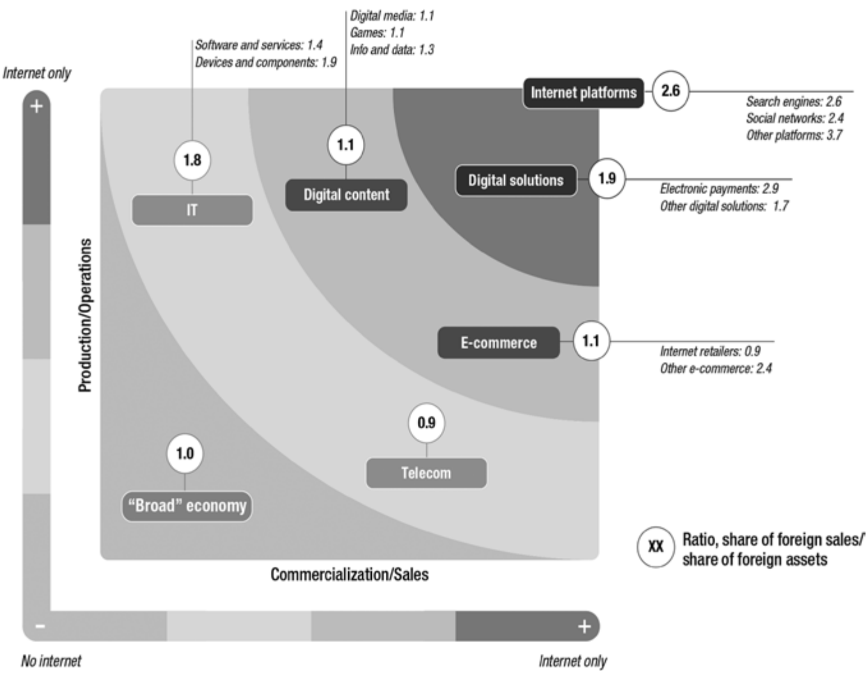


Fig. 5. The Internet Intensity Matrix and the FDI Lightness Indicator.
Source: Based on UNCTAD *World Investment Report* (2017).

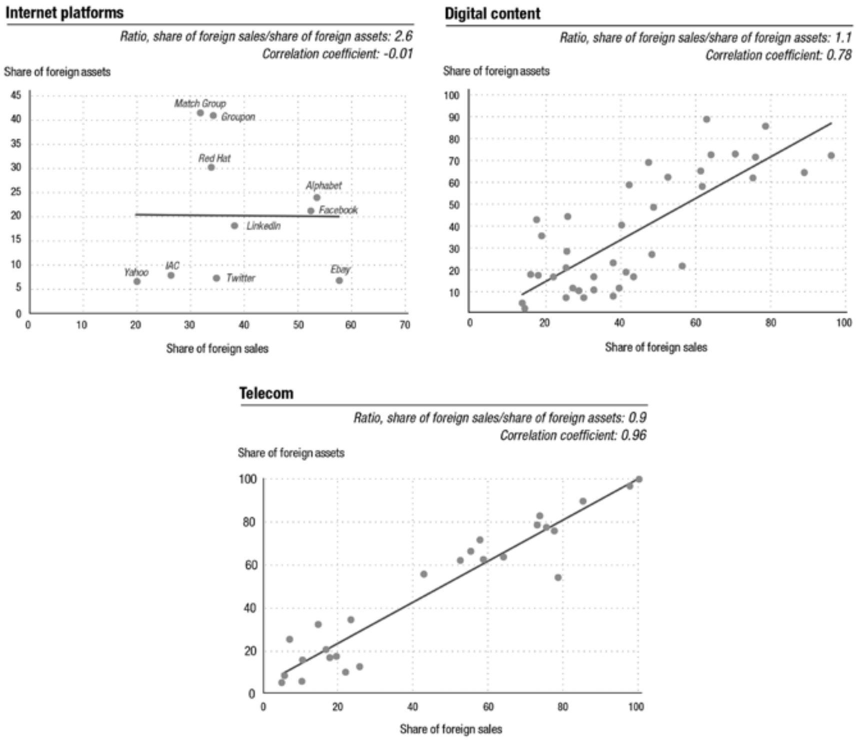


Fig. 6. Correlation between the Share of Foreign Sales and the Share of Foreign Assets, by Category (per cent).
Source: Based on UNCTAD *World Investment Report* (2017).

investment choices (Fig. 6). In other words, digitalization tends to "break" the operational nexus between foreign sales and foreign assets. Conversely, for MNEs in telecom and in digital content, which have relatively heavier foreign asset footprint, the share of foreign sales correlates highly with the share of foreign assets. This suggests that physical presence in a foreign market is a critical condition for sales.

2.4. FDI by Digital MNEs: Intangibles and Cash

Also *the nature of foreign investment* of digital MNEs differs from traditional ones, as the sources of value are moving from tangible assets to intangibles and cash.

The average market capitalisation of tech megacorporations is almost three times higher than that of other MNEs (Fig. 7). At the end of 2015, 10 tech MNEs made up about 26 per cent of the total market capitalisation of the top 100 MNEs in the ranking. Such market capitalisation can be largely attributed to highly valuable unrecorded intangibles, such as brand, know-how and intellectual property (IP) (as shown by the wide gap between market value and asset book value). When including this component (calculated according to the market capitalisation method), tech MNEs' intangibles are estimated to be roughly equal to their asset book value – significantly more than the average 40 per cent recorded for other MNEs. The second distinctive feature in the asset composition of tech MNEs is the large share of cash and cash equivalents, which stands at 28 per cent of total asset book value, or more than three times higher than the share of cash in other MNEs. Strong liquidity and high spending capacity have fuelled the exceptional growth of these companies in recent years.

These major differences in asset profile indicate a structural shift in the sources of corporate value from fixed, tangible assets to intangibles and current assets, and illustrate the profound disruption brought about by digital and tech MNEs. The traditional approach to growth and investment – characterised by high capital expenditure and debt, stretched liquidity, high fixed costs and squeezed margins – is largely absent in the digital world.

Despite their limited tangible assets, foreign affiliates of tech and digital MNEs retain a sizeable part of their foreign earnings overseas, typically in the form of cash and cash equivalents. This practice has been in the spotlight recently due to its tax-related implications (Bloomberg, 2016a, 2016b). A significant part of this

Fig. 7. Sources of Value of the Top 100 MNEs: Market Capitalisation and Asset Composition, 2015.
Source: Based on UNCTAD *World Investment Report* (2017).

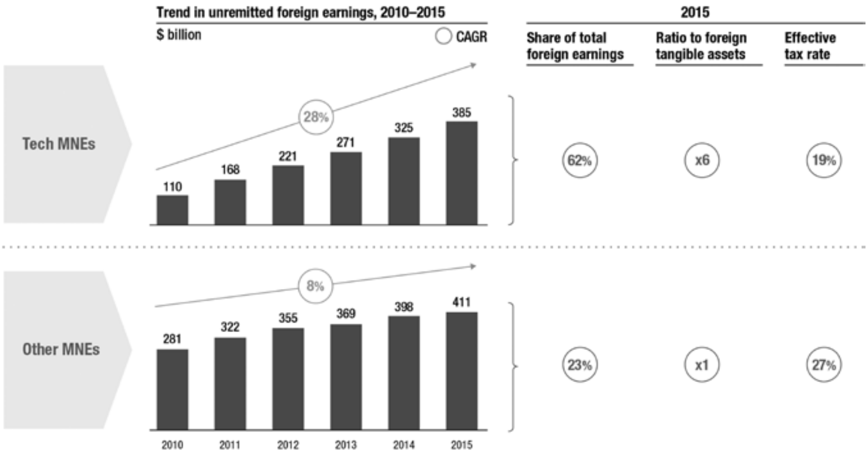


Fig. 8. Unremitted Foreign Earnings of United States MNEs in the UNCTAD Top 100 MNEs ranking.
Source: UNCTAD *World Investment Report* (2017).

cash consists of unremitted foreign earnings, retained abroad for tax optimisation purposes. In the group of 2015 UNCTAD Top 100 MNEs, tech megacorporations from the United States in the 2015 ranking of the top 100 MNEs kept 62 per cent of their total foreign earnings unremitted, a share almost three times higher than that of the other United States MNEs (Fig. 8). Furthermore, total foreign earnings retained abroad by tech MNEs from the United States are growing faster, at an average annual rate of 28 per cent between 2010 and 2015, against 8 per cent for other MNEs. As a result, tech megacorporations each retained about $75 billion abroad on average in 2015, against $45 billion for other MNEs. The fact that unremitted foreign earnings are equivalent to about six times the estimated value of foreign tangible assets suggests that these resources are only in small part used to finance foreign productive capacity. The main objective is rather to minimise the tax burden by (indefinitely) deferring the payment of the tax adjustment upon repatriation of foreign earnings to the United States. Accordingly, tech MNEs incurred an average effective tax rate of 19 per cent in 2015 – almost half of the statutory corporate tax rate in the United States and lower than the tax rate paid by other United States MNEs. These patterns are likely to apply to digital MNEs as well, given the common characteristics they share with tech MNEs. This phenomenon of high retained foreign earnings, however, is strictly linked to the United States territorial tax system and likely to be less relevant for MNEs from other countries. Furthermore, the very recent reform of the United States tax system may radically change the picture on this aspect.

2.5. The Geography of Digital FDI: Concentration in Developed Economies

The opportunity to operate globally with limited foreign investment may slow down the globalisation of international production, at least from the perspective

	Parent companies					Subsidiaries								
		United States		Other countries			Domestic		Foreign		United States		Other countries	
	Number	Number	Share	Number	Share	**Number**	Number	Share	Number	Share	Number	Share	Number	Share
Digital MNEs	**100**	63	63%	37	37%	**22,742**	10,199	45%	12,543	55%	8,968	39%	13,774	61%
ICT MNEs	**100**	21	21%	79	79%	**27,950**	6,522	23%	21,428	77%	7,463	27%	20,487	73%
Other MNEs	**81**	15	19%	66	81%	**57,002**	12,353	22%	44,649	78%	11,834	21%	45,168	79%

Fig. 9. Ownership Structure of MNEs.
Source: Based on UNCTAD *World Investment Report* (2017).

of tangible assets. This trend is further exacerbated by the fact that most digital MNEs are from developed countries, in particular the United States. The share of digital MNEs based in the United States is high, at almost two-thirds (Fig. 9). The predominance of digital MNEs that are based in the United States, coupled with the tendency of these companies to retain most productive assets at home, results in a geographic distribution of subsidiaries that is highly skewed towards domestic companies based in the United States. Just above 50 per cent of digital MNEs' subsidiaries are foreign, compared with almost 80 per cent of other MNEs' subsidiaries; conversely, about 40 per cent of digital MNEs' subsidiaries are based in the United States, almost twice the share for other MNEs. As a result, the growth of digital economy MNEs could reverse the trend in outward FDI observed in the last decade towards 'democratisation' – back towards concentration in a few large home countries.

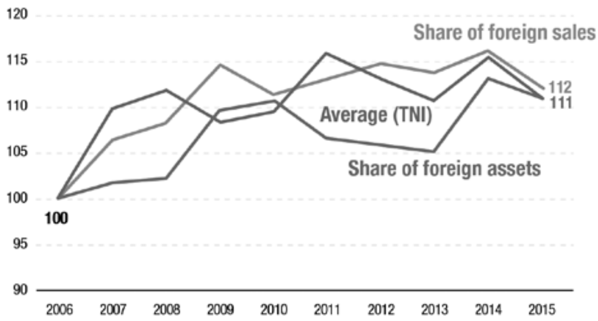
2.6. Summary: The Onset of a New Era for International Production?

The empirical analysis highlights the following three key trends in the mode of internationalisation of digital and tech MNEs:

1. A relatively limited international asset footprint (Figs. 5 and 6).
2. The outsized role of intangibles and large cash reserves held overseas (Figs. 7 and 8).
3. The concentration of productive investment in a few developed economies, especially in the United States (Fig. 9).

These trends describe an entirely new multinational business model and have the potential to radically transform the international operations of many MNEs. The key question, of course, is to what extent the international production patterns associated with digital MNEs are a harbinger of the future for MNEs across all sectors.

For now, the process of digital disruption of international production patterns is still limited to digital and tech MNEs, or MNEs with strong links to the digital economy, whether as providers or enablers. For other MNEs, traditional patterns of internationalisation are still resilient. However, the penetration of leading digital MNEs into large portions of the real economy outside typical digital markets will give some impulse to the digitalisation of more traditional activities. The fast growth of online sales channels within traditional industries shows that



	2006	2015
Share of foreign assets	56%	62%
Share of foreign sales	57%	64%
TNI	57%	63%

Fig. 10. Evolution of the Share of Foreign Sales and the Share of Foreign Assets for the Top 100 MNEs, 2006–2015 Indexed, 2006 = 100. *Source*: UNCTAD *World Investment Report* (2017).

companies are in fact moving towards the digitalisation of commercial activities. The digitalisation of production, in contrast, is clearly more challenging, but technological developments and the digital transformation are expected to continue to support the transition. Section 3 examines possible trends in more detail.

3. DIGITALISATION OF THE WIDER ECONOMY: THE NEW INDUSTRIAL REVOLUTION

3.1. A Major Transformation, But Gradual

To date, the adoption of digital technologies in non-ICT MNEs is not yet visible in international production patterns in the way that it is for ICT and digital MNEs, as described in Section 2. Overall, internationalisation, or the foreign share in MNEs' assets and sales, has been increasing (Fig. 10). However, the relative contributions of foreign sales and assets have not substantially changed over the last 10 years, with the share of foreign sales roughly aligned to the share of foreign assets. On average, in 2015 the largest MNEs generate 64 per cent of their sales abroad, with 62 per cent of their assets overseas.

The relative resilience of investment patterns in traditional industries may just reflect the fact that digital transformation and the new industrial revolution (NIR) – also known as 'industry 4.0' or 'advanced manufacturing' – production processes are still relatively confined to few industries. Fig. 11 from UNCTAD's Trade and Development Report (UNCTAD, 2017c) confirms the widespread use of robotics in the automotive and ICT industries while the penetration of robots in other manufacturing industries is still marginal. The factors behind the different penetration of robots across industries are related both to technological considerations and economic considerations, with economic considerations being prominent. Interestingly, as highlighted in the previous section, ICT and automotive are also the industries with the higher FDI lightness ratio, according to the analysis of the top 100 MNEs.

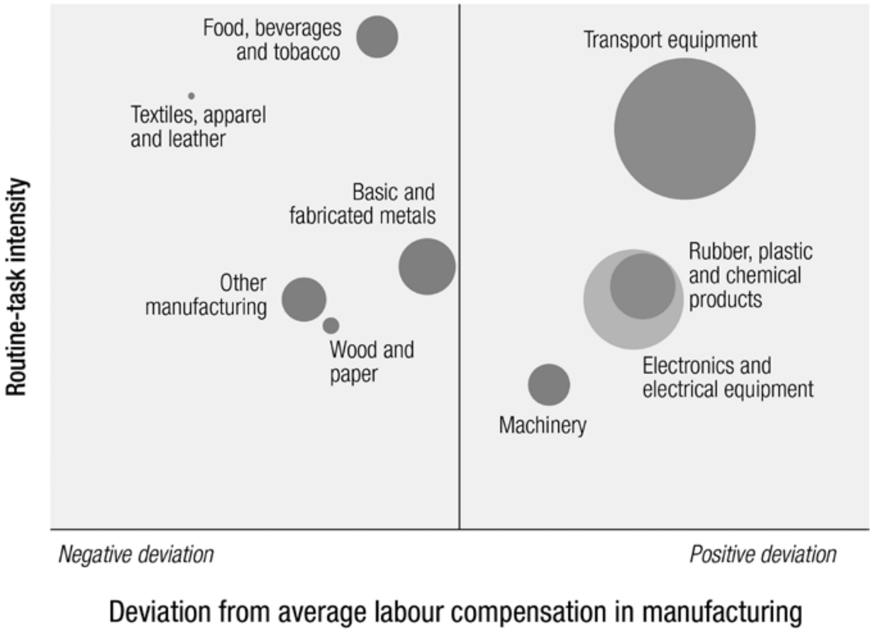


Fig. 11. Relationship between Technical and Economic Feasibility of Routine-Task Automation and Estimated Stock of Industrial Robot, by Manufacturing Industry.
Source: UNCTAD *Trade and Development Report* (2017).

Although digital adoption has so far not affected international production statistics, anecdotal evidence confirms it has the potential to transform the way companies across different industries run their internal operations, interact with customers and suppliers and govern their international supply chains.

In supply chains, digital tools can coordinate a multitude of vendors around the globe with greater efficiency, opening up new possibilities for procurement. Many MNEs are centralising global functions and back-office operations, while cloud computing is used to share resources within MNE networks and facilitate new forms of pooling arrangements.

The speed of digitalisation in individual MNEs is driven by various factors. Developing an end-to-end digital supply chain involves a major transformation, organisation-wide disruption and significant levels of investment. This is particularly the case for global giants with a history of mergers and acquisitions and an array of legacy systems to integrate. The urgency depends on industry characteristics and competition. Companies digitalise aspects of their supply chain in response to industry-specific challenges and drivers. They may have a pressing need to address inventory management challenges. They may rely on digitalisation to address quality-control issues, ensuring that their products are of a consistently high standard and their provenance traceable. Or, they may adopt a digital approach in order to maintain or regain competitive advantage through improved customer service or reduce their environmental impact. In some sectors, the digitalisation of products and services themselves is changing the nature of supply and consumption. For instance, streaming of media and entertainment products as well as online purchasing of financial services are now widespread.

In traditional manufacturing industries, the impact of digitalisation is significant. Within fast-moving consumer goods, the connection to individual consumers through e-commerce transactions offers retailers and manufacturers alike opportunities to capture product and delivery preferences. In engineering industries, the 'power-by-the-hour' business model (in which revenues from product use, service and repair exceed those of the initial sale of the primary asset) is now the norm, enabled by the ability to track product performance in real time through sensors that provide data back to manufacturers. MNEs in engineering sectors are also deploying digital 3D printing technologies to deliver enhanced functionality and lightweight structures. In the pharmaceutical sector, new digitally enabled production technologies such as continuous processing with advanced analytics are providing alternatives to the centralised production of large batches that is still prevalent in the sector. These technologies allow for more flexible volume and variant production to better target niche customer populations.

Technologies enabling the sharing economy are also affecting services industries. These business models, based on facility or product access rather than ownership, can be replicated beyond consumer transport and hotels (such as Uber and Airbnb) in any services sector where underutilised, time-limited capacity can be sold through digital platforms. Although many supply side actors are small businesses, the owners of these digital platforms have quickly become dominant sector players at an aggregate level.

3.2. Potential Impact on International Production

The adoption of digital technologies by non-ICT MNEs can have significant implications for their international operations, potentially affecting all stages of the value chain (Fig. 12):

- *Upstream* in the value chain, in inbound processes and supplier interactions, e-auctions can have multiple effects. They can bring in new suppliers and have a democratising effect, allowing new entrants to participate in cross-border supply chains. Conversely, if purchasing platforms are complex or require qualifying capabilities that are challenging or closed by design, they can also drive exclusivity and favour established partners. In non-commodity supply chains, digitalisation can promote greater levels of supplier integration in terms of inventory control and new product development.
- In *internal* production processes, greater automation drives higher capital intensity and favours high-skilled, high-value jobs. Advanced manufacturing

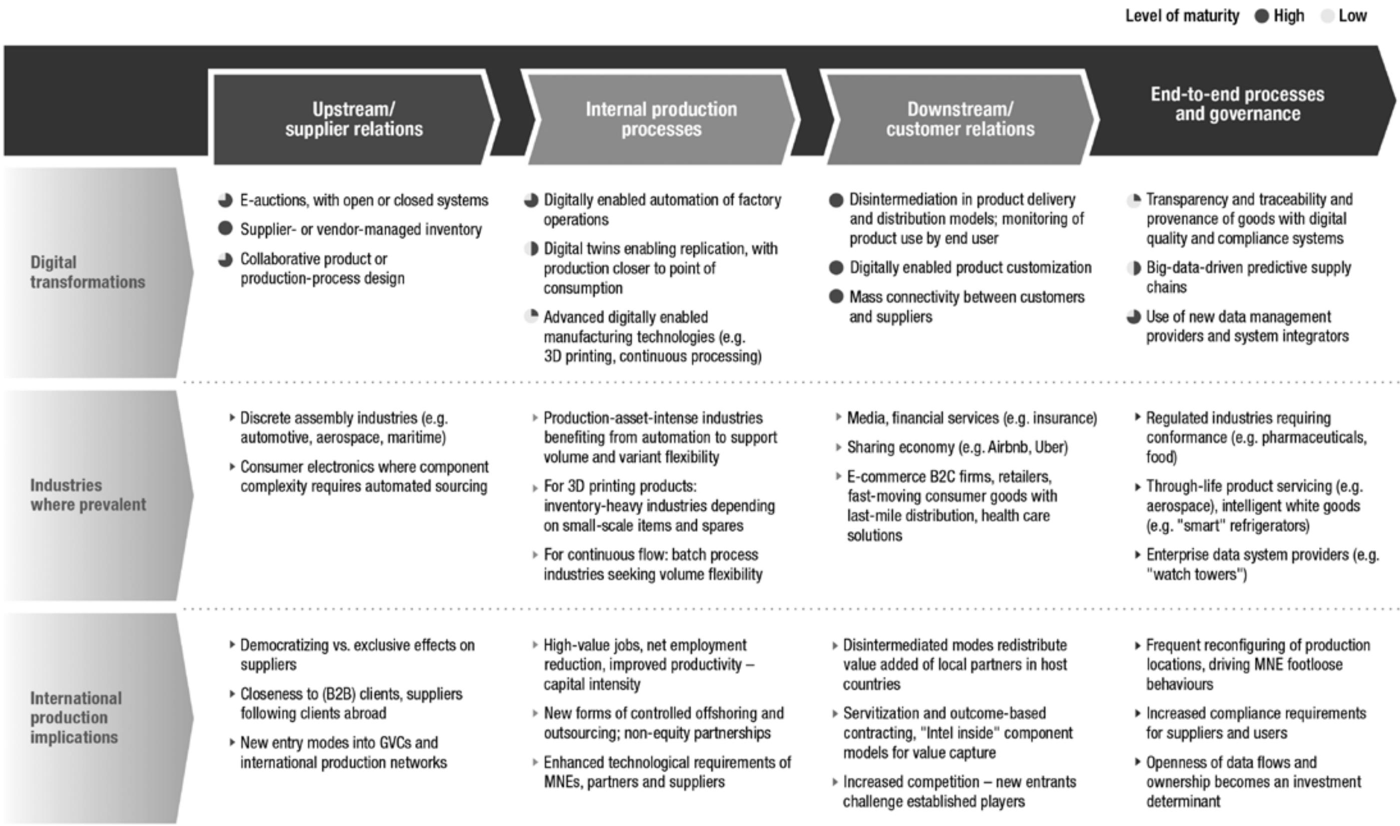


Fig. 12. Digital Transformation and Impact on International Production.
Source: UNCTAD *World Investment Report* (2017).

technologies that enhance replication and scale flexibility could also drive more distributed manufacturing models with significant local value added in host countries but sophisticated centralised coordination.

- *Downstream*, digitalisation offers opportunities for disintermediation, with component and final-product manufacturers no longer constrained by retailers and wholesalers but accessing new channels to the end customer. MNE partnerships may change, with a shift from traditional distribution partners to new services partnerships and non-equity modes.
- Across the *end-to-end* supply chain, continuous reconfiguration of optimum site locations and sourcing options are being supported by more dynamic network design tools and improved forecasting driven by market data. This can lead to increasing 'footloose' behaviour of MNEs and higher fluctuations in production levels in affiliates or in the supplier base. Data across the supply chain will become increasingly valuable, with data ownership and free flow of data increasingly important as investment determinants.

Digital transformation in global supply chains pushes international production in conflicting directions, in terms of *where and how MNEs invest*. More capital-intensive production tends to result in fewer large production sites, often in locations with highly skilled advanced economy capabilities; yet, distributed manufacturing options support larger numbers of small-scale production locations. As for *how and with whom MNEs partner*, e-auctions lead to broader supplier relationships, and disintermediation to looser distribution partnerships, but complex co-design encourages closer and more exclusive supplier partnerships, and e-commerce fulfilment can lead to new customer service partnerships.

These opposing effects in the nature and direction of investment and partnerships, which are not mutually exclusive, in turn influence the impact of international production in host economies, following several possible scenarios (Fig. 13).

(i) Distributed production: implications for international production

Distributed production is characterised by higher levels of customisation, localised close to the point of consumption but with elements of centralised control, and supported by new production technologies, such as 3D printing, which enable factory replication (digital twins) to ensure consistent product quality. It can also involve end-user participation in product design and production (see Srai, Harrington, & Tiwari, 2016; Srai et al., 2016).

For example, digitalisation in the pharmaceutical sector will lead to more distributed production. The industry is currently characterised by predominantly large-batch, centralised manufacturing that supports the 'blockbuster' drug supply model. This has led to a slow, inventory-heavy operating model that is increasingly regarded as inflexible and unsustainable. New markets and the rapidly evolving pharmaceutical and biotechnology landscape are driving greater product variety, shorter product life cycles and smaller drug volumes, exacerbating the accelerating unsustainability of the traditional production model. Future pharmaceutical supply chains will involve new production models that manufacture

Scenario	Descriptive elements	Possible international production implications
Distributed production	• Localized manufacturing closer to the point of consumption • Factory replication (digital twins) under centralized control	*Patterns of investment and modes of governance:* • More, smaller production locations, rather than few, large locations • Sophisticated centralized coordination and quality control
Accelerated servicification	• Product servitization (power-by-the-hour models) • Increased use of contract manufacturing and outsourcing of ancillary operations across more industries	*Types of investment:* • More investment in services • More non-equity modes of production
Extended disintermediation	• Direct delivery of products and services to end users • Branded manufacturers reaching out to end users; “Intel inside” model	*Investment impact:* • Increased value capture by MNEs • Fewer local distribution partnerships, new service partnership opportunities
Flexible production	• Automation to support ‣ Customization (increased product variety) ‣ Production to order (volume flexibility)	*Investor behaviour:* • More fluctuations in output and use of labour • More footloose production

Fig. 13. Digital Adoption Scenarios and Implications for International Production.
Source: UNCTAD *World Investment Report* (2017).

drugs to order and closer to the point of consumption. This scenario requires more widely distributed microfactories rather than the traditional centralised model. Final product or pack finishing may also take place at the local clinic or pharmacy to meet a patient's individual medical needs.

Although digitally enabled distributed production is still in its infancy, it is taking shape in many industries. One manifestation is the emergence of 'makerspaces', or community-based centres of production. Although many of the early examples of makerspaces were largely educational, often closely related to universities and technology centres, some have now evolved into commercially viable centres of early-stage prototyping and manufacturing. Gearbox (Kenya) is an example of a makerspace facility where 3D printing and other advanced manufacturing technologies are being used to develop local skills and support prototype manufacturing and small-scale production.

(ii) Accelerated servicification: implications for international production

The servicification of manufacturing – the rise of services in the global economy – is a longstanding trend. It takes different forms, each of which is being accelerated by digitalisation.

First, the fragmentation of value chains into separate 'tasks' has brought to the surface many services activities that were previously part of manufacturing. Services can be incorporated as separate business entities or outsourced to external service providers. Digitalisation is enabling the separation from the value chain and outsourcing of services activities – beyond the administrative support and ancillary tasks that were already widely contracted out. Technical services, for example, are outsourced more and more often for specialist diagnostics, condition monitoring of equipment and quality testing.

Second, the outsourcing of production to contractors has led to activities previously categorised as manufacturing being carried out as a service on a commission basis. The emergence of global contract manufacturing organisations (CMOs) has been accelerated by digital technologies: lower transaction costs through improved international communication capabilities between independent organisations have been vital. Beyond enhanced day-to-day operations that support inventory-light control mechanisms (such as Vendor Managed Inventory), digital technologies have also enabled improved product design and specification. As a result, outsourcing has become increasingly competitive, with firms focussing on core competences and outsourcing ancillary activities. On both the supplier and distribution ends of manufacturing supply chains, crowdsourcing platforms allow new partners to enter the supply chain.

Third, many manufacturers of engineering equipment or capital goods have adopted business models that add services to their sales, as in the 'power-by-the-hour' model for aircraft engines, where most revenues come from maintenance rather than direct asset sales. Digitalisation is central to this transformation, with data on usage allowing for 'air miles', as well as the condition of the engine, to be monitored using sensors and wireless communications to assess maintenance and servicing requirements. In terms of geographic dispersion, the service model promotes the centralised control of asset management, with local intervention on servicing. The model has become widely prevalent in engineering industries and is being rolled out across other industries, as in Xerox's 'pay-per-page' system for photocopiers. In addition, physical goods are increasingly incorporating digital services content through apps or geolocation devices (e.g., in shipping containers), giving a further boost to servicification.

(iii) Extended disintermediation: implications for international production

The role of digitalisation in downstream supply-chain disintermediation is perhaps most obvious with the ability to bypass wholesalers and distributors to move directly to final delivery. Effective demand capture can enable more direct delivery. For physical goods, this generally involves shorter supply chains. In the case of non-physical goods, such as media streaming or financial services, intermediaries are bypassed altogether. As such, the value added of MNEs' distribution partners in overseas markets is under pressure. At the same time, e-commerce delivery requires sophisticated distribution models, which challenges manufacturers and retailers alike by allowing the emergence of new entrants managing the last mile delivery. Also, the disintermediation of distribution is resulting in the emergence of new service partnerships.

But, disintermediation in the supply chain can extend to branded goods manufacturers. The digitalisation of product design and equipment specifications enables component suppliers to engage directly with end users to ensure that they require the inclusion of their product into final goods. Here, the disintermediation is in the specification of products, rather than in the distribution: an original equipment manufacturer no longer selects a component; instead, this choice becomes an end-user requirement fostered by component suppliers. Often, this shift involves component providers from developed countries supplying branded high-end parts into final assemblies, lowering the final assembly value added. Although this phenomenon is not new, as illustrated by the 'Intel inside' example in computers and automotive firms specifying componentry to module manufacturers, it is now increasingly prevalent in more sectors, enabled by digital technologies.

For example, in consumer home appliances, Strix heating-control elements are required componentry in the majority of kettles manufactured globally, with production largely undertaken by CMOs on behalf of brand owners. Digitalisation facilitates communication with users, specification control, production quality control and final-product quality and safety. Local suppliers to CMOs, often in developing countries and offering inferior quality, are sidelined. Similarly, in shipping, vessel designers engage with fleet operators who require the use of specialised equipment and components; for example, Brunvoll thrusters. Again, disintermediation is enabled by digitalisation, which allows specification control and fleet operator engagement.

(iv) Flexible production: implications for international production

Digitalisation continues to promote further automation in production, driven by expectations of significant productivity gains. Investment in automation and robotics pushes fixed capital costs for production higher. The business case for investment therefore requires scale, which, unlike the scenarios just described, will result in more centralisation and high-volume manufacturing.

At the same time, highly automated and digitally enabled production can also support greater product variety and customisation. Furthermore, production lines that are more flexible in terms of product allocations and manufacturing of multiple products allow more volume flexibility to meet seasonal or demand fluctuations. This could result in less stable output levels. Several emerging manufacturing production technologies, enabled by digitalisation, affect the optimum scale of production and hence investment requirements and location decisions.

With 3D printing, for example, the dominant scenario is the small-scale production of components or spares close to the point of need. Continuous processing, another digitally enabled technology that is most evident in industries where traditional batch operations are being replaced by continuous flow (e.g., pharmaceuticals), may also transform production scale, and hence investment characteristics.

4. INVESTMENT POLICY CHALLENGES

A key challenge for policymakers under the NIR – particularly, in developing countries – is how to ensure their economy's continued attractiveness as a production location for MNEs in order to maintain or improve global value chain (GVC) participation. Closely related is the question of how best to promote upgrading to higher value-added production. A further challenge relates to the impact that the NIR could have on the way MNEs organise themselves globally; in particular, the aforementioned trends towards shorter value chains and lighter international asset footprints (i.e., less FDI) spreading across more industries.

The NIR will change the determinants and modalities of investment decisions. Some economic factors long critical for the attraction of efficiency-seeking foreign investment, such as low labour costs, may lose in significance, while others assume greater prominence (e.g., the quality of a location's digital infrastructure). Policy determinants will also change, shifting for instance from more generic forms of investment incentives to more targeted ones linked to R&D and innovation. The NIR also places greater emphasis on the quality of IP frameworks, both in terms of levels of IP protection and their enforcement, and data protection regimes. Overall, countries that have an economic policy conducive to innovation and R&D, a well-developed modern infrastructure and a high-quality education system supplying an abundance of human capital will likely be more successful in attracting and retaining foreign investment and enjoy first-mover trading benefits in an NIR context.

The changes brought about by the NIR, not least the ability of high cost-high wage countries to recapture through technologically advanced means competitive advantages that have progressively shifted to developing countries in recent decades, point to a significantly more contestable global market for FDI attraction. Such an environment holds important implications for investment policy design in developing countries, notably in terms of investment attraction, facilitation and retention through improved business environments and strengthened investment promotion efforts. It also heightens the importance of policies targeting innovation and the resilience and growth of SMEs.

The ability of SMEs to participate in GVCs is both an important investment determinant for MNEs and a key factor in ensuring that investment creates positive spillovers in terms of employment generation, technology and knowledge diffusion and expanded trade opportunities. An important challenge faced by many developing countries in reducing gaps in technological capacity and promoting the participation of SMEs in international trade and GVCs is the level of private sector ITC investment and digital adoption.

To keep up with the rapidly evolving global manufacturing landscape, SMEs in developing countries and economies in transition need to improve their competitive abilities, meet the product and process standards required in world markets, benefit from reduced trade costs and stay connected with both lead (typically foreign) investors in GVCs and external markets.

The main policy challenge for making the NIR work in favour of SME internationalisation thus consists of facilitating the spread of new digital technologies and ensuring SMEs' access to such technologies. Ongoing technological disruptions are likely to affect five key determinants of SME internationalisation: access to market information, access to finance, access to infrastructure, access to skills and the ability to meet relevant standards and regulations.

Regulatory uncertainty can be particularly problematic for small players in the economy. Costly access to certification can make it difficult for SMEs to meet regulatory requirements such as cyber security standards. Given the speed at which technology changes, policymakers have a role in ensuring easy access to information on digital standards. The promotion of harmonisation or equivalence of digital standards with a focus on openness, transparency and interoperability can also be beneficial for operators, and especially SMEs.

Support for the adoption of new technologies and business models can take many forms. In addition to strengthening local absorptive capacities through education and training, there is a role for supporting investment in local NIR manufacturing capabilities through, for example, the establishment of 'maker spaces' and innovation hubs, incubation centres, technology parks and other dedicated economic zones. Such policies will become all the more important in countries where the NIR motivates MNEs to replace cross-border ownership linkages with non-equity modes of corporate governance (see *WIR11*), which will significantly increase the importance of domestic business capabilities, including with respect to access to capital.

Specific policies can also harness the potential for the NIR to generate more opportunities for firms headed by women and in sectors and firms that employ women most intensively. Policy actions could include encouraging investment in – and enhanced access to finance for – women-owned firms, strengthening women's entrepreneurial networks, removing obstacles to the higher labour market participation of female workers, promoting entrepreneurship for women, directing trade and investment support institutions to design promotional activities for women-owned firms, and ensuring better access to education and training for girls and female workers.

The various aforementioned policy responses to the NIR are being pursued in a growing number of countries through industry development policies in which trade and investment policies play a central part. The proliferation of industrial policies, already a trend since the second half of the 2000s and now accelerated in light of the NIR, with more than 80 countries adopting new industrial policies in the last five years alone (UNCTAD, 2018), can prove challenging for the existing international policy framework for trade and investment. This is so because of competing goals and increasingly proactive and, at times, explicitly trade- and investment-protective, policy measures.

Furthermore, many policies specific to the digital economy, such as location requirements and policies related to the treatment of digital data, often represent new forms of investment and trade policies since they address cross-border economic linkages. These policies are set to grow in salience as talks towards a possible plurilateral agreement on e-commerce get underway.

5. FORWARD-THINKING: NEW THEORIES OF INTERNATIONAL PRODUCTION?

This chapter, which builds on research findings developed in UNCTAD's annual *World Investment Report* series, has illustrated how the digital economy is fundamentally changing international production, both through the direct role of digital MNEs and through the adoption of digital technologies in other industries, with important consequences for global patterns of investment. The most important and most visible aspect of this fundamental change is that, while international production continues to expand, the rate of expansion is slowing down, and the modalities of cross-border transactions and exchanges of goods, services and factors of production are shifting.

The gradual growth in the sales and value added of MNE foreign affiliates, as reported in UNCTAD's annual statistics, is inherent in the functioning of international production networks. Existing stocks of investment, accumulated in affiliates already located overseas, generate returns that can be reinvested in foreign markets (approximately 50 per cent of the income of foreign affiliates is reinvested, on average). However, the average annual growth rates over the last five years of foreign affiliates' sales, value added and employment (between 1.5 and 3 per cent) were all lower than during the equivalent period before 2010 (between 7.5 and 11 per cent). This is in line with the loss of growth momentum in the FDI trend – net of peaks caused by one-off transactions and corporate restructurings. The deceleration in international production has also been a contributing factor behind slower growth in trade.

After the global financial crisis, the slow-down in the rate of growth of trade in goods and services, relative to global GDP, was only the first manifestation of the broader change discussed in this chapter. The relative rates of growth over the last five years of royalties and licensing fee receipts (almost 5 per cent annually) compared with trade in goods and FDI (less than 1 per cent per year) show how international production is shifting from tangible cross-border production networks to intangible value chains. The asset-light international production trend is visible again in the latest statistics (UNCTAD, 2018), with assets and employment in foreign affiliates growing significantly more slowly than sales.

With such fundamental changes in the behaviour of MNEs, a research question going forward inevitably becomes: Can the phenomena that we currently observe still be fully explained by the main theoretical frameworks of international business, for example the Ownership-Location-Internalization (OLI) and GVC frameworks?

Many concepts of the digital economy and the NIR have been accounted for or accommodated by theorists (Dunning, 2001; Dunning & Wymbs, 2001). For example, the weakening of the lead firm concept, platform governance versus lead firm governance in GVCs and the reduced importance of boundaries (of firms, industries, countries) have been flagged in existing research (Singh & Kundu, 2002). But, much of the work has been relatively limited in scope, mostly looking at e-commerce or at specific applications of Industry 4.0 (Laplume, Petersen, & Pearce, 2016), but rarely at the full impact of digital adoption and advanced manufacturing technologies across the value chain (exceptions include Alcácer, Cantwell, & Piscitello, 2016; Chen & Kamal, 2016; Strange & Zucchella, 2017). Much of the work has so far been theoretical, with little empirical evidence or data. And no clear connections have been made with global macrotrends, patterns of investment, financial flows, goods and services trade, payments for intangibles and so forth. For example, the asset-light phenomenon, until recently, had been taken for granted in the literature, without a systematic evidence.

There is work to do for researchers in *theoretical development* and in *challenging perceptions*. For example, recent evolutionary additions to classical IB theories, which depended on market imperfections, try to accommodate near-perfect markets and reduced relevance of oligopolies. However, the reality shown by the data presented here are radically different, with growing concentration of market power and assets. Perceptions of trends among policymakers also need nuancing. A key perception that drives policy is that digital technologies bring democratisation of product markets, with limitless opportunities for start-ups and SMEs to access markets. The reality appears far more monopolistic and winner-takes-all.

The impact of the digital economy and the NIR should satisfy IB scholars searching for grand challenges: when major trends and observations of realities clash with theories and perceptions there is room for new and innovative theoretical thinking.

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CHAPTER 7

INTERNATIONALISATION THROUGH DIGITALISATION: THE IMPACT OF E-COMMERCE USAGE ON INTERNATIONALISATION IN SMALL- AND MEDIUM-SIZED FIRMS

Jonas Eduardsen

ABSTRACT

This chapter contributes to the ongoing debate about how digitalisation affects the internationalisation of small- and medium-sized firms (SMEs). By applying the Uppsala Internationalisation Process model, this chapter examines the impact of e-commerce on the internationalisation of SMEs. The study uses a unique dataset, which includes 14,513 SMEs across several sectors in 34 countries. The results show that firms using the Internet as a means to provide information about the firm exhibit a higher degree of internationalisation, while using the Internet to facilitate transactions was found to have a positive impact on the ratio of foreign sales to the total sales; however, these foreign sales are likely to be concentrated in less regions/markets. Furthermore, perceived export barriers were found to be a significant moderator of the effects of e-commerce usage on international intensity and international diversification. This suggests that e-commerce does not automatically facilitate the internationalisation of SMEs.

Keywords: Internationalisation; international diversification; small- and medium-sized firms; e-commerce; perceived export barriers

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Small- and medium-sized enterprises (SMEs), in many parts of the world, are now seeking growth by engaging in internationalisation – the increasing involvement in foreign markets. In recent years, new types of firms have started to emerge, such as born globals (Knight, 2015), international new ventures (Oviatt & McDougall, 2004) and micro-multinationals (Dimitratos, Johnson, Slow, & Young, 2003). Common to these firms is that they all engage in internationalisation while being small and often right from or shortly after inception. This has resulted in an increasing number of empirical studies focusing on the antecedents and outcomes of SMEs' international involvement. Although several studies have looked at the antecedents and the process of internationalisation among SMEs, little effort has been made to understand the potential influence of the Internet and the development of e-commerce on SMEs' internationalisation (Etemad, Wilkinson, & Dana, 2010; Hagsten & Kotnik, 2017; Sinkovics, Sinkovics, & Jean, 2013).

The Internet has been hailed as 'the most important innovation in recent years for SME exporters' (Mostafa, Wheeler, & Jones, 2005, p. 292) and the emergence of born globals, international new ventures and micro-multinationals is often closely linked to advances in information and communication technology and the emergence of e-commerce (Cavusgil & Knight, 2015; Oviatt & McDougall, 2005). SMEs are generally considered to be restricted by their size when seeking to expand their business abroad (Buckley, 1989; Kahiya, 2013; Leonidou, 2004). However, it is often suggested that the Internet and, more specifically, e-commerce open up new trading opportunities for SMEs and enable them to (at least, partially) overcome many of the traditional internationalisation barriers (Sinkovics et al., 2013). As a consequence, the World Trade Organization (WTO) (2016) argues, 'the development of e-commerce promises to expand export opportunities for SMEs and give them a global presence that was once reserved for large multinational firms' (p. 6). Similarly, Oviatt and McDougall (1999) argued, 'the Internet may greatly increase the level of internationalisation of even the smallest businesses of the 21st century' (p. 8). Thus, it is commonly assumed that the Internet is an enabling technology, making internationalisation a viable growth strategy for even the smallest firm.

This assumption has not, however, been sufficiently examined and tested under close scholarly scrutiny. To date, surprisingly few studies have empirically examined the impacts of e-commerce on SME internationalisation (Hagsten & Kotnik, 2017). As a consequence, the extant literature offers only a limited understanding of how the use of the Internet to conduct business activities, including buying, selling and marketing products and services, influence SMEs' ability to expand their business operations internationally. Furthermore, we have limited insight into the potential factors constraining SMEs' ability to use the Internet as a means to conduct or support international business activities. Thus, many questions about the impact of e-commerce on SMEs' internationalisation remain unanswered. Consequently, there has been a call for more systematic research focusing on incorporating the role of the Internet in mainstream internationalisation literature by specifically examining how the Internet influences the internationalisation of SMEs (Coviello, Kano, & Liesch, 2017; Etemad et al., 2010; Tseng & Johnsen, 2011).

To address this gap, this study draws upon the Uppsala Internationalisation Process model (IP model) (Johanson & Vahlne, 1977) to examine the impact of e-commerce on the internationalisation of SMEs in terms of international intensity and the geographical dispersion of their business activities. The study puts two arguments forward. First, it is suggested that e-commerce is positively associated with SMEs' internationalisation as it increases their exposure to international opportunities while, at the same time, reduces the market commitments necessary for exploiting these opportunities. Second, it is proposed that this relationship is strengthened for firms that perceive export barrier to be low. The reason for this is that perceived export barriers can prevent SMEs from exploiting international opportunities by increasing doubts about the feasibility and desirability of capturing international opportunities. These ideas are tested on a representative sample of 14,513 European SMEs across several sectors in 34 different countries.

The study contributes to a better understanding of the impact of e-commerce on the internationalisation of SMEs. First, rather than looking at how e-commerce influences the international intensity of SMEs as done elsewhere (Hagsten & Kotnik, 2017), this study acknowledges the multidimensional nature of internationalisation and examines how e-commerce influences the international intensity and diversification of SMEs. Thus, the study not only looks at the impact of e-commerce on SMEs' dependence on foreign sales, but also the potential impact on the dispersion of the firm's international sales. Second, this study moves beyond looking at the direct relationship between e-commerce and internationalisation, by examining the moderating impact of perceived export barriers. Previous results regarding the relationship between e-commerce and internationalisation remain inconclusive, with some studies suggesting a positive relationship (Berry & Brock, 2004; Hamill & Gregory, 1997; Loane, 2006; Tiessen, Wright, & Turner, 2001), while other studies demonstrate a little or no impact upon internationalisation (Bianchi & Mathews, 2016; Hagsten & Kotnik, 2017; Moen, Madsen, & Aspelund, 2008). Thus, previous studies suggest that a direct relationship between e-commerce usage and internationalisation is incapable of explaining the relationship. Including potential moderators can therefore potentially increase our understanding of the complex relationship. This knowledge is important for the SMEs seeking to expand their business abroad, as understanding whether and how e-commerce can influence firm internationalisation can help managers, who have to design and implement internationalisation strategies, reach a balanced assessment of the opportunities afforded by the Internet for increasing firms' involvement in foreign markets.

The chapter proceeds as follows. Section 1 reviews prior literature on market commitment, market knowledge and the internationalisation of SMEs, which serves as the basis for developing the hypotheses. Section 2 describes the methodology used in answering the research question, including the data sources and techniques used in testing the hypotheses. Section 3 presents the findings of the analyses, before Section 4 concludes the chapter by discussing the implications of the findings and suggesting directions for future studies.

1. THEORY AND HYPOTHESIS DEVELOPMENT

1.1. Market Commitment, Market Knowledge and Internationalisation of SMEs

For the purpose of this study, the Uppsala IP model is applied. The IP model has developed into a 'workhorse' theory for studying the process of firm internationalisation (Coviello et al., 2017) and is highlighted as being suitable for examining the impact of the Internet on the international involvement of firms (Berry & Brock, 2004; Nieto & Fernández, 2005; Petersen, Welch, & Liesch, 2002). Furthermore, while this model was first developed based on the internationalisation process of large multinationals, it has also proven appropriate for studying and explaining the internationalisation process of SMEs (Paul, Parthasarathy, & Gupta, 2017).

The IP model identifies the basic mechanisms of firm internationalisation and argues that firms' international involvement is contingent upon market knowledge and market commitment (Johanson & Vahlne, 1977). The basic argument of this model is that market commitment and market knowledge affect both perceived opportunities and risks, which, in turn, influences internationalisation decisions. The underlying assumption is that firms are able to acquire market knowledge from their activities in foreign markets, which, over time, reduces the level of uncertainty and allows them to increase their commitment in foreign markets (Figueira-de-Lemos, Johanson, & Vahlne, 2011). Thus, the international involvement of firms is essentially explained by their experience and ability to learn about foreign markets. The model, therefore, also implies that firms typically make additional market commitments in small incremental steps, as they strive to keep risk-taking at a low level, unless the firms have large resources, operate in stable and homogeneous market conditions or possess a considerable experience from similar markets (Johanson & Vahlne, 1990; Welch, Nummela, & Liesch, 2016).

1.1.1. Market Commitment

Market commitment is related to both the amount of resources committed (i.e. size of the investment in the market) as well as the degree of commitment (i.e. the transferability of resources committed) (Pedersen & Petersen, 1998). Large investments in resources do not necessarily suggest a strong commitment, as it depends on how specialised the resources are to the specific market (Freeman, Giroud, Kalfadellis, & Ghauri, 2012). Market commitments, therefore, refer to all those assets that a firm accumulates in a particular foreign market, which can constrain its freedom of actions and can best be described as 'the product size of the investments times its degree of inflexibility' (Johanson & Vahlne, 2009, p. 1412). These market commitments include both tangible market commitments (production plants, subsidiaries' offices, transportation, etc.) and intangible market commitments (personnel education, advertisement actions, managers' meetings, etc.) (Hadjikhani, 1997).

As SMEs are typically considered to be resource constrained, market commitment is often considered a constraining factor in the internationalisation process (Leonidou, 2004). Furthermore, increasing market commitments are associated with an increase in risk due to an increase in significance and severity of potential loss (Figueira-de-Lemos et al., 2011). As a consequence, in order to minimise the risks and uncertainty of operating abroad, firms will pursue a step-wise or gradual internationalisation process or rely on entry modes that require low resource commitments, such as exporting, licensing or joint ventures (Oviatt, Shrader, & McDougall, 2004; Sasi & Arenius, 2012).

While the original IP model expected firms to increase market commitments when uncertainty is reduced or the tolerable risk level increases (e.g., due to an increase in the total resources of the firm), firms are also likely to increase market commitments when the amount of resources required for making such investments is reduced. For example, the reduction in transportation and communication costs has allowed smaller firms to increase foreign market commitments and operate internationally (Mathews & Zander, 2007). This is because a decrease in the amount of resources required for operating internationally allows the firm to use this latitude to increase their involvement in existing foreign markets or expand to new foreign markets.

1.1.2. Market Knowledge

The IP model is based on the assumption that knowledge about foreign markets and operations is an important barrier constraining firms' ability to initiate and develop international operations (Welch et al., 2016). Expanding into foreign markets requires knowledge, as firms are venturing into 'strange new lands' (Maitland & Sammartino, 2014). As a consequence, firms may experience a significant gap between existing knowledge and the knowledge needed to successfully expand into a foreign market (Petersen, Pedersen, & Lyles, 2008). These knowledge gaps, in turn, have been found to be critical in explaining SMEs' commitment decisions and a significant barrier constraining their ability to initiate, sustain and develop foreign market operations (Leonidou, 2004). While the original IP model emphasised the importance of experiential learning in acquiring the necessary knowledge for internationalisation, that is, learning through the firm's own, ongoing operations, others have since encouraged research to look beyond learning by experience and focus on alternative learning processes (Pellegrino & McNaughton, 2017). In addition to experiential learning, firms have also been found to acquire knowledge via indirect experience (Schwens & Kabst, 2009), external search (Åkerman, 2015) and internal information (Petersen, Pedersen, & Sharma, 2003). It is typical to distinguish between two broad forms of knowledge required for internationalisation: (1) internationalisation knowledge and (2) market knowledge (Pellegrino & McNaughton, 2017). Market knowledge refers to objective or explicit information about specific foreign markets, while internationalisation knowledge concerns how to develop and execute internationalisation strategies (Fletcher & Harris, 2012; Mejri & Umemoto, 2010). While both types of knowledge are found to be important when seeking to expand abroad, knowledge of *opportunities* is often highlighted as being of utmost importance. Knowledge of opportunities provide a framework for perceiving and formulating opportunities in foreign markets and is the single most important driver of internationalisation (Johanson & Vahlne, 2006, 2009). In order to internationalise, an individual must first become aware of an international opportunity. This can be achieved either through deliberate search or accidental discovery (Muzychenko & Liesch, 2015). Thus, both deliberate intentionality as well as serendipitous discovery can be considered catalysts for internationalisation (Chandra, Styles, & Wilkinson, 2009; Kontinen & Ojala, 2011).

1.2. The Influence of e-Commerce Usage on SME Internationalisation

There has been ongoing discussion about the potential impact of the Internet – or firms' use of the Internet for commercial purposes – on the international expansion of SMEs. Scholars are discussing whether, and to what extent, the Internet and e-commerce use can facilitate internationalisation in SMEs. Many argue that the Internet offers promising potential for SMEs wanting to increase their involvement in foreign markets, as the Internet has reduced the relevancy of distance (Servais, Madsen, & Rasmussen, 2006) and removed or reduced many of the traditional barriers hindering their ability to initiate, develop and sustain operations in foreign markets (Nguyen & Barrett, 2006; Sasi & Arenius, 2012). E-commerce refers to using the Internet to conduct business, including buying, selling, and/or marketing products and services (Bharadwaj & Soni, 2007; Kraemer, Gibbs, & Dedrick, 2005). The Internet is a global and decentralised technological structure consisting of networked computer networks, allowing its users to obtain and exchange information, without being constrained by physical barriers or geographical spaces. The Internet provides unprecedented opportunities for firms seeking to expand their business abroad, by allowing them to engage with firms and consumers from all parts of the globe (Coviello et al., 2017). Today, firms can use the Internet to market their products and services, find and communicate with customers and complete transactions. What makes the Internet such an interesting innovation to SME exporters is its ability to reduce or even eliminate many of the barriers and frictions constraining SMEs from increasing their involvement in foreign markets. The main benefit of the Internet as an internationalisation facilitator is its ability to reduce search costs (Petersen et al., 2002). Using the Internet as a tool for promoting the company and its products and/or services can potentially reduce search costs related to obtaining the knowledge of foreign market opportunities. SMEs can now achieve global exposure for their brand, products and services by building an online presence (Bianchi & Mathews, 2016). The Internet is a worldwide computer network connecting computers in more than 100 countries and allowing its users to obtain and exchange information, without being constrained by physical barriers or geographical spaces. Websites are, therefore, globally accessible more or less instantaneously at practically any time, because the Internet is inherently global in reach. Thus, in theory, firms are able to gain immediate access to international customers simply by being present on the Internet (Kotha, Rindova, & Rothaermel, 2001; Oviatt & McDougall, 1999). Due to the inherently global reach of the Internet, being present on the Internet is likely to expand SMEs opportunity horizon and increase the extent to which SMEs come into contact with international knowledge (Berry & Brock, 2004). This may be achieved either by using the Internet as an intended vehicle for internationalisation, or as a consequence of an increasing number of unsolicited orders from abroad (Prashantham, 2005; Yamin & Sinkovics, 2006). As a consequence, firms are increasingly pulled into foreign markets, because of their greater visibility to international customers, who are using the Internet to search for products and services (Petersen & Welch, 2003). In other words, using the Internet as a platform for marketing is likely to increase firms' international exposure and may directly result in international growth. Furthermore, the Internet can reduce the costs related to searching for and gathering information as well as the costs associated with the coordination and monitoring of information (Mostafa, Wheeler, & Dimitratos, 2004). For example, using the Internet as a promotional tool to present, publicise and promote the firm is typically less costly than using traditional marketing (Houghton & Winklhofer, 2004). In addition, SMEs are able to reduce search costs associated with locating international customers due to the increased exposure made possible through the Internet (Petersen et al., 2002). Thus, the Internet can significantly lower the costs and risks associated with international expansion and provide a low-cost gateway into foreign markets (Angelides, 1997; Hamill, 1997). Based on the aforementioned discussion, it can be argued that e-commerce presents a significant opportunity for SMEs seeking to expand abroad to identify opportunities in foreign markets and lower the costs and risks associated with international expansion. Thus, the following hypothesis is proposed:

H1. Using the Internet for information dissemination purposes will be positively associated with internationalisation.

In addition, the Internet can be used as a transaction medium, that is, as a sales channel (Gabrielsson & Gabrielsson, 2011). This includes both using the Internet as a platform for ordering procedures as well as payment. The introduction of the Internet has led to the emergence of a completely new marketspace and created the possibility for SMEs to serve international markets in new ways, for example, by using virtual export channels or e-intermediaries (Cho & Tansuhaj, 2013; Morgan-Thomas & Bridgewater, 2004). The Internet has, therefore, been recognised as a new mode of entry into international markets, exhibiting significant differences with respect to traditional ones (Plakoyiannaki, Kampouri, Stavraki, & Kotzaivazoglou, 2014). It is generally assumed that SMEs using the Internet as an entry mode are subject to fewer barriers when seeking to expand abroad compared with the firms with expensive physical presence in foreign markets (Luo, Zhao, & Du, 2005). One reason for this is because the Internet provides SMEs with a resource-conserving international entry mode (Arenius, Sasi, & Gabrielsson, 2005). Using the Internet to facilitate customer transactions can improve SMEs to reduce the costs of internationalisation by improving the efficiency in terms of receiving customer orders and handling inquiries (Sheth & Sharma, 2005). Another reason is that the Internet 'can potentially create an instant global and near-frictionless exchange environment, with customers worldwide minimising end-users' transaction costs and establishing direct rather than indirect channel structures' (Andersen, 2005). Consequently, using the Internet as a sales channel instead of relying on traditional export channels has arguably made it easier for SMEs to become active in global markets, by providing a low-cost gateway into foreign markets. According to the IP model, the degree of resource commitment with respect to internationalisation influences the propensity to internationalise, that is, if a firm can internationalise while making a lower resource commitment, the propensity to internationalise will increase, leading to a higher degree of international involvement. Thus, the following hypothesis is proposed:

H2. Using the Internet to facilitate customer transactions (e.g., ordering and payment) will be positively associated with internationalisation.

1.3. The Moderating Role of Perceived Export Barriers

Knowledge about international opportunities occupies a vital position in our understanding of the internationalisation of SMEs, where it has been found that the ability of SMEs to recognise and exploit international opportunities influences the internationalisation of the firm (Mainela, Puhakka, & Servais, 2014). As argued earlier, one of the main benefits of the Internet for SMEs seeking to expand abroad is that it provides these firms with significant opportunities to identify and exploit opportunities for international growth. However, an international opportunity is only a prospect to conduct exchange with new partners in new foreign markets (Hilmersson & Papaioannou, 2015). For opportunities to be exploited, managers 'must first escape ignorance that an opportunity for someone exists within the environment and then overcome doubt about the feasibility and desirability of action' (Shepherd, McMullen, & Jennings, 2007, p. 78). This suggests that even when an international opportunity is identified, managerial doubt may inhibit action and cause managers to leave international opportunities unexploited. Thus, for international opportunities to be exploited, managers must believe they can successfully enact the opportunity, should they commit to its pursuit. As a consequence, the decision to exploit international opportunities may be strongly influenced by managerial interpretations (Barreto, 2012).

An important factor, which has been found to significantly prevent SMEs from exploiting international opportunities, is managerial perceptions of barriers to internationalisation (Baum, Schwens, & Kabst, 2013). Perceived internationalisation barrier is found to be one factor preventing firms' from internationalising (Pinho & Martins, 2010) as well as a significant predictor of internationalisation patterns (Kahiya, 2013). According to Leonidou (2004), barriers to internationalisation are all those attitudinal, structural, operational and other constraints that hinder SMEs' ability to exploit international opportunities. Such barriers, whether actual or perceptual in nature, are critical to understanding SME internationalisation, as they have an important impact on managers' evaluation of international opportunities in terms of the desirability and profitability associated with exploiting international opportunities (Crick, 2007). For example, if managers consider the barriers as significant, the opportunity is less likely to be considered worth exploiting. Thus, managerial perceptions of barriers to internationalisation is likely to have a moderating effect, changing the impact of e-commerce on internationalisation in SMEs.

Based on the aforementioned discussion, the following hypotheses are proposed:

> *H3a.* Perceived internationalisation barriers (negatively) moderate the relationship between using the Internet for information dissemination and internationalisation.

> *H3b.* Perceived internationalisation barriers (negatively) moderate the relationship between using the Internet to facilitate customer transactions and internationalisation.

In sum, it is argued that using the Internet to present, publicise and promote the firm as well as using the Internet to facilitate customer transactions is positively related to internationalisation; however, this relationship is moderated by perceived internationalisation barriers (see Fig. 1).

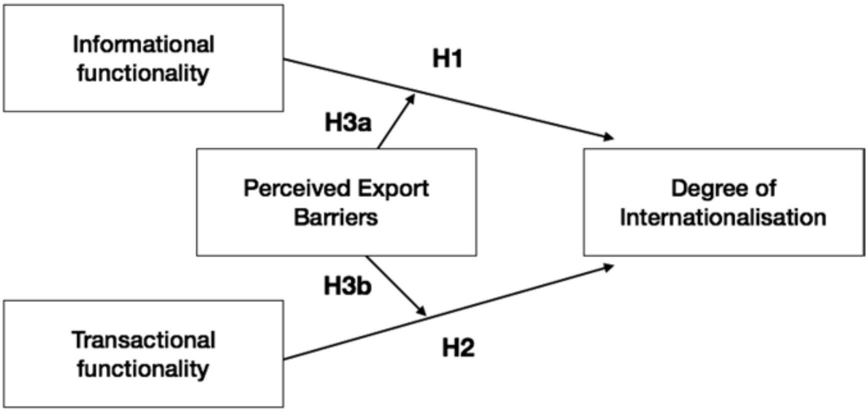

Fig. 1. Theoretical Model.

2. METHODOLOGY

2.1. Sample and Data Sources

To examine the impact of e-commerce use on the internationalisation of SMEs, the Flash Eurobarometer survey on 'Internationalisation of Small and Medium-sized Enterprises' was used. The survey was conducted by TNS Political & Social Network on behalf of the European Commission with the purpose of exploring SMEs' involvement in international business activities, their experiences and perceptions of internationalisation barriers, as well as their use of e-commerce.

Data were collected in 34 countries taking part in the European Union (EU) programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME),[1] using structured telephone interviewing. In total, 14,513 SMEs participated in the survey. At least, 500 interviews were conducted in each country, except for some of the smaller Member States (Cyprus, Malta and Luxembourg) and most of the non-EU countries surveyed (Albania, Iceland, former Yugoslav Republic of Macedonia [FYROM], Montenegro and Moldova).

Following prior studies, SMEs were defined as firms employing less than 250 employees (Hilmersson, 2014; Moen, Heggeseth, & Lome, 2016). To ensure that the sample would most accurately reflect the target population, stratified random sampling was used by applying country specific quotas on both company size (using four different range: 1–9 employees, 10–49 employees and 50–249 employees) and sectors (manufacturing, services and industry). Whenever a company was eligible, the selected respondent had to be a general manager, a financial director or a significant owner.

Missing data are a common issue in empirical research, which is both natural and unavoidable. However, if managed improperly, missing data may lead to both bias and error. The number of missing values were calculated for all variables. The results of the missing value analysis showed that only one variable contained missing values, where the missing data were less than 3 per cent. To deal with this missing data, multiple imputation was used. Multiple imputation is a statistically sound and disciplined approach for dealing with missing data, where missing data are simulated by generating multiple imputations for a given missing data point (Fichman & Cummings, 2003). It then takes advantage of the variation between the different imputations to create a more conservative standard error estimate leading to more robust hypothesis tests (Shinkle & Kriauciunas, 2009).

2.2. Measures

2.1.1. Dependent Variables

Internationalisation. Internationalisation is a multidimensional construct (Sullivan, 1994). In line with previous studies, internationalisation was measured using two distinct indicators: international intensity and international diversification (Nielsen, 2010; Raymond & St-Pierre, 2011). International intensity was measured using the common ratio of foreign sales to total sales (Reuber & Fischer, 1997), while international diversification was measured using an entropy approach using data on the percentage of the firm's international revenues earned from different geographic regions (Hitt, Hoskisson, & Kim, 1997). The entropy measure was calculated with the formula:

$$INTDIV = \sum_{i=1,3}^{n} \frac{P_i \times \ln \frac{1}{P_i}}{\ln(3)},$$

where P_i is the proportion of sales attributed to region$_i$ (1: national market; 2: EU markets; 3: rest-of-world) by the managers of each firm and $\ln(1/P_i)$ reflects the weight given to each market region. The entropy measure will be equal to zero for firms that have all their sales concentrated in one country, and reach a maximum value of 1 for firms with exactly the same share of sales in each of the regions. Thus, maximum values indicate more dispersed external growth strategies in a larger number of regions, while near zero values reveals a market concentration strategy (Majocchi & Strange, 2012).

2.1.2. Independent Variables

E-commerce use. E-commerce is defined broadly as use of the Internet to buy, sell or market products and services (Bharadwaj & Soni, 2007; Kraemer et al., 2005). E-commerce use was measured in terms of the extent of e-commerce use for different activities (Gibbs & Kraemer, 2004; Raymond, Bergeron, & Blili, 2005). Respondents were asked to indicate the business activities for which the Internet is used in their organisation. The activities include: (1) advertising and marketing, (2) online ordering and (3) online payment. Following prior studies, these activities are grouped into two groups: information and transactional activities (Mostafa et al., 2004). Thus, two dummy variables were calculated to indicate whether the firm is using the Internet for informational and/or transactional activities.

2.1.2. Control Variables

Other factors are also likely to influence the international involvement of SMEs. For example, previous studies have identified important variables at three different levels: (1) environment-level variables, (2) firm-level variables and (3) individual-level variables (Martineau & Pastoriza, 2016). To remove the effect of other relevant factors when explaining SMEs internationalisation, I controlled for several variables.

Various studies (Hitt, Bierman, Uhlenbruck, & Shimizu, 2006; Majocchi, Bacchiocchi, & Mayrhofer, 2005) have demonstrated the importance of both size and age in explaining internationalisation. Firm size is often used as a proxy for financial and managerial resources, and the empirical evidence suggests that a critical size is necessary for SMEs to engage in international business (Dhanaraj & Beamish, 2003; Martineau & Pastoriza, 2016). Furthermore, firm age is also likely to influence the international involvement of SMEs, as export activity often develops as a consequence of an SME's success in its domestic market (Johanson & Vahlne, 1977). Consequently, to control for firm size and age, firm age was measured as the number of years the company has existed, while firm size was measured as the logarithm of the total number of employees. Because firm age was right skewed, it was corrected using logarithmic transformation.

Five industry dummies based on NACE categories were also included to control for industry, as internationalisation strategies are likely to be influenced by the competitive nature of the industry within which firms operate (Dasí, Iborra, & Safón, 2015; Majocchi & Strange, 2012). The nature of the industry can have a significant impact on the firm's internationalisation, as the industry comprises the environment in which the firm operates. For example, the nature of the industry can influence both the choice of foreign market and geographical scope (Andersson, Evers, & Kuivalainen, 2014). Thus, the nature of the industry has been highlighted as an important factor in understanding firm internationalisation. To allow the estimated coefficients to be interpreted as the dependent variable's difference, one industry (retail) was omitted from the regression analysis (Li, Qian, & Qian, 2012).

At the individual level, several studies highlight the manager's socio-cognitive characteristics as an influential antecedent of international involvement (Martineau & Pastoriza, 2016). In particular, manager's attitudinal barrier (e.g., perceived export barriers) is one of the most significant internal barriers to SME's international expansion (Suárez-Ortega, 2003). Following Silva and Rocha (2001), respondents were presented a list of 12 export barriers and asked to indicate their perception of the importance of each barrier. This scale ranged from 1 to 4, with higher scores indicating the higher levels of perceived importance.

Finally, I controlled for country-specific factors, as previous studies have emphasised the importance of a firms domestic environment on firm's internationalisation (Baum et al., 2013). Firms face different incentives and opportunities to internationalise depending on the size of their home markets. Insufficient size of the domestic market is likely to constrain firm growth and push firms into considering internationalisation (Crick & Spence, 2005). Thus, firms from small economies are, therefore, likely to exhibit higher degrees of internationalisation,

Table 1. Variables Included in the Analysis.

Variables	Operationalisation	Author(s)
Dependent:		
International intensity	Proportion of a firm's revenue in foreign countries to its total revenue in a given year (FTST)	Fernandez and Nieto (2006)
International diversification	Entropy measure of international diversification	Raymond and St-Pierre (2011)
Independent		
Informational	Dummy variable = 1 if firm has a website	Hagsten and Kotnik (2017)
Transactional	Dummy variable = 1 if firm use Internet to facilitate customer transactions	Hagsten and Kotnik (2017)
Control		
Firm age	Logarithm of the number of years since firm was established	Shinkle and Kriauciunas (2009)
Firm size	Number of employees	Banalieva and Eddleston (2011), Shinkle and Kriauciunas (2009)
Export barriers	An index of perceived exporting barriers	Baum, Schwens, and Kabst (2011)
Domestic market size	Logarithm of the average home country GDP over the previous 10 years	Ojala and Tyrväinen (2007), Banalieva and Eddleston (2011)
DMANU	Dummy variable = 1 if firm is in the manufacturing industry	
DRETAIL	Dummy variable = 1 if firm is in the retail industry	
DSERV	Dummy variable = 1 if firm is in the service industry	
DINDUS	Dummy variable = 1 if firm is in the industrial industry	

compared to firms from large economies. Thus, the degree of internationalisation is likely to depend on the domestic market size (Glaum & Oesterle, 2007). The economic size of the firm's home country was measured as the log transformation of its average real Gross Domestic Product (GDP) in Euro over a three-year period (Blake & Moschieri, 2017). These data were obtained from Eurostat. Table 1 provides an overview of the variables included in my analysis..

3. RESULTS

Table 2 presents a summary of the descriptive statistics, including the minimum, maximum, means and standard deviation of all variables included in the regression models and their bivariate correlations.

The bivariate correlations displayed in Table 2 showed no serious risk for multicollinearity, as all correlations are below the commonly used 0.8 cut-off (Mason & Perreault, 1991). In addition, variance inflation factors (VIF) were calculated for all variables to further check for multicollinearity. However, the VIFs also showed no sign of multicollinearity, as all VIFs are close to 1, ranging from 1.05 to 1.42 (Hair, Black, Babin, & Anderson, 2009)

Table 3 displays the results of the regression analyses used to test the hypotheses. Following Cuervo-Cazurra, Andersson, Brannen, Nielsen, and Reuber (2016), the

Table 2. Descriptive Statistics and Bivariate Correlations.

	1	2	3	4	5	6	7	8	9	10	11
1 International intensity	1										
2 International diversification	0.71**	1									
3 Firm size	0.17**	0.17**	1								
4 Firm age	0.02*	0.08**	0.20**	1							
5 Perceived barriers	–0.25**	–0.26**	–0.07**	–0.03**	1						
6 Domestic market size	–0.07**	0.01	–0.01	0.16**	0.13**	1					
7 Manufacturing	0.26**	0.27**	0.15**	0.10**	–0.09**	0.01	1				
8 Service	–0.10**	–0.11**	0.04**	–0.04**	0.03**	0.06**	–0.34**	1			
9 Industry	–0.15**	–0.17**	–0.02*	–0.05**	0.09**	–0.04**	–0.25**	–0.31**	1		
10 Informational e-commerce usage	0.09**	0.18**	0.16**	0.09**	–0.10**	0.09**	0.06**	0.04**	–0.06**	1	
11 Transactional e-commerce usage	–0.04**	0.00	0.03**	0.01	0.00	0.00	–0.04**	0.06**	–0.04**	0.28**	1
Minimum	1	0	1	0.09	1	3.53	0	0	0	0	0
Maximum	100	1	249	216	3	6.45	1	1	1	1	1
Mean	15.55	0.17	31.74	24.34	1.76	5.21	0.22	0.3	0.18	0.76	0.40
SD	28.46	0.28	44.15	22.08	0.53	0.72	0.41	0.46	0.39	0.43	0.49

** $p < 0.01$, * $p < 0.05$.

Table 3. Results of Regression.

	Dependent Variable: International intensity			Dependent Variable: International diversification		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Control variables						
Firm size	0.133**	0.127**	0.127**	0.127**	0.110**	0.110**
Firm age	–0.037**	–-0.042**	–0.041**	.020*	0.013^{ns}	0.012^{ns}
Perceived barriers	–0.213**	–0.208**	–0,206**	–0.223**	–0.210**	–0.130**
Domestic market size	–0.030**	–-0.038**	–0.037**	0.041**	0.029**	0.028**
DMANU	0.172**	0.168**	0.166**	0.164**	0.164**	0.160**
DSERV	–0.070**	–0.070**	–0.069**	–0.095**	–0.095**	–0.096**
DINDUS	–0.107**	–0.107**	–0.106**	–0.130**	–0.129**	–0.126**
Independent variables						
Informational (*H1*)		0.062**	0.135**		0.129**	0.336**
Transactional (*H2*)		0.058**	–0.200**		–0.033**	–0.114**
Moderating variables						
Informational × perceived barriers (*H3a*)			–0.081**			–0.228**
Transactional × perceived barriers (*H3b*)			0.151**			0.086**
Constant						
Adjusted R^2	0.144	0.149	0.151	0.158	0.173	0.176
F		43.51**	15.00**		122.24**	29.48**

$^{**}p < 0.01$, $^{*}p < 0.05$.

analysis was performed by employing hierarchical regression analysis. First, only the control variables were included in the analysis (Models 1 and 4). Next, the direct effect of the two types of e-commerce usage on internationalisation was analysed (Models 2 and 5), before adding the moderation effect of perceived export barriers (Models 3 and 6).

Models 1 and 4 examine the effect of the control variables on the international intensity and international diversification, respectively. All control variables performed largely as expected, except for firm age. Consistent with previous studies, firm size was found to be positively related to both international intensity and international diversification, reinforcing the argument that a critical size may be needed for SMEs to engage in international business (Dhanaraj & Beamish, 2003; Martineau & Pastoriza, 2016). Perceived internationalisation barriers were found to be negatively related to both international intensity and international diversification, suggesting that high levels of perceived internationalisation barriers are likely to constrain SMEs from committing to internationalisation. Moreover, home market size is negatively related to international intensity, suggesting that insufficient size of the domestic market is likely to constrain firm growth and push firms into considering internationalisation (Crick & Spence, 2005). However, contrary to expectations, firm age was not found to be positively correlated with either international intensity or diversification. This may suggest that experiential learning is no longer a necessary condition for internationalisation as suggested earlier (Johanson & Vahlne, 1977), thus reinforcing the view that it is now possible for even new ventures to internationalise right from, or shortly after, inception (Oviatt & McDougall, 1999; Reuber & Fischer, 2011).

In Models 2 and 5, the direct effect of e-commerce usage on international intensity and international diversification was added. As predicted in *H1*, the results of the main effects models show a positive association between informational e-commerce usage and internationalisation in terms of both international intensity ($\beta = 0.062$, $p < 0.001$) and international diversification ($\beta = 0.129$, $p < 0.001$). This suggests that having an online presence, in the form of having a website, can facilitate SMEs' internationalisation, by enabling firms to increase their global reach and expanding the extent to which they come into contact with knowledge about international opportunities.

Furthermore, the main effects models provide partial support for *H2*, which predicts that transactional e-commerce usage is positively associated with SME internationalisation. While the association between transactional e-commerce usage and internationalisation was positive and significant in terms of international intensity ($\beta = 0.058$, $p < 0.001$), it was significant but negative for international diversification ($\beta = -0.033$, $p < 0.001$). This suggests that using the Internet to facilitate transactions is likely to have a positive impact on SMEs' dependence on foreign sales, but that this foreign sale is likely to be more concentrated in less regions/markets.

H3a and *H3b* posit that perceived internationalisation barriers moderate the impact of e-commerce usage on SME internationalisation. Thus, while the relationship between e-commerce usage and SME internationalisation is positive overall, it is to a lesser extent for SMEs where decision-makers perceive internationalisation barriers to be high. To test these hypotheses, the interaction between perceived internationalisation barriers and informational and transactional e-commerce usage was included as predictors of international intensity and international diversification in Models 3 and 6.

The results reveal that if perceived internationalisation barriers increase, the positive effect of informational e-commerce usage on SME internationalisation fades for both international intensity ($\beta = -0.081$, $p < 0.01$) and international diversification ($\beta = -0.228$, $p < 0.001$). The plots in Fig. 2 illustrate how informational e-commerce usage has a stronger impact on international intensity and diversification at low levels of perceived export barriers; whereas, when perceived barriers are high, the effects become significantly weaker. This suggests that having an online presence has a smaller impact on firm internationalisation when managers consider internationalisation difficult. Thus, the results provide empirical support for *H3a*.

In contrast, *H3b*, which stipulates that perceived internationalisation barriers negatively moderate the relationship between transactional e-commerce usage and internationalisation, was not supported. As tested in Models 3 and 6, the coefficients of the interaction terms are significant, but positive, for both international intensity ($\beta = 0.151$, $p < 0.001$) and international diversification ($\beta = 0.086$, $p < 0.001$). Thus, *H3b* cannot be accepted. The plots in Fig. 3 illustrate how transactional e-commerce usage has almost no impact on the international intensity and international diversification at high levels of perceived internationalisation barriers. At low levels of perceived internationalisation barriers, transactional e-commerce usage is also found to have little or no impact on international diversification, whereas it is found to be negatively associated with

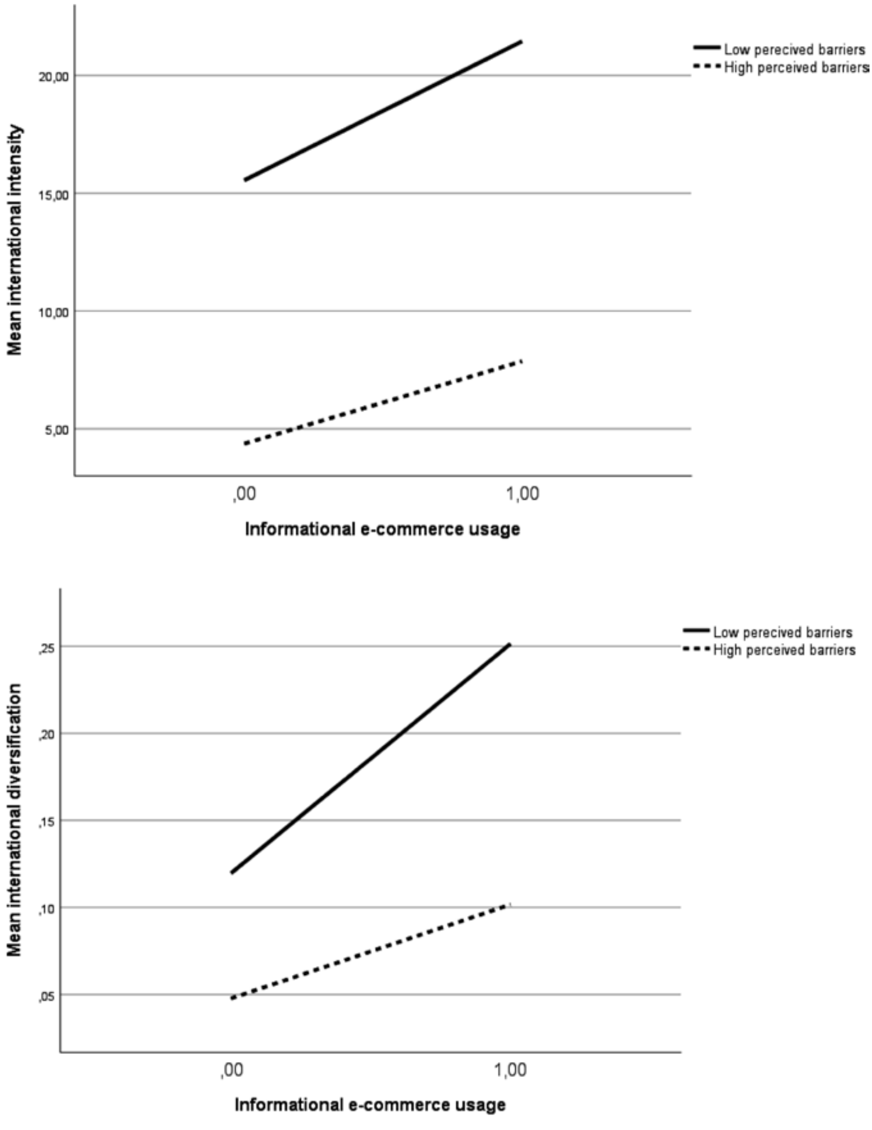

Fig. 2. The Moderating Role of Perceived Barriers on the Effects of Informational E-commerce Usage on International Intensity and International Diversification.

international intensity. Thus, contrary to expectations, SMEs with low levels of perceived internationalisation barriers are found to be less international, when measured in terms of dependence on foreign sales.

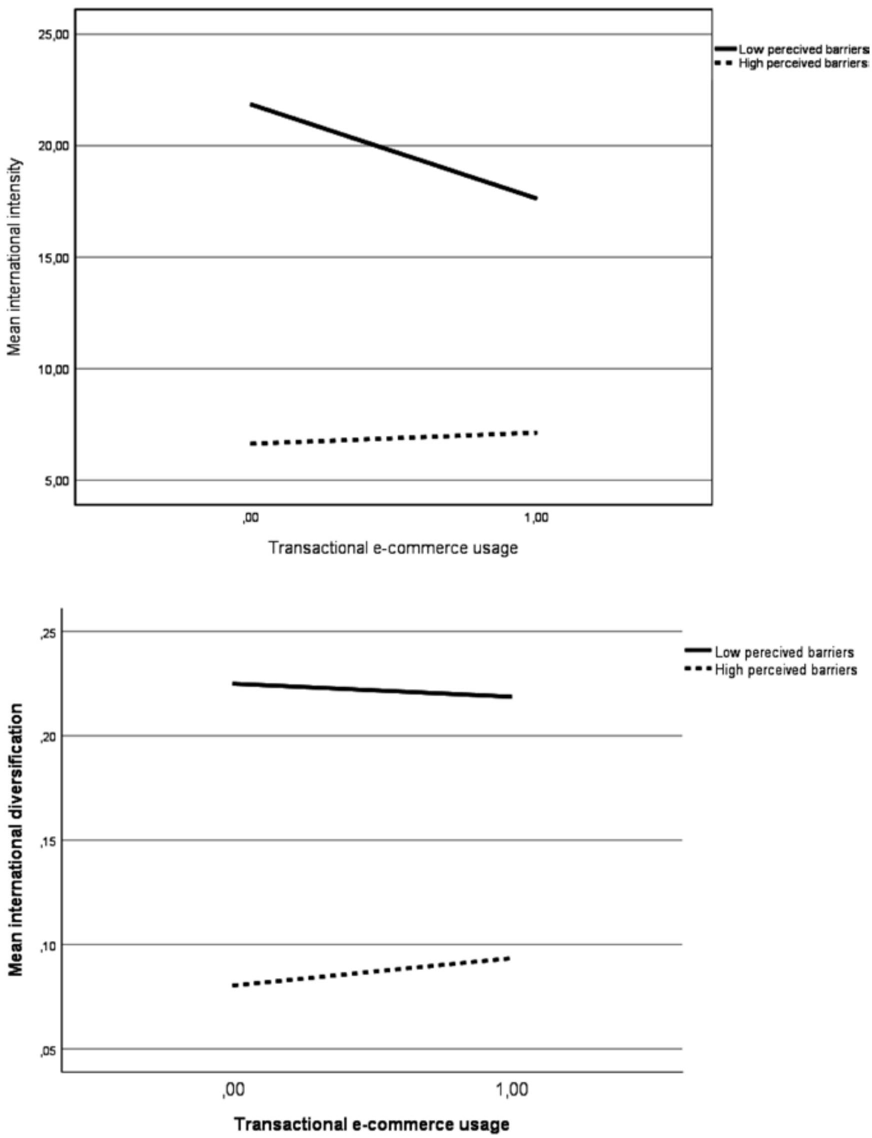

Fig. 3. The Moderating Role of Perceived Barriers on the Effects of Transactional E-commerce Usage on International Intensity and International Diversification.

4. DISCUSSION AND CONCLUSIONS

Although our knowledge of internationalisation of SMEs has expanded greatly over the past several decades, the true impact of the Internet is yet to be determined. The aim of this study was to contribute to the ongoing debate about how digitalisation affects firm internationalisation by analysing the impact of e-commerce usage on internationalisation among SMEs in terms of international intensity and diversification. More specifically, drawing upon the Uppsala IP model, I argue that e-commerce usage will facilitate SME internationalisation, but that the impact of e-commerce usage on the international intensity and diversification of SMEs is moderated by perceived export barriers.

4.1. Discussion of Findings

Several interesting findings related to the impact of e-commerce usage on internationalisation among SMEs were generated from this research, which covered 14,513 SMEs across several sectors in 34 countries. First, the empirical findings demonstrate how informational e-commerce usage has the biggest impact on SME internationalisation in terms of both international intensity and international diversification. Thus, simply having an online presence in the form of a website is positively associated with both the amount of sales coming from abroad as well as the firm's level of international diversification as reflected by the number of different markets in which it operates and their importance to the firm. This suggests that using the Internet as a promotional tool for disseminating information about the firm is likely to increase the extent to which SMEs are exposed to international opportunities and reduces the uncertainties associated with internationalisation. These findings resonate with previous studies on SME internationalisation and the role of the Internet. For example, Hagsten and Kotnik (2017) find that the possession of a website is positively related to the exporting performance of SMEs in a number of countries. The Internet offers means for SMEs to reduce costs directly associated with spatial distance and reach a large potential customer based (Loane, 2006). This, in turn, enables firms to reduce the effects of resource scarcity, which has traditionally constrained SMEs from participating in international trade (Sasi & Arenius, 2012). The findings are also consistent with Freund and Weinhold (2004), who find that the Internet reduces the fixed costs associated with internationalisation, which is then likely to enhance export growth.

Second, there is clear evidence of a positive relationship between transactional e-commerce usage and internationalization in terms of international intensity, but not international diversification. Thus, transactional e-commerce is likely to have a positive impact on SMEs' dependence on foreign sales, but this foreign sale is likely to be more concentrated in fewer regions/markets. Thus, while it has been suggested that using the Internet as a sales channel can increase both the international intensity and international diversification of SMEs, by reducing the effects of liability of foreignness and resource scarcity (e.g., Arenius et al., 2005; Plakoyiannaki et al., 2014), this is not unambiguously reflected in the findings of this study. The results demonstrate how using the Internet has a small positive impact on the amount of sales coming from foreign markets, while having a negative impact on the number of different markets in which it operates and their importance to the firm. This finding was a little surprising, as it seems to contradict recent studies suggesting that the importance of geographical distance is greatly reduced in online trade, compared to offline trade (Gomez-Herrera, Martens, & Turlea, 2014; Lendle, Olarreaga, Schropp, & Vézina, 2016). However, these findings are partly supported by recent studies (Hagsten & Kotnik, 2017; Moen et al., 2008).

These findings do not, however, necessarily signify that using the Internet as a sales channel is not suitable for firms seeking to expand their business abroad. While using the Internet as a sales channel may provide a potential avenue for SMEs to internationalise, as cross-border e-commerce continues to expand, these findings may also indicate that there are still barriers deterring SMEs from taking full advantage of the opportunities provided by cross-border e-commerce. For example, barriers related to the logistics of shipping a good or delivering a service, security and data protection, and payments are all likely to constrain SMEs from seizing the opportunities provided by e-commerce for international expansion (WTO, 2016). Another possible reason could be that using the Internet as a sales channel involves using the Internet as an intended vehicle for conducting business in particular foreign markets (Yamin & Sinkovics, 2006). Thus, using the Internet to facilitate international transactions is an example of active online internationalisation, which is more likely to require proactive, deliberate search for an opportunity, while having an online presence is likely to lead to accidental discovery of international opportunities, as it may generate unsolicited orders from abroad.

Finally, the findings also suggest that the positive effect of having an online presence fades for both international intensity and international diversification as the perceived internationalisation barriers increase. This suggests that while having an online presence may lead to an accidental discovery of international opportunities, these opportunities are more likely to be exploited if the manager believe they can successfully enact the international opportunity, should they commit to its pursuit. Thus, to fully capture the opportunities provided by e-commerce, managers must first overcome their anxiety about internationalisation.

4.2. Practical Implications

The findings also have practical implications for managers of SMEs whose aim is to increase their involvement in foreign markets. First, investing in informational e-commerce usage, that is, investing in establishing an online presence is more effective than investing in e-commerce if the goal is to increase the firm's involvement in foreign markets. Thus, SMEs seeking to expand their business abroad should first invest in establishing an online presence. Establishing an online presence not only enables SMEs to get exposure to new foreign markets, but having an online presence in the form of a website also provides a means for SMEs to gain customer insights and find new contacts through different kinds of analytics. Thus, having a strong online presence must be considered a crucial component of SMEs' internationalisation strategy.

Another implication is that SMEs with an online presence may need to be careful not to expand into too many countries. Results show that having an online presence in the form of a website is positively associated with international diversification; in particular, when internationalisation barriers are perceived to be low. Although internationalisation can potentially improve firm performance, previous studies on the internationalisation-performance relationship have cautioned against high degrees of internationalisation in SMEs. For example, Benito-Osorio, Colino, Guerras-Martín, and Zúñiga-Vicente (2016) provided an evidence suggesting a linear and negative relationship between internationalisation and performance in the specific case of small firms, while others have found that performance decreases after a certain level of internationalisation (Chiao, Yang, & Yu, 2006). This is because too much international diversification requires a significant amount of financial and human resources, which SMEs typically lack (Cieślik, Kaciak, & Welsh, 2012). As a consequence, focusing on a limited number of key markets is more likely to be an appropriate strategy to follow for SMEs seeking to increase their involvement in foreign markets (Brouthers, Nakos, Hadjimarcou, & Brouthers, 2009). Thus, while the empirical results show that informational e-commerce usage can be viewed as a way of accelerating internationalisation, it remains unclear if this is desirable. It can also be that using the Internet as a tool for promoting the company and its products and/or services entices SMEs to expand into a large number of foreign markets with ill-considered haste (Petersen et al., 2002). Thus, SMEs should be cautious not to be enticed to over-diversify in terms the number of foreign countries or markets in which they operate.

Third, SMEs seeking to increase their involvement abroad via transactional e-commerce should be attentive to potential impediments to online cross-border trade. This study shows that while using the Internet as a sales channel provides opportunities for SMEs seeking to expand their business abroad, these opportunities does not automatically transformed into increased internationalisation. In fact, SMEs that have already invested in transactional e-commerce were found to be only a little more international measured in terms of their dependence on foreign sales, while being less international measured in terms of international diversification. One logical explanation for the disparity between potential and realised benefits is that certain barriers are still constraining SMEs from seizing the opportunities provided by e-commerce for international expansion (e.g., logistics of shipping goods or delivering services, security and data protection, legal differences and intensified competition). Thus, SMEs must be mindful that increasing involvement in foreign markets via transactional e-commerce is likely to require more than just investing in Internet-based sales channels.

4.3. Limitations and Future Research

Like other empirical research studies, this study has a number of limitations. First, there are certain limitations related to measurement. In this study, e-commerce was measured by asking respondents to indicate the business activities for which the Internet was used in their company. Thus, the study examines the impact of adoption versus non-adoption on SME internationalisation. While this measure has been successfully used in prior studies (e.g., Gibbs & Kraemer, 2004; Raymond et al., 2005), one problem with this measure is that it fails to take into consideration the *extent* to which the Internet is being used for a specific business activity and the *depth* of use for each activity (Zhu & Kraemer, 2005). Furthermore, such a measure does not account for how *well* companies use the Internet to sell or market products and services. Thus, for example, it was not possible to differentiate between SMEs that use the Internet as a minor supplement to physical sales channels and SMEs that use it as their dominant sales channel in this study. In addition, the study fails to distinguish between SMEs that use their website as a brochure and SMEs that use the website as an integral part of doing business (Karjaluoto & Huhtamäki, 2010). For this reason, future research is encouraged to examine how post-adoption variations in usage influence the internationalisation of SMEs to see how the extent and depth of e-commerce usage influences the impact on internationalisation.

Furthermore, as participants were only asked whether their company used the Internet to sell their products, it was not possible to distinguish between SMEs selling their products via their own web shops and SMEs relying on e-intermediaries, also referred to as online platforms or electronic marketplaces. Using e-intermediaries may provide SMEs with several benefits pertaining to direct Internet-based exchange, which can be risky, time-consuming and costly for SMEs seeking to expand their business abroad through e-commerce. For example, e-intermediaries can help SMEs address the problem of limited knowledge and experience with respect to foreign markets (Cho & Tansuhaj, 2013). Thus, e-intermediaries can help SMEs to reduce information frictions associated with geographic distance by facilitating the matching of buyers and sellers from all over the world and consolidating the entire market into one easily accessible platform (Lendle et al., 2016). Thus, future research is encouraged to distinguish between transactional e-commerce via e-intermediaries and direct Internet-based exchange.

Second, due to the nature of the study, it was not possible to establish any causality. Thus, while it is argued that internationalisation is a consequence of e-commerce, it cannot be ruled out that the relationship between the two is reciprocal. While the Internet may enable SMEs to explore foreign markets, increasing internationalisation may also increase the need for SMEs to adopt e-commerce (Yu, De Koning, & Oviatt, 2005). Analysing the impact of e-commerce use on firm internationalisation, and ruling out reverse causality, can only be achieved by collecting and analysing longitudinal data. Therefore, future studies are encouraged to use longitudinal data to better examine the relationship between e-commerce usage and firm internationalisation. For example, the future research may apply the longitudinal case study method to examine in depth the internationalisation process of SMEs, including the causal linkages between e-commerce usage and internationalisation (Arenius et al., 2005).

Third, while the findings demonstrate how firms with an online presence are more likely to exhibit higher degrees of international diversification and are engaged in doing business in a larger number of regions, the findings do not tell if this is desirable, as data on firm performance were unavailable. Prior studies have cautioned that the Internet may cause rapid, diversified international expansion, but that this may have a negative impact on firm performance (Petersen et al., 2002). Wide diversification can, according to some studies, be risky due to the resource-constrained nature of SMEs and have a negative impact on export performance (Brouthers et al., 2009; Cieślik et al., 2012). Thus, more research is needed to examine more closely the relationship between e-commerce use, internationalisation and firm performance in order to determine whether the Internet is helpful or harmful for SMEs. This can potentially improve our understanding of how using the Internet as an instrument to expand a firm's operations beyond national borders can influence its subsequent performance.

Finally, contrary to expectations, the results failed to demonstrate a strong positive association between transactional e-commerce and internationalisation among SMEs. This opens up important questions about transactional e-commerce usage and its impact on internationalisation among SMEs. For example, why do firms, who have already invested in e-commerce, not engage more actively in cross-border e-commerce? Is it because the opportunities afforded by transactional e-commerce are over inflated or is it because SMEs are constrained in their ability to seize the opportunities afforded by the increase in cross-border e-commerce? If so, what are the factors constraining SMEs from engaging in cross-border e-commerce? These, I believe, are all important questions that needs to be answered in order to understand the true impact of the Internet on internationalisation among SMEs, by clarifying the conditions under which the e-commerce usage is more likely to increase internationalisation. In addition, answering such questions can assist policy makers in supporting SMEs in developing their ability to benefit from the opportunities afforded by the Internet for participating in international trade. To fully understand the impact of the Internet and e-commerce on SME internationalisation, much work, therefore, remains to be done.

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NOTE

1. COSME participants include the 28 EU countries as well as Albania, Former Yugoslav Republic of Macedonia, Iceland, Moldova, Montenegro and Turkey.

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CHAPTER 8

GLOBAL COMPETITORS? MAPPING THE INTERNATIONALIZATION STRATEGIES OF CHINESE DIGITAL PLATFORM FIRMS

Kai Jia,Martin Kenney and John Zysman

ABSTRACT

The recent emergence of Chinese digital platform firms, whose size rivals that of the US platform giants, has attracted much popular interest. Given the size and increasing technical sophistication of these firms, there has been increasing interest in whether they have developed sufficient capacities and resources to become global-class competitors for the reigning US platform giants. The authors assembled a database of all overseas operations of the Chinese platform firms. Nine of them have foreign operations, with Tencent and Alibaba being the most important offshore investors. The authors describe the globalization patterns of these firms and analyze the strengths and obstacles to their globalization. Their globalization has proceeded on a number of vectors: first, these firms, with a few exceptions, when they have global strategies, have largely invested in firms with useful technology or content. One common strategy has been to follow Chinese customers abroad. Second, Chinese firms have made equity investments in a number of foreign Internet firms. And yet, in nearly all foreign markets, Chinese websites and apps still trail the US firms in market share and salience. Finally, Chinese investments are concentrated in proximate countries. Chinese platform firms, while having some state-of-the-art technologies, have a far smaller foreign presence than their US competitors

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do. Finally, the authors consider the implications of their research for discussions of whether emerging nation multinational firms require new theories for explaining their globalization.

Keywords: Digital platforms; China; globalization; Tencent; Alibaba; emerging market multinational enterprises

In 2018, seven of the world's 10 most valuable firms were digital platforms owners; five were American and two of these firms were Chinese. There are three generalizations. First, the American firms have dominated in particular segments – search with Google, social media with Facebook, and retail sales with Amazon – and then tend to broaden out to domains that their initial positions facilitate. In contrast, Chinese firms have tended to build horizontal linkages and then develop deeper competencies in particular technologies and segments. Second, the US platform giants are the global leaders, while the Chinese platform giants dominate the Chinese market. The Chinese market today is the world's largest single internet market with the most smartphones, personal computers, online shoppers, etc., and, by all accounts, Chinese platform firms are innovating and, particularly, in apps for smartphones have developed global-class technology (Chandler, 2017; Mozur, 2016; Roth, Seong, & Woetzel, 2015). Finally, the Chinese firms have tended to buy equity stakes in partner firms in the Chinese market and, increasingly, overseas and search for cross-firm synergies. Having observed the increasing strength of Chinese firms, it is important to keep in mind that Japanese electronic and network firms were early leaders in mobile technologies and deployments (Funk, 2001; Kushida, 2011), but they were not able to break out of their home market. Will Chinese platform firms be able to build from domestic market innovations to establish a broader global presence?

This chapter considers whether Chinese platform firms are developing competencies that facilitate their expansion from their dominant position at home into global markets, where, in nearly every case, they face the powerful US giants, such as Amazon, Expedia, Facebook (WhatsApp and Instagram), Google, and Microsoft (Skype and LinkedIn), etc. China is particularly interesting as it is the only other nation with a significant number of platforms of sufficient size that one might expect them to be capable of globalizing.[1] One might expect the Chinese platform giants to be able to expand to foreign markets using their now substantial technical and financial resources. Does the Chinese market provide the conditions to develop from specific capacities that can be exploited globally?[2] Will their domestic innovations be transferrable to external markets? Or, alternately, will Chinese firms only be innovators and control the domestic market making China an anomaly?

The recent literature on emerging nation multinational enterprises (EMNEs) can offer theoretical insight into the nature of such expansions (for recent summaries of these debates, see van Tulder, 2010; van Tulder, Verbeke, Carneiro, & Gonzalez-Perez, 2016; for Chinese multinationalization, see Deng, 2013). For example, Dunning, Kim, and Park (2008) suggest that to enter foreign markets, EMNEs are more likely to use alliances or acquisitions, emphasizing securing assets abroad because they either lack firm-level advantages, are more likely to invest in proximate markets, and/or have more government support. There is an ongoing debate about whether the new theory is needed to understand EMNE overseas investment. While this chapter cannot definitively address this debate, our three major results conform to the previous MNE theory. First, the Chinese platform firms have often used joint ventures as a way of tapping into local knowledge, while co-opting possible opposition. Second, most of the operational-level investments are in proximate markets. Third, the investments to access cutting-edge global technology are in technology clusters, in particular, in Silicon Valley.

Despite their enormous global reach and implications for the debates about weightless global trade (Keller & Yeaple, 2009), there has been little academic research on the globalization strategies of the US platform firms much less those from other nations. To contextualize any foreign investment by these firms, it is important to note the distinct characteristics of platform competition as it differs from that in traditional markets. Platform success is characterized by strong network effects, winner-takes-all (or most) dynamics, increasing returns, and lock-ins (Gawer & Cusumano, 2002; Parker, Van Alstyne, & Choudary, 2016). Market entry, where there are significant incumbents, is always difficult, because the structure of platforms permits their owners to cross-subsidize various "sides" of the platform (Jullien, 2011; Rochet & Tirole, 2003), thereby providing powerful incumbents the potential to undercut new entrants. The platform-related obstacles to entry are offset, in part, because Internet websites can be accessed from anywhere in the world. So, presumably, the initial entry costs for foreign firms are close to zero particularly for content that is delivered and consumed digitally. This suggests that any entrant with a better solution should be competitive; though as Kenney and Zysman (2018) suggest that the acquisition of a budding competitor has become an important strategy for forestalling competition.

While our objective is to locate the character and challenge of Chinese platform firms, this chapter does not develop a general or theoretical argument. Rather, it prepares us for that more ambitious task by exploring the goals, advantages, and strategies that Chinese platform giants are using in their efforts to expand externally. We systematically assembled data on all overseas operations of the Chinese platform firms. We identified the following Chinese platform firms, Alibaba, Tencent, Baidu, Ctrip, Didi, JD.com, Toutiao, VIP Shop, and Sohu, as having foreign operations.[3] We consider where possible whether firm-specific advantages, which, of course, emerged with their success in their home market, can be used to compete abroad. We explore whether their motivation for globalizing is based upon firm-specific advantages or advantages derived from the home market.

1. CONTEXT FOR THE CHINESE PLATFORM ECONOMY

Since the 1990s, the Chinese Internet market was largely protected and thus, in contrast, to other countries, the rapidly growing Chinese market has spawned an entirely separate ecosystem of platforms and firms; a number of which has grown in size sufficiently large to rival the US platform giants. As of 2017 with 772 million users, China was the world's largest Internet market, despite the fact that the penetration rate was only 55.8% (China Internet Network Information Center, 2018). As these Chinese platform firms have grown to enormous size and as the domestic market matures, the leading firms have begun to enter overseas markets through acquisition or investment.

The Chinese digital platforms have had a variety of motivations to globalize. Global expansion initially was tentative and began in the early 2000s when Alibaba and Baidu introduced websites for offshore customers.[4] Their success in the protected, rapidly expanding, and now enormous Chinese market provided them with significant capabilities; in particular, operational experience managing large platforms, massive amounts of data, and fickle consumers. These Chinese platforms are highly profitable and thus continue to have significant capital reserves that allow them to finance both domestic and international initiatives and investments from their cash flow. Finally, the Chinese government actively supports their globalization. This set of capabilities and assets permits them to undertake sustained attempts to enter global markets.

Two general observations are necessary. First, previous research indicates that Chinese firms have been biased toward expansion in Southeast and East Asian countries; particularly, the less developed regions (Morck, Yeung, & Zhao, 2008), as emerging market firms are found to expand to less developed markets (Cuervo-Cazurra & Genc, 2008; Morck et al., 2008). The rationale stems from the fact that these emerging market firms given their experience have competitive advantages in less developed countries where the governance conditions are "difficult," because they are experienced at operating in legally weak conditions (Morck et al., 2008). We confirm that Chinese firms are making such investments.

Second, our data shows that the acquisition of technology and investment in existing firms, particularly in gaming, has been a driver of their developed country investments. While the motivation to globalize has been complex for all firms, the case of the Chinese platform firms is particularly so. Because China is still a developing country, although its platform firms have advanced rapidly, the firms still trail the US giants in technological sophistication. So, evidently, an important globalization goal for the Chinese is to secure access to technology and content.

2. GENERAL MEASUREMENTS OF CHINESE PRESENCE IN OVERSEAS MARKETS

Before considering the globalization strategies of Chinese platform firms, let us situate the globalization of Chinese platform firms in aggregate terms. In a 2016 report, Peter Evans and Annabelle Gawer (2016) suggested that China has

64 platform firms, while the United States has only 63. While this may be the case, the most general way to understand platform globalization is the use of websites and apps outside the country of origin, that is, digital exports. To gauge this most basic form, we compare the usage of Chinese and US websites and apps in selected nations during March 2018 as reported by Alexa and AppAnnie. As Table 1 shows, that for the earlier technology, websites, when the entire world is considered, there are 13 Chinese websites in the top 50, while US firms own 33 of them (together these two countries had 92% of the top 50). The more interesting data are the national comparisons. What these show is that the global importance of Chinese websites is driven almost exclusively by their dominance of the Chinese domestic market. Similarly, the United States is completely dominated by the US websites.

The data for the Chinese and the US firms show the overwhelming dominance of US websites over those owned by Chinese firms in every nation, except in China itself. However, in some countries, such as Russia and South Korea, domestic websites continue as the most successful in their home markets. Even in nations geographically proximate to China, such as South Korea, or even locations such as Hong Kong and Taiwan that are part of China itself, the mainland Chinese websites and apps have experienced limited adoption.

The story is more complicated, though, when we consider particular applications. First, for smartphones and their apps, China was able to enter earlier in the industry life-cycle and this may explain why the Chinese platform firms have experienced greater success in globalizing their offerings. Chinese-related smartphone apps have been far more successful internationally (see Table 1). Not only do Chinese firms dominate the domestic market, but they also have a significant presence in all other countries including the United States. The smartphone apps data show significant Chinese presence globally. However, Chinese strength overseas is driven by entertainment (games and music streaming) and not by core apps such as search, maps, social media, messaging, etc. Moreover, nearly all of these successful gaming apps are actually produced by Western firms that Tencent, in particular, either purchased outright or in which it has an equity stake. Even in regionally proximate nations, where previous research suggests that Chinese firms are likely to experience significant competitive success (Buckley, Clegg, Cross, Liu, Voss, & Zheng, 2007; Ramasamy, Yeung, & Laforet, 2012); most Chinese globalization has been through acquisitions or equity investments, not user adoption of an application introduced by the Chinese firm.[5]

Websites are far more PC-centric and are a technology that the United States commercialized in the late 1990s, when China was far behind the United States in Internet penetration. More recently, traffic and the technological cutting edge have moved to mobile applications. To measure the relative strength of the United States and Chinese firms, we count the Top 50 downloaded and earning smartphone apps. As Table 1 indicates, in smartphone apps, the Chinese presence is global and extends to the United States, where China has 10 of the top grossing apps. In a number of nations, China has more top-grossing apps than the United States does, and as many free apps. In the apps market, the division of labor between the United States and Chinese may be emerging – in the non-gaming

Table 1. Ownership or Significant Equity of the 50 Top Websites and Smartphone Apps (Most Downloaded Free and Gross Revenue) Globally and by Selected Country, 2018.

Location	US Websites	Chinese Websites[a]	US Apps (Free)	US Apps (Gross)	Chinese Apps (Free)[a]	Chinese Apps (Gross)[a]
Global	33	13	n/a	n/a	n/a	n/a
China	10 (4 Google sites, 2 Amazon sites)	40	1	0	49	49
Taiwan (China)	10	2 (Baidu, Taobao)	11	2	11	16
South Korea	11	6	5	4	10	22
Russia	8	1 (Aliexpress)	9	7	9	13
United States	50	0	31	29	4	10
United Kingdom	37	0	20	24	7	10
France	26	1 (Aliexpress)	16	6	15	15
Germany	35	1 (Aliexpress)	22	10	7	19
Brazil	34	1 (Aliexpress)	22	18	6	10
India	31	1 (Paytm)	17	12	10	7
Singapore		6	20	11	11	20
Thailand	15	3 (Lazada, Hao123, Sanook)	14	7	14	16
Indonesia	21	2 (Tokopedia & Lazada)	18	16	20	16
Vietnam	12	2 (Zing and Lazada)	11	6	15	20

Source: Alexa Traffic Rankings (2018), AppAnnie (2018). Created by authors.
[a] Own or possess a significant equity stake.

applications, the US firms such as Facebook, Google (including YouTube), and LinkedIn (Microsoft) are dominant, while the Chinese firms, particularly Tencent, own or have invested in many of the world's most popular online app games.

Finally, data centers are the "refineries" for the digital age and the cost of a state-of-the-art data center is in the hundreds of millions of dollars (Business Facilities, 2018). Google, Amazon, Microsoft, Facebook, and IBM, roughly in the order of size, have offshore data centers necessary to service their global operations. In terms of data center capacity, their closest competitors are the Chinese digital platforms. As Table 2 indicates, both Alibaba and Tencent are establishing offshore data centers, while none of the other Chinese digital platforms have overseas data centers.

Given the cost of a data center, a necessary condition for establishing one is that it has sufficient traffic to justify not only the capital expenditures for its establishment, but also the operating costs in particular in terms of energy. Roughly speaking, there are two sources of traffic: first and most important is the traffic from the data center owner's operations. Second, the traffic from other firms that contract for data center services. Alibaba, which is the data center services leader in China, has established data centers offshore, not only for its own operations, but also to support its Chinese customers' global activities. And yet, the limited scale of Alibaba's investments (and presumably traffic) is evident from the fact that four of them lease space from independent providers. The newest expansions are in India, Malaysia, and Indonesia, where Alibaba has operations or major investments in domestic firms, thereby providing sources of potential traffic.

In terms of data centers, an important indicator of global business, Alibaba has largely leased cloud space abroad, while Tencent owns its overseas data centers. For offshore data center operations, Tencent's advantage is that its global

Table 2. Alibaba and Tencent Offshore Data Centers, Location, and Year Established.

Alibaba		Tencent	
Location	Date Established	Location	Date Established
Hongn Kong	2014	Hong Kong	2014
Singapore	2015	Canada[a]	2015
US SV[a]	2015	Singapore	2015
US Virginia[a]	2015	US SV	2017
Germany[a]	2016	Germany	2017
Dubai	2016	India	2017
Australia	2016	Korea	2017
Japan[a]	2016	Russia	2017
India	2018	Thailand	2018
Indonesia	2018		
Malaysia	2018		

Source: News media and various press releases. Created by authors.

[a] Space from local data center provider.

online-gaming business and the many Chinese tourists using WeChat guarantee significant traffic (Xia, 2017).[6] This makes it possible for Tencent's offshore data centers to also provide services to other Chinese firms with offshore operations. For Chinese customers, having firms that can provide global coverage is vital and of the Chinese firms, only Alibaba and Tencent have a global footprint.

3. CHINESE DIGITAL PLATFORMS GLOBALIZATION STRATEGIES

This section explores the globalization strategies of the various Chinese digital platforms. Prior to our firm-by-firm analysis, it is significant to note that only a small number of the Chinese digital platforms have a global presence. In most nations, a combination of domestic or US firms controls the vast majority of the most used websites and apps.[7]

The number of Chinese platform firms with overseas operation or even presence is quite small. To illustrate, as mentioned earlier, Evans and Gawer (2016) identified 64 Chinese platform firms; however, our database finds that only nine of these firms have an offshore investment or operation. There are only three firms that have a substantial global presence: Tencent, Alibaba, and Baidu. The remaining six firms have smaller foreign operations and, in fact, are little threat to the incumbents.

In global terms, Tencent is among the world's ten most valuable firms. It began by reverse engineering the Israeli instant messaging application, named ICQ , and grew rapidly by diversifying into gaming, mobile, social media, and eventually smartphone payment systems.[8] In 2018, it had become the largest online gaming firm in the world and 2017 revenue from all of its operations was $36.3 billion and operational profit was $13.8 billion (Tencent, 2018). Tencent might be thought of as China's Facebook/WhatsApp combined with the largest gaming firm in the world. Due largely to its gaming operations, Tencent is the most globalized of all the Chinese platform firms having stakes in nearly all of the important global gaming firms. However, the most important strategic technologies it possesses are likely the most sophisticated social media platform in the world, which is connected to a sophisticated payment system. Finally, it is perhaps the most powerful platform business group, as it uses its exceptional cash flow to expand its network of affiliated firms, which now includes Jingdong (JD), VIPshops, and other Chinese firms.

Alibaba is, in certain respects, the Amazon of China with a powerful payment system that provides it with enormous cash flow giving it some of the characteristics of a bank. Alibaba's revenues for the 2018 fiscal year were nearly $40 billion with profits of $11 billion (Alibaba, 2018). The marketplaces that Alibaba has developed are mainly focused on the domestic market, but it also has a marketplace, AliExpress, that serves foreign countries. As was the case with Tencent, it is experiencing growth rates of approximately 50% per annum as China rapidly intermediates increasing portions of its economy digitally. Alibaba is also aggressively investing abroad, particularly, in neighboring nations including SE

Asia and India, while simultaneously purchasing smaller technology firms in the United States and Europe. A particularly important part of its investments are in the financial sector as it attempts to knit together a global payment system.

The final important firm is Baidu, which can be seen as the Chinese analog of Google, as it also started in search and has steadily diversified by offering other services. Unfortunately, for Baidu, it has grown more slowly than Tencent or Alibaba and, in particular, its payment system has far less market share. With less revenue ($13.03 billion in 2017) and profits ($2.41 billion in 2017) (Baidu, 2018) and no particular competitive advantage against the Western giants, Baidu's globalization efforts have largely been confined to technology purchasing, establishing R&D laboratories in the United States, and a few small initiatives in the developing world. Baidu does continue to invest aggressively in fields, such as artificial intelligence and autonomous vehicles, but its portfolio suggests that, at this time, its globalization will be relatively subdued. In Sections 4-7, we examine the globalization strategies for each of the firms in greater detail.

4. TENCENT

Tencent was established in 1998 by reverse-engineering an Israeli-developed instant messaging application, named ICQ and it was introduced in 1999. By 2001, there were 50 million registered Chinese users.[9] Eventually, AOL, which had purchased ICQ, sued Tencent, which then changed its name to QQ (Huang, 2017). In the next three years, Tencent introduced QQ for mobile and quickly introduced value-added services including instant messaging, ring tones, an online dating service, and online games (Huang, 2017, p. 42). Already profitable in 2004, Tencent was listed on the Hong Kong Stock Exchange.[10] These early applications created the two product trajectories that would undergird Tencent's growth, entertainment (gaming and music streaming) and instant messaging that evolved into the social media-based WeChat platform to which it soon added a payment platform.

Tencent's globalization strategy has thus far had two prongs using games, instant messaging/social media, but it recently added the third prong, payment systems. The most successful of these appears to be gaming, where it has acquired or made investments in global gaming firms. It can draw upon a number of firm-specific advantages, namely its dominant position in the Chinese game industry, which draws upon the country-specific advantage, which is that China is the largest game market in the world. These linked advantages permit it to acquire rights to Western games that it can promote in China – something that is far more difficult to do for the foreign game-maker. In addition to acquiring the rights, it also secures the opportunity to make an equity investment in the Western game firm. This strategy began in 2007, when Tencent licensed CrossFire, which went on to become the highest-grossing online game ever in China, from SmileGate, a Korean game developer.[11] This deal and the success of Tencent's own games provided the firm with a platform upon which to introduce yet other games into the Chinese market. Through 2018, Tencent had invested more than $13 billion in gaming firms globally and its estimated gaming revenues in 2017 were over $16 billion (Newzoo, 2017) though the domestic and foreign percentage is unknown. The best estimate was that in 2016, Tencent garnered 13% of global gaming revenue (Newzoo, 2016) and it was growing faster than the overall market.

After licensing CrossFire, Tencent began purchasing equity stakes in the foreign firms whose games it would introduce into the Chinese market. In 2008, it purchased equity in the Vietnamese firm, Vinagame, and introduced its games into China, while also providing Chinese games to Vinagame. Simultaneously, at the same time, Vinagame adopted QQ software to replace its failed Zing Chat and, today, it is the sixth most used site in Vietnam (Truoc, 2012). In 2009, Tencent made its initial investment in United States-based Riot Games that would gradually lead to its acquisition of near-total control in 2015.[12] As the Chinese gaming market continued to expand to be the world's largest and the fact that it was largely closed to foreign firms, Tencent's distribution ability became a powerful bargaining chip for foreign game producers (Hancock, 2018). As is often the case with Chinese platform firms, Tencent has begun integrating its value chain by investing in distribution channel partners. For example, in 2012, Tencent acquired Level Up, a game distributor located in Singapore and covering Brazil, Philippine, and India (Ong, 2012). In 2013, Tencent invested in Garena, another Singaporean game platform with strong distribution in SE Asia (Table 3).[13]

While facing some competition in China, Tencent Music, with 120 million subscribers and 700 million monthly-active-users is also globalizing.[14] Its investments were first in the proximate nations in SE Asia. In January 2015, Tencent established an Asian music streaming subsidiary, Joox, aimed at East Asia nations and it has expanded rapidly (Bundgaard, Karlsson, & Lau, 2016). In addition to Joox, Tencent Music invested in a US music streaming firm aimed at Asian markets, Smule, and an Indian music streaming firm, Gaana. In December 2017, Tencent Music agreed to an equity-swap alliance with the world's largest music streaming firm, Spotify.[15] This network of music sites and apps in Asia allows Tencent to leverage its power in China into the rest of Asia.

While game publishing has become an important global business for Tencent, its most important business and its core platforms in China are, of course, the social media/messaging platforms, QQ and WeChat, which it has actively, but largely unsuccessfully tried to extend to foreign countries. This is despite the fact that when WeChat was first introduced in 2011 it had an English version. Moreover, by 2016, WeChat supported 22 languages covering more than 100 countries.[16] While Tencent hoped that WeChat would be successful in SE Asia, Europe, and the United States, it has been unable to develop a significant installed base (except for its use by Chinese tourists and citizens abroad). Outside of China, WeChat and QQ must compete with Facebook, Instagram, and WhatsApp. In both of the Alexa website and AppAnnie app ranking, Tencent's overseas social media presence is limited to firms within which it has made equity investments, such as the Russian social media site, DST, the US social media firm, Snapchat, and a Thai firm it acquired.[17] It also acquired the Thai social media firm, Sanook. Finally, Vinagame's Zing, an instant messaging application, is largely based on

Table 3. Investments of Tencent in Global Gaming Industry.

Firm	Country	Type of Investment	Percent Ownership	Date	Investment (US$ Millions)
VinaGame	Vietnam	VC	20	July 2008	Unknown
Riot Games	United States	Equity	93	September 2009	350
Level Up	Singapore	Equity	49	January 2012	27
Zam	Europe	Unknown	Unknown	March 2012	Unknown
Epic Games	United States	Equity	48	June 2012	330
CJ Games	Korea	Equity	28	March 2014	500
PATI Games	Korea	VC	20	August 2014	20
4:33 Creative Lab	Korea	Equity	25	November 2014	110
Aiming	Japan	VC	Unknown	December 2014	Unknown
Miniclip SA	Switzerland	VC	Majority	February 2015	Unknown
Glu Mobile	United States	Equity	20	April 2015	126
Paradox Interactive	Sweden	Equity	5	May 2016	528
Supercell	Finland	Equity	84	June 2016	8,600
Activision Blizzard	United States	Equity	25	September 2016	2,300
Garena	Singapore	VC	Unknown	September 2016	Unknown
Pocket Gems	United States	Equity	38	May 2017	150
Ubisoft	France	Equity	5	March 2018	350
Total					13,400

Source: News media and press releases. Created by authors.

QQ.[18] In addition to these operations, it has invested in a number of startups, in particular, the Indonesian ride-sharing firm Go-Jek[19] and the Indian ride-sharing firm, Ola.[20] These complement Tencent's large equity stake in the Chinese ride-sharing firm, Didi.[21] It also has a miscellaneous collection of investments in other platform firms.

Tencent has significant overseas operations and the consequent data-processing needs, and this has allowed it to establish offshore data centers. To illustrate, Supercell's data center provider prior to the Tencent acquisition was Amazon Web Services,[22] but recently, Tencent announced that its offshore data centers were serving Supercell, Netmarble, Aiming, and Gamevil ("Tencent cloud to," 2017).[23] Tencent's first overseas data center was established in Hong Kong in 2014. In 2015, it leased data center space from a Canadian provider, opened one in Singapore. Then in 2017, it opened data centers in Silicon Valley, Germany, India, Korea, and Russia, and then, in 2018, it opened one in Thailand.

In international business terms, with 13% of the global market, Tencent has established a global games publishing empire largely through acquisition and equity investments. As is the case, to a lesser degree, for music in Asia, it has leveraged its dominant position in the Chinese gaming market to purchase equity stakes in various game producers. It then introduces the games into the Chinese market and even requests redesign or versioning of the game for the Chinese market.[24] In essence, Tencent is integrating the game design part of the value chain, even as it produces its own games. The equity connections with the game producers also allow Tencent to guide traffic to its international data centers, thereby allowing Tencent to build data centers abroad to serve a ready market.

5. ALIBABA

Alibaba's globalization can be traced back to 2000 when they received a $20 million investment from Softbank.[25] Jack Ma was eager to expand the Alibaba business-to-business (B2B) operations globally. He recruited managers and developers from advanced countries, established a technical infrastructure in the Silicon Valley, and opened branches in the United States, Europe, Korea, etc. This globalization strategy failed quickly as Alibaba could not attract sufficient buyers or sellers to its platform. As a result, Alibaba closed its overseas offices and relied on its Aliexpress website to enable Chinese retailers to sell to overseas customers (Erisman, 2016, p. 205). After this, Alibaba concentrated on the domestic market and grew extremely rapidly until approximately 2010, when it again began considering global operations.

First, e-commerce globalization is still the top priority for Alibaba. Instead of working as an intermediary between foreign sellers and foreign buyers, Alibaba serves as a platform for Chinese business to sell to other countries or selling foreign goods to China. According to Alibaba's 2017 Annual Report, 11% of its sales were outside of China, though this did not include the rapidly growing revenue of Alibaba global cloud-computing service. AliExpress, the global e-commerce brand of Alibaba, which when combined with Lazada, has approximately 83 million annual active buyers globally.[26] It is difficult to estimate its market share by country, but Aliexpress is present in many countries including emerging economies like SE Asia, Russian, Brazil, etc., and as Table 1 shows, it is among the top 50 websites in a number of European nations including Germany, France, and Italy. So while, Aliexpress has a global presence, which makes it a competitor with Amazon and eBay, with the exception of a few countries such as SE Asia where Alibaba-controlled, Lazada, is dominant, Aliexpress badly trails Amazon and eBay in each of these markets.

Second, global financial platforms are a new strategic focus of Alibaba based on its domestic success with its payment service that has evolved into a powerful comprehensive financial services platform. Known as Alipay, the payment service initially grew out of the e-commerce platform. However, today, it is a comprehensive platform that serves wide range of transactions and is growing rapidly.[27] Based on the Chinese tourists traveling internationally, Alipay has become available in many foreign markets, though its usage is almost entirely confined to the Chinese tourists (PYMNTS, 2017).

Recently, Alibaba has been investing to extend its payment system to foreign countries. For example, in Malaysia in September 2017, it created a joint venture with a Malaysian bank and, in Russia, it partnered with Foreign Trade Bank (VTB Bank).[28] In November 2016, it acquired 20% of Ascend Money, a firm based in Thailand that provides online small loans in SE Asia.[29] This was followed by an investment in Paytm, the largest Indian payment platform.[30] In February 2017, it invested in the Korean payment platform, Kakao Pay.[31] Simultaneously, in February 2017, it invested in Mynt, a Philippine micro-finance site.[32] In addition to these investments in spreading its platform, Alibaba is investing in small firms with advanced technology. For example, they invested in V-Key in 2014, a Singaporean firm focused on encryption technology,[33] and ThetaRay in 2015, an Israeli company specializing in the financial network security.[34] Finally, Lazada, within which Alibaba is the controlling shareholder, had a payment system that is being rebranded from Hellopay to Alipay (PYMNTS, 2017).

Alibaba has made many other investments abroad that do not appear to be guided by any particular strategy. For example, it purchased 5.6% of the US firm, Groupon, 9.3% of the US e-commerce site, Zulily, and a small position in Snapchat. It also made a small investment in the US ridesharing firm, Lyft. In gaming, it invested in Gamepind in India and Kabam in Canada. In 2017, it signed a joint venture agreement with Marriott International to improve its service to Chinese tourists. In some respects, these seemingly disconnected investments fit with the strategy in China of expanding joint ventures as a part of developing the platform business group operations (Jia & Kenney, 2016), but there are also potential capital gains. Alibaba may be able to discover ways of using its capabilities to assist the firms in its investment portfolio. In this way, the investments can feed the core platforms, payments, and e-commerce, and contribute to an even greater accumulation of consumer data.

Finally, as with the other Chinese digital platforms, Alibaba has invested in or acquired small foreign technology firms. Very often, these acquisitions are not market entry strategies but rather to acquire control of the technology with the aim of integrating it into its domestic platforms. Recent acquisitions include Tango, which has developed technologies to adapt instant messaging for e-commerce and MagicLeap, which develops AR/VR technologies. For Alibaba, it is difficult to separate its firm-specific advantages from the benefits it receives by having only token domestic competition from Amazon (Keyes, 2017).

6. BAIDU

Baidu operates the largest search engine in China and offers a number of other significant services in the Chinese market such as maps, cloud storage, an encyclopedia, translation, etc., nearly all of which are monetized through ad revenue. Effectively, Baidu is the Chinese analog to Google. More recently, Baidu has begun developing and testing autonomous vehicles in the United States.[35] In the case of Baidu, for nearly all of its technologies outside of China, it faces the much larger and more established Google, which nearly always has greater experience in whatever the local culture is. Further, in nearly all of these language areas, users also use English-language Google. Most users outside of China have little use for Chinese-language sites. Effectively, being the premier English-language site is an inherent advantage.

Baidu did attempt to globalize its search function beginning in 2006, when it introduced a Japanese-language search engine. However, the service never generated sufficient traffic and in 2015, it discontinued operations (Millward, 2015). In 2014, Baidu introduced a Portuguese-language search engine in Brazil;[36] however, according to Alexa.com, it was not in the Top 50 Brazilian websites. Simultaneously, Baidu purchased a group buying site in Brazil, which also was not in the Top 50. In 2016, it introduced a number of mobile apps into the Indian market,[37] though, in 2018, none of these apps were the Top 100. In 2017, it announced a partnership with the former Nokia Maps firm, HERE, which currently is owned by the German automakers, to provide global mapping functionality to Chinese tourists abroad (Stevenson, 2017). Despite these efforts, in terms of operations outside of the Chinese market, Baidu has had limited success.

Baidu has made a number of acquisitions and investments abroad (see Table 4). The vast majority of these are not for market entry, but technology acquisition appears to be the primary motivation, as appears to be the case with its overseas R&D operations.

Baidu's attempts to globalize its search operations have largely failed, and its operations are largely confined to the domestic market. It has established R&D centers in Silicon Valley and Singapore, and made a number of investments in firms, but these are meant to access knowledge and talent in those regions and do not appear to be market-entry strategies. The market-entry investments are in Brazil, where it has introduced its search engine and acquired an e-commerce site, and in India, where it has introduced a number of mobile apps; both of these modest initiatives appear to be having a modicum of success. At this time, Baidu is a domestic giant, but, as its revenues indicate it is not, at present, an important actor on the global technological scene.

Table 4. Baidu Investments by Firm, Nationality, Technology, Market, Type, and Date.

Firm	Country	Technology	Market	Type	Date
Simeji	Japan	Input method editor	Global	Acquisition	December 2012
Pixellot	Israel	Video capture	Global	Venture Capital (VC)	December 2014
Taboola	United States	Search engines	Global	VC	May 2015
popIn	Japan	Advertisement	Global	Acquisition	June 2015
Circle	United States	Payment	Global		June 2016
Dynamic Yield	United States	Machine learning	Global		July 2016
Zest-Finance	United States	Online finance	United States	Joint Venture	July 2016
Velodyne LiDAR	United States	Laser radar	Global	VC	August 2016
Dynamic Yield	United States	Hardware	Global	VC	December 2016
Xperception	United States	AI	Global	Acquisition	April 2017
KITT.AI	United States	AI	Global	Acquisition	July 2017
TigerGraph	United States	Data management	Global	VC	November 2017
TrustGo	United States	Anti-virus software	Global	VC	February 2018

Source: Various websites. Created by authors.

7. GLOBALIZATION OF OTHER CHINESE PLATFORM FIRMS

With the few exceptions discussed in the following paragraphs, most of the other Chinese platform firms have not invested abroad and remained entirely focused upon the domestic market. With the exception of Jingdong (JD) which is an e-commerce firm affiliated with the Tencent group, the other firms are smaller and sectorally specialized. For this reason, their investments are in specific sectors. For example, Ctrip, the online travel agency, confines its investments to travel, Didi, the Uber equivalent, invests in ride hailing, and Toutiao, a news aggregating platform, invests in firms that develop or supply news and information to users.

In contrast to Baidu, Alibaba and Tencent (BAT), these firms have focused their overseas initiatives in their core businesses and directly related sectors. JD, which is the fourth largest Internet firm in China and has developed a more diversified overseas investment strategy that roughly conforms to the platform business group model of BAT. It is expanding horizontally to other sectors that are not closely related to e-commerce. In contrast, nearly all of the investments and acquisitions of Ctrip, Didi, and Toutiao are closely related to their Chinese operations, being the online traveling, ride-hailing, and content sharing, respectively. In Sections 7.1–7.5, the globalization strategies for these smaller platforms are briefly discussed.

7.1. Jingdong.com

Established in 1998, JD is an e-commerce platform and, while smaller than Alibaba, is its primary competitor within China.[38] As Table 5 shows, JD has invested in a number of online sales platforms, particularly in the neighboring SE Asian countries and Russia. It has also invested in three firms in the United States and the United Kingdom. For example, JD invested in Traveloka and Go-Jek in 2017, because both were located in Indonesia and participated in online traveling and ride-hailing, respectively. And yet, JD is more focused than BAT because nearly 60% of its global expansion is still in e-commerce. More recently, JD accelerated its overseas investments. In 2015, JD established a research center in Silicon Valley; almost certainly as a technology outpost.[39] Despite these investments, over 95% of its sales are in China.

As has been the case with Alibaba, and even more so, the smaller, JD, with a few exceptions, has been investing in neighboring markets, such as Russia and SE Asia. JD's more conservative approach to invest in foreign markets is certainly a function of its smaller size and far lower market capitalization; both of which limit its ability to undertake large-scale foreign investment.

7.2. Ctrip[40]

In 2018, Ctrip was the largest non-US travel platforms in the world and, while significantly smaller than the US travel platforms that dominate most of the rest to the world, Ctrip is now one of the world's leaders. Ctrip's remarkable success is

Table 5. JD Overseas Investments by Firm, Nationality, Technology, Market, Type, and Date.

Firm	Nationality	Technology	Market	Type	Date
Misfit Wearables	United States	Wearable device	Global	VC	December 2014
JD Russia	Russia	e-Commerce	Russia	Greenfield	June 2015
Zest-Finance	United States	Online finance	United States	Joint venture	November 2016
FarFetch	United Kingdom	Online luxury goods	Global	Equity	June 2017
Traveloka	Indonesia	Online travel	Indonesia	VC	July 2017
GO-JEK	Indonesia	Ride-hailing	Indonesia	VC	August 2017
Pomelo Fashion	Thailand	Online fashion	SE Asia	Joint venture	October 2017
Central Group	Thailand	e-Commerce/ fintech	Thailand	Joint venture	September 2017
Tiki	Vietnam	e-Commerce	Vietnam	VC	January 2018

Source: Various websites. Created by authors.

inextricably linked with massive growth of Chinese tourism. Currently, the bulk of Ctrip's overseas investment has been investing in or acquiring firms/websites in developed nation markets that can service the enormous flow of Chinese tourists it controls (see Table 6). For example, the investments in ezTravel, Tours4fun, Universal Vision, and Ctour integrate offshore service providers for Chinese tourists.

The acquisitions of Travelfusion, Skyscanner, Trip.com, and Travstarz are investments meant to provide services to non-Chinese customers. With these investments, it can not only route its customers to these subsidiaries, thereby providing them with demand, but also offer the services to non-Chinese travelers. Prior to these acquisitions, Ctrip had directed Chinese tourists to Priceline for fulfillment of most foreign travel, thereby sharing the revenues.[41] With these acquisitions, it can route those customers to its subsidiaries.

At this point, Ctrip's globalization strategy has two prongs: the first prong has been using its enormous cash flow to acquire or co-invest in local firms that dominate other developing country markets that are expanding rapidly. The two cases in point are its equity investment in the Indian travel giant, MakeMyTrip, and investments in SE Asia. The second prong is that, Ctrip can provide for these investments infrastructural and capital support to allow these operations to expand more quickly. It is uncertain how successful Ctrip's initiatives in international markets will be. However, given that Chinese tourism is likely to continue its rapid growth and Ctrip monopolizes this market, it has significant financial resources, enormous leverage in directing this flow of tourists for strategic advantage, and a rapidly developing capability in analyzing the enormous inflow of data that it receives. For the reasons we describe, Ctrip is likely to be an increasingly formidable competitor to the US global travel and tourism platform giants, Expedia, Priceline, and TripAdvisor.

Table 6. Ctrip Offshore Investments by Country, Technology, Country Served, Investment Type, and Year.

Firm	Country	Technology	Country Served	Type of Investment	Year
ezTravel	Taiwan	Online travel	Taiwan	Strategic alliance	2006
Tours4fun	United States	Online travel	United States	Acquisition	2013
Universal Vision	United States	Bus operator	United States	Acquisition	2013
Travelfusion	United Kingdom	Online ticketing	Global	Acquisition	2015
Ctour	United States	Group tour operator	United States	Investment	2016
Skyscanner	United Kingdom	International ticket reservation	Global	Acquisition	2016
MakeMyTrip	India	Online ticketing	India	VC	2016
Trip.com	United States	Predictive technology	Global	Acquisition	2017
Travstarz	India	Travel services	Global	Equity	2018

Source: Various news reports. Created by authors.

7.3. Didi

Didi is the largest mobile transportation platform in China, providing more than 7.43 billion rides for 450 million users in more than 400 cities nationwide in 2017.[42] Founded in 2012, Didi imitated the business model of Uber but subsidized both the drivers and passengers in an effort to capture the market as rapidly as possible. Didi merged with its main competitor, Kuaidi, in 2015 and became the largest domestic ride-hailing platform.[43] Didi bought the China assets of Uber in 2016, which further solidified its domestic dominant position.[44] Since then, Didi aggressively started globalizing by investing in and working with local players. Besides the investment in Ola in India in 2015, Didi undertook five other investments in 2017 including Brasil' 99 in Brazil, Careem in Middle East, Taxify in Europe and Africa, GrabTaxi in SE Asia and Lyft in the United States. In 2018, Didi entered the Mexican market to directly compete with Uber, which has built strong Latin American operations.

This globalization strategy is supported by raising capital from domestic and global capitals. After the first few rounds of investment from Alibaba, Tencent, and some other investors, including Chinese investors and firms such as Softbank and Apple, in February 2018, DiDi's valuation had grown to $56 billion, which was even greater than that of Uber (Shen, 2018).

7.4. Toutiao

Toutiao is one of China's largest mobile platforms of content creation, aggregation, and distribution underpinned by machine learning techniques. It will recommend the most relevant contents, like news, videos, music, blogs, etc., to users by learning their preferences.[45] Founded in 2012, Toutiao now has over 120 million domestic daily active users (Huang, 2017). Like social network platforms, the Toutiao revenue model is based upon advertising.[46]

Toutiao began globalizing in 2016 and tried to export its business model. As part of this strategy, Toutiao made an equity investment in *Dailyhunt*, a news aggregator in India in 2016, and then acquired Flipagram, a Los Angeles-based video startup, News Republic, a mobile news and information platform, and Musical.ly, a most global popular short video startup, which has been ranked as high as No. 1 in iOS App Store.[47] In addition to these investments, Toutiao has localized its news service to Korea, SE Asia, Brazil, and North America, with the name of Topbuzz, the content-recommendation platform, and Tik Tok, the short video platform.[48] Despite the success of Topbuzz in Japan and Tik Tok in Thailand, it is too early to say how successful the globalization strategy of Toutiao will be, given the fierce competition in the advertisement market and uncertainty as to whether the service will be widely adopted.[49]

7.5. Vipshop, Sohu, and Ctrip

Vipshop is the third largest e-commerce platform in China trailing only Alibaba and JD.com. Founded in 2008, Vipshop provides high quality and popular branded products at a significant discount to listed retail prices.[50] It was listed on the New York Stock Exchange (NYSE) in 2012 and fulfilled 335 million customer orders in 2017, generating more than $11 billion net income and $805 million in profits.[51] In 2015, Vipshop initiated its globalization strategy by investing in BrandAlley, a British fashion online platform, and Ensogo, an e-commerce platform in the SE Asia. Given its relatively small market share in China,[52] but close relationship with Tencent and JD, thus far Vipshop has made only a few smaller investments. Finally, the online portal, Sohu, bought a small online portal in the United States, but otherwise is restricted to the Chinese market.

A few of the largest Chinese digital platform firms are globalizing. However, this number remains limited. The most important of these is clearly Tencent closely followed by Alibaba and Baidu. Ctrip is globalizing following its customers, Chinese traveling abroad. However, it has acquired some Western firms in an effort to increase its role in global travel markets. To be successful globalizing, Ctrip will have to develop the capability to serve non-Chinese customers and find a way to displace the incumbents. Recently, with the acquisition of Trip.com and Skyscanner, it has made investments aimed at building a travel website that will be used by non-Chinese consumers. Moreover, the income it receives from its near-monopoly of the Chinese travel market has created sufficient profits to sustain losses in order to capture market share outside of China. The other Chinese platforms are largely absent from the global market and most of them have less financial and technological strength and thus have been more conservative in their attempts to move into foreign markets.

8. FUTURE PROSPECTS FOR CHINESE DIGITAL PLATFORM GLOBALIZATION

In fields such as smartphone payment systems and social media applications, the two Chinese giants, Alibaba and Tencent, have developed new-to-the-world technologies. In addition, these firms have expanded in China integrating an ever greater variety of firms, offline and online, into the complex patterns of crossholding and ecosystem-based dependence that we have termed "platform business groups" that feed traffic to one another. They have developed rich ecosystems within the protected Chinese market. This has enabled them to grow to a massive scale that provides them with sufficient financial wherewithal to enter the ranks of the most valuable firms in the world and to become sufficiently large to theoretically threaten their Western rivals. However, as our data on top 50 websites and apps indicates, there is a little evidence of a significant threat outside of gaming.

The Chinese internet giants have significant strengths. First, they are located in the world's largest online market and have no overseas competition, which means that they will continue to accumulate financial resources. For Ctrip, the Chinese tourism market is a vital competitive advantage as it is already the largest single market in the world and growing far faster than any other one. As important, the global online travel market may be rather easy to enter for a firm with deep pockets as there do not appear to be any salient entry barriers. Similarly, Tencent has been able to establish a powerful position in gaming by leveraging access to the Chinese market that it dominates. In cases where Chinese firms can leverage the enormous domestic market, they may experience substantial global success. In other fields, where there are entrenched global platform incumbents with powerful lock-ins such as those of Google, Facebook, Microsoft, etc., dislodging them is likely to be nearly impossible absent a powerful technological shift or political decisions by the home-country governments. Amazon and online retail remains a mixed case, as Amazon is entering various Asian markets outside of Japan, where it is already very powerful, but in SE and South Asia there are significant local competitors in which the Chinese giants hold important equity stakes.

In strategic terms, an important strategy that Chinese firms use to enter new markets is to invest capital in domestic platform firms, enter joint ventures, or even acquire a domestic firm to secure a foothold in the various markets. Examples of this include Alibaba and Lazada, Tencent's investments in SE Asian music websites, and Tencent's provision of WeChat to Vinagames in Vietnam. These joint ventures and investments allow the Chinese platform firms to provide global-class technology to their partners; this may provide another subtler strategy for globalization in a world dominated by the US giants.

At other times, these investments may not lead to acquisition, but just significant financial returns. For example, in May 2018, Walmart made a $16 billion purchase of 80% of the Indian online shopping giant, Flipkart, which had, only one year earlier, received a large investment from Tencent. In this case, Walmart invested as a riposte to Amazon, which has been quickly gaining market share in India (Economic Times, 2018). It is uncertain whether Tencent exited the investment, but they certainly reaped a significant financial return.

The Chinese firms are also investing in developed country firms as exemplified by Tencent's purchase of equity in Snapchat and Spotify. While these are small in terms of the percent stake, they may be sufficient to provide the Chinese firms insight into the Western firm's business strategies and technologies and, perhaps, evolve into vehicles for exporting the technologies the Chinese firms have developed. One case in point is Tencent's investment in Snapchat. Other investments in sectors, such as ride-hailing, appear to be more financial than strategic.

The Chinese digital platforms have another powerful and rapidly expanding asset, namely given the size of their market they have enormous volumes of data, at a scale only rivaled by the leading US platform firms. They can use these assets to improve their cloud computing, machine learning, and artificial intelligence skills. In other words, they can develop global-class data management skills that they will be able to apply to various technical problems. The development of these skills may provide a leverage for overseas commercial activities, such as offering these services to firms in smaller markets.

9. OBSTACLES TO CHINESE DIGITAL PLATFORM GLOBALIZATION

Despite the current enthusiasm to expand worldwide, there are still significant weaknesses that handicap their global ambitions. The large but protected market provides them with ample opportunity for domestic success, but may prevent the development of global competences and understanding of non-Chinese markets. Here, the salient exception is Tencent whose ability to leverage their control of the Chinese game market to either acquire control or hold significant equity in foreign game makers has made it the most powerful game publisher in the world.

At this time, the Chinese digital platforms, as the late-comers, lack the experience to attain global success (Li, 2007). The Chinese firm's first attempts at globalization in the early 2000s were led by Alibaba and Baidu, but they experienced limited success, as their products were inferior to those offered by the US giants. Even later, in 2011 when WeChat was launched in China, it created an English-language version, but it and versions for other languages, were incomplete and not localized.[53] For example, for Asian markets, WeChat did not provide local packages such as emojis optimized for the individual countries. As a result, the Japanese messaging app, LINE, and the US messaging app, WhatsApp, captured dominant market share in SE Asia – and, thereby, established themselves as incumbents.[54]

Second, there may be some issues concerning regulation. In the domestic market, these Chinese firms operated in a loose regulatory environment within which the government accepted horizontal expansions and acquisitions that resulted in the creation of the platform-business-group model (Jia & Kenney, 2016). While it might be possible to expand horizontally and provide subsidies or channel traffic in some developing countries, this is unlikely to be accepted in developed nations. This means that Chinese platform firms have become accustomed to a market where they deliver entire packages of tightly interknit services, but in foreign nations, they normally enter with individual services and thus do not benefit from the cross-platform synergies they experience in China.

Third, in terms of technology even as the Chinese platform firms have rapidly developed their technology, as are the US platform giants, the Chinese firms are purchasing and making venture capital investments in foreign small- and medium-sized firms. In the United States, in particular, their ability to purchase firms is increasingly constrained. In 2018, the US government blocked Ant Financial, an Alibaba affiliate, from acquiring MoneyGram, the second largest US money transfer firm (Russell, 2018). The investment was blocked on purported national security concerns, but it is likely that the true concern was that MoneyGram could become a way for Alibaba to introduce its Alipay platform into the global money transfer system and begin to threaten the control of US firms on the global financial transfer system.[55]

10. DISCUSSION AND CONCLUSIONS

Two Chinese digital platforms, Alibaba and Tencent, are among the world's 10 most valuable publicly traded firms and many others have grown to a significant scale in terms of revenues and profits on the basis of their operations in the protected Chinese market. Given their near-monopoly in the enormous and very profitable domestic market, this chapter examined the existing evidence regarding whether they had developed sufficient firm-specific advantages to effectively enter foreign markets and described their expansion strategies.

Competition in markets organized by digital platforms is subject to winner-take-most or all markets, network effects, lock-ins, and long-tail economics, which provide incumbents remarkable advantages. China is a particularly interesting case because it is today the largest single online market and the leading Chinese digital platforms have developed and deployed some innovative technologies; in particular, payment and messaging, particularly for the mobile internet. Also, a number of Chinese digital platforms are growing rapidly in terms of revenues, have large profits, and have access to substantial amounts of capital. These resources provide important advantages for entering the overseas markets.

The difficulty for Chinese digital platforms is that, in most markets outside of China, there are nearly always two groups of incumbents. The first group being local firms; many of which in larger countries such as India have grown to a significant size. However, the more important incumbents are the US platform multinationals led by Google, Facebook, Microsoft, and, often, Amazon. In specialty niches such as travel, the US firms, such as Expedia, Priceline, and TripAdvisor, are present. These US firms almost always have the advantages of network effects and lock-in that Chinese firms would have to overcome – simply being cheaper or somewhat better will not be sufficient to dislodge their competitors.

Faced with this reality and several failures such as Baidu's attempt to enter the Japanese search market, as theory suggests, Chinese firms developed a complex portfolio of strategies for their entering foreign markets: the first strategy was to enter new markets where they did directly compete with the US platform giants. As EMNE theory predicts, one of most frequent entry strategies was to conclude joint ventures with indigenous firms; many of which were being threatened by far larger US platform firms. Chinese firms such as, Ctrip, and the other Chinese internet services, such as Alipay and WeChat Pay, followed Chinese travelers abroad as a method for diffusing the system – effectively integrating the product delivery chain. Unfortunately, this has met with little success outside providing for Chinese visitors.

The most successful of these firms was Tencent that, by using its leverage in largely controlling access to the Chinese gaming market and financial resources, became the largest game publisher in the world. This allowed Tencent to invest in or acquire many of the world's most important gaming firms. The firms that receive the investments are potential customers for Tencent's global network of data centers offering cloud computing. This secures steady traffic for Tencent's offshore data centers and allows Tencent to provide global cloud solutions to other Chinese firms with global business operations. There is little evidence that these offshore cloud data centers are attracting unrelated customers in foreign markets. This contrasts with Amazon, Google, and Microsoft that dominate local markets for cloud services.

Chinese digital platform firms have also expanded into developing economies in sectors where US competitors are not yet dominant, most often by acquiring outright or taking an important stake in a local firm with significant market share. For example, Alibaba leveraged its success in China with online payments competences to invest in firms in similar markets in proximate nations and purchased small equity stakes in the US firms.

The final goal of the Chinese platform firm foreign investments, often through their venture capital arms, is to acquire or understand newly developed technologies or content being developed abroad. These initiatives are underway even as there are increasing pressures from foreign governments to curtail technology acquisition.

If we can make any generalizations about the globalization patterns of the Chinese platform firms, it appears that their behavior provides some support for the theorization that EMNEs are different from developed nation MNEs; particularly, in terms of using joint ventures to enter foreign markets and for productive investments in proximate nations. For technology acquisition, investments are largely concentrated in developed nations. What seems certain is that the Chinese platform firms will continue to search for ways to expand outside the domestic market, particularly through joint ventures with domestic rivals, such as Ctrip's investment in the Indian domestic travel giant, Makemytrip.com, to the US platform giants. And yet, at this time, the Chinese firms are not significant competitors to the US platform firms.

NOTES

1. There are nationally important websites in a number of nations including India, Iran, Japan, Korea, and Russia. However, in all of these nations, US website providers also have significant market share. China, which blocks most foreign websites, is unusual in the effort it expends to sequester the Chinese market.

2. There is a significant literature that considers the national market advantages firms may have and firm specific assets that develop (Bartlett & Ghoshal, 2002; Dunning, 1988).

3. Our initial source was CrunchBase, but we found that was incomplete. In addition, we visited the websites of all of the Chinese platform firms we could identify in an effort to identify their overseas operations. Finally, we searched the Internet media in English and Chinese for their other overseas operations such as data centers. For each investment, we attempted to identify the Chinese platform firm, the activity in the foreign country, the investee firm's target market, investment type, amount, and investee firm revenues where available. Using this methodology, we were able find 142 overseas investments by Chinese platform firms. We caution, this does not include use of Chinese websites and Apps in foreign markets. These investments can be considered the "points of presence." Finally, in the descriptive portion of the chapter, we compare the status of the Chinese and the US platforms in selected countries. We consulted Alexa, which is a website that ranks the most used websites by country, and AppAnnie, which ranks the most used apps in each country by country of origin, for the websites and apps were then examined as to their country of origin. In addition, we checked to see whether these websites had equity-based relationships with any Chinese or US operating firm. To be clear having an equity investment from a Chinese venture capital firm did not constitute a relationship with China, unless the venture investment came from a Chinese platform firm's venture capital arm. If the Chinese platform firm's venture capital arm had invested that was included as an equity relationship.

4. The first globalization of Alibaba began around 2000 when Alibaba established its core team in Silicon Valley, which was shut down later (Erisman, 2016), while Baidu started its global expansion by launching Japanese search engine in 2007, which was shut down eight years later. See https://www.techinasia.com/baidu-shuts-japan-search-engine.

5. In contrast, the US platforms entered these foreign markets through direct expansion. As we mentioned earlier, essentially anyone can access any platform globally. In the normal sequence events for the English-language websites or apps that successfully globalize, it is introduced in English, but as it adopted internationally, the US firms introduce native-language versions, and soon establish domestic offices for the larger markets (Rothaermel, Kotha, & Steensma, 2006).

6. As important is that online gaming data traffic from 2016 to 2021 is projected to grow at Compound Annual Growth Rate (CAGR) of 57%. In 2016, global Internet gaming traffic was 1% of global consumer Internet traffic and it is projected to be 4% in 2021 (Cisco, 2017).

7. European platforms, with the exception of Spotify, are not significant of their home country and none of them are in the top 50 websites outside their home country – with the exception of some gaming sites. Similarly, Japanese and Korean websites are also seldom of significance outside their home markets. In smartphone app markets, there is slighter greater penetration into global markets by European, Korean, and Japanese apps.

8. On the disputes between Tencent and ICQ, see http://www.project-disco.org/competition/042414-a-tale-of-two-instant-messengers-tencent-aol-and-disruptive-innovation/#.WvcIrpe-nIU.

9. In 2001, the online users of Tencent instant message app reached 1 million. See, The history of QQ at http://www.sohu.com/a/125973649_437281.

10. The Roadmap of Tencent. See https://www.tencent.com/en-us/company.html#company_dev.

11. See, No-one wants to talk about Tencent, the biggest gaming company in the world. https://www.pcgamesn.com/tencent-stock-pc-games.

12. See, This Chinese Tech Giant Owns More Than Riot Games. http://fortune.com/2015/12/22/tencent-completes-riot-games-acquisition/.

13. See, Garena, Southeast Asia's most valuable tech startup, lands additional funding https://techcrunch.com/2016/09/05/garena-southeast-asias-most-valuable-tech-startup-lands-additional-funding/.

14. See, China's Tencent Music Expects a $1B IPO Next Year–It Already Has Double the Paying Users of Spotify. http://fortune.com/2017/12/14/tencent-ipo-spotify/.

15. See, Tencent Music, Spotify's strategic partner in China, is valued at over $12B. https://techcrunch.com/2018/02/28/tencent-music-spotify/.

16. See, seven years of WeChat. https://www.techinasia.com/history-of-wechat.

17. Some have speculated that Tencent with its experience in China with WeChat may be able to assist Snapchat with improving its website and operations (Russell, 2017). However, there is no evidence that this is the case. It may be more likely that Tencent could provide superior technology to the Russian DST or Thai Sanook social media operations.

18. See, "企鹅" 腾讯的国际化全局. http://www.cb.com.cn/deep/2010_0512/129149_4.html.

19. See, Indonesia's Uber rival Go-Jek raises $1.2 billion led by Tencent at a $3 billion valuation. https://techcrunch.com/2017/05/03/go-jek-tencent-1-2-billion/.

20. See, Ola raises $1.1B led by Tencent to fuel battle with Uber in India. https://techcrunch.com/2017/10/10/ola-raises-1-1b-from-tencent-and-softbank/.

21. See, Didi Chuxing, a Chinese Rival to Uber, Raises $4 Billion. https://www.nytimes.com/2017/12/21/business/dealbook/didi-chuxing-softbank-uber.html.

22. See, Supercell Case Study. https://aws.amazon.com/cn/solutions/case-studies/supercell/.

23. Three of these four firms have large equity investments from Tencent.

24. For example, in 2018 Supercell introduced a special Lunar New Year game pack that explicitly appealed to Chinese gamers.

25. See, Softbank to Invest $20 Million In Hong Kong's Alibaba.com. https://www.wsj.com/articles/SB948202996877749173.

26. See Alibaba Group Announces March Quarter 2017 and Full Fiscal Year 2017 Results. https://www.alibabagroup.com/en/news/press_pdf/p170518.pdf.

27. See, Everything You Need to Know about Alipay and WeChat Pay. https://medium.com/@charliecliu/everything-you-need-to-know-about-alipay-and-wechat-pay-2e5e-6686d6dc.

28. See, Alipay enters partnership with VTB to expand merchant network in Russia. https://globenewswire.com/news-release/2017/08/04/1079603/0/en/Alipay-enters-partnership-with-VTB-to-expand-merchant-network-in-Russia.html.

29. See, Ant Financial invests in Thailand's Ascend Money as part of global expansion play. https://www.cnbc.com/2016/11/01/ant-financial-invests-in-thailands-ascent-money-as-part-of-global-expansion-play.html.

30. See, Alibaba to invest $177m in India's Paytm. https://www.ft.com/content/5cbb69bf-a2ae-3288-8500-27656a12067b.

31. See, Alibaba's Ant Financial to invest US$200m in Korea's Kakao Pay. http://www.scmp.com/tech/china-tech/article/2072731/alibabas-ant-financial-invest-us200m-koreas-kakao-pay.

32. See, Alibaba's Ant Financial extends global reach with first investment in the Philippines. https://techcrunch.com/2017/02/20/ant-financial-mynt/.

33. See, Singapore security startup V-Key gets important new investor and customer: Alipay. https://www.techinasia.com/alipay-investor-customer-singapore-security-startup-vkey.

34. See, 专注金融网络安全 ThetaRay 获Alibaba 和 PwC 等大集团青睐. http://www.weiyangx.com/154205.html.

35. See, Baidu gets approval to test self-driving cars in California. https://techcrunch.com/2016/08/31/baidu-gets-approval-to-test-self-driving-cars-in-california/.

36. See, Baidu launches Portuguese search engine. Retrieved from http://usa.chinadaily.com.cn/business/2014-07/24/content_17915623.htm.

37. See, Baidu, China's biggest search engine, has growing ambitions in India. Retrieved from https://www.techinasia.com/baidu-india-ambitions.

38. See, JD's history. http://corporate.jd.com/ourHistory.

39. See, China's JD.com expands operations to Silicon Valley. http://www.scmp.com/business/article/1866876/chinas-jdcom-expands-operations-silicon-valley.

40. For an in-depth discussion of Ctrip, see Shao and Kenney (2018).

41. Priceline is a major investor in Ctrip owning about 9% of the total stock (O'Neill, 2017).

42. See, DiDi completes 7.43 bln rides in 2017. https://article.wn.com/view/2018/01/08/DiDi_completes_743_bln_rides_in_2017/

43. See, China taxi apps Didi Dache and Kuaidi Dache announce $6 billion tie-up. https://www.reuters.com/article/us-china-taxi-merger/china-taxi-apps-didi-dache-and-kuaidi-dache-announce-6-billion-tie-up-idUSKBN0LI04420150214

44. See, Uber China Merges with Didi Chuxing. https://www.uber.com/newsroom/uber-china-didi/

45. See, It Built an Empire of GIFs, Buzzy News and Jokes. China Isn't Amused. https://www.nytimes.com/2018/04/11/technology/china-toutiao-bytedance-censor.html.

46. See, Chinese startup Toutiao raising funds at over $20 billion valuation. Sources: https://www.reuters.com/article/us-china-toutiao-fundraising-idUSKBN1AR0DE.

47. See, How a failed education startup turned into Musical.ly, the most popular app you've probably never heard of http://www.businessinsider.com/what-is-musically-2016-5.

48. See, Yiming Zhang: The Keyword for Toutiao in 2018 is Globalization. https://pandaily.com/yiming-zhang-the-keyword-for-toutiao-in-2018-is-globalization/.

49. The fierce competition could be seen from the recent case between Toutiao and Baidu. See, Toutiao is suing Baidu for unfair competition after (alleged) biased search results and security warning. https://technode.com/2018/01/30/toutiao-baidu/.

50. See, Wikipedia of Vipshop. https://en.wikipedia.org/wiki/Vipshop.

51. See, Vipshop Revenue, Profits – VIPS Annual Income Statement. https://amigobulls.com/stocks/VIPS/income-statement/annual.

52. Alibaba and JD occupied most of the domestic e-commerce market. For example, in the last 11.11, Chinese shopping festival similar to Black Friday in the western world, Vipshop only took 3.43% of the total sales while Alibaba and JD took 66.23% and 21.41%, respectively. See, "双11"澎湃消费新动能(经济聚焦). http://paper.people.com.cn/rmrb/html/2017-11/13/nw.D110000renmrb_20171113_2-22.htm.

53. The original WeChat English version was merely a skeleton of Chinese version, reflecting Tencent's strategy that domestic market is of the most important position. See comments like https://www.fastcompany.com/3060494/why-chinas-biggest-social-app-has-sputtered-overseas.

54. See comments like http://blog.btrax.com/en/2017/10/25/asias-battle-of-the-messaging-app-wechat-vs-line-vs-kakaotalk/.

55. MoneyGram is of vital importance for Ant Financial to become a global powerful payment platform (Bukhari, 2017).

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CHAPTER 9

NEW DIGITAL LAYERS OF BUSINESS RELATIONSHIPS – EXPERIENCES FROM BUSINESS-TO-BUSINESS SOCIAL MEDIA

Susana Costa e Silva and Maria Elo

ABSTRACT

Contemporary businesses face rapidly evolving changes and complexities that challenge their respective managerial responses and capabilities. The natures of information and communication systems, ways of doing business, knowledge-transfer methods, diffusion channels of innovation, and industrial habitus are shifting. Additionally, methods, concepts, and frameworks to study these challenges need to be in accordance.

Many of these features characterizing the new business environment influence not only the consumer business, but also the business-to-business (B2B) sectors and their ways of functioning. Interestingly, the influence also connects domestic with international business through the global connectedness. This is particularly visible in marketing communication, as the difference between domestic and international business communication has further diminished due to digital and virtual dimensions and applications. In this new age, it is assumed that new ventures and small- and medium-sized enterprises can turn their vulnerabilities and size constraints into competitive advantages by addressing

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these challenges with efficient social media usage. To address this technology-enabled dimension of B2B relations, the authors present a case study illustrating how a firm advances its relationship management and communication by introducing social media instruments. The study contributes to relationship management and international marketing communication and provides new insights into the workings of social media within the B2B context.

Keywords: *Business-to-business* companies; internationalization; digital relationship management; social media; Facebook; LinkedIn; Shortcut

1. INTRODUCTION

Communicating effectively through social networks is of growing importance for businesses. However, successful incorporation of such channels in the communication strategies of business-to-business (B2B) companies is not an issue as linear as for business-to-consumer (B2C) firms. B2B companies establish fewer relationships than B2C do; however, when established, these connections are more intense and direct and are based on trust (Lacka & Chong, 2016; Silva, Bradley, & Sousa, 2012). Digital relationship management has arrived in B2B business. When communicating with stakeholders, B2B companies tend to rely on Facebook and, particularly, LinkedIn (Siamagka, Christodoulides, Michaelidou, & Valvi, 2015). These channels are used to promote their brands and engage customers, especially by sharing informational brand content with links for information searches (Swani, Milne, Brown, Assaf, & Donthu, 2017).

The digital era and competitive environment demand intelligent solutions for business and marketing communication, both internal and external; in addition, at the same time, they set new pressures to address the “multilayeredness” of contemporary business relationships (Gronroos, 1994; Paswan, Blankson, & Guzman, 2011). First, the roles of seller–buyer relationships are becoming more complicated through co-creation of value and stakeholder integration (Banyte, Gudonaviciene, & Grubys, 2011; Payne, Storbacka, Frow, & Knox, 2009) and the ways of staying in contact with these actors are radically changing and getting more complicated and more digital (Brouthers, Geisser, & Rothlauf, 2016; Owen & Humphrey, 2009). Second, the business relationships and customer bases are becoming increasingly international – or, are at least subject to international competitive pressures – and even small firms may develop international sales and internationalize rapidly (Alcácer, Cantwell, & Piscitello, 2016; Moen & Servais, 2002; Oviatt & McDougall, 2005; Terjesen & Elam, 2009). For software-information and communications technology (ICT) companies especially, there are studies pointing out that these firms’ internationalization processes tend to be facilitated by the use of networks and network resources, such as the ones the firm can indirectly access through its partners (Coviello & Munro, 1997; Ibeh & Kasem, 2011; Johanson & Mattsson, 2015). Internationalization may be more reactive to customer pull, or more active, through targeted marketing and networking activities abroad, but ownership, network, and digital and other configurations also influence internationalization (Alcácer et al., 2016; Elo, 2016; Johanson & Vahlne, 2009).

Given that the competitive landscape has changed toward more internet and digital businesses, and that ICT companies are more technologically affine, it could be assumed that these firms are potentially better equipped to address the challenges of coping with internal and external marketing communication and digital customer relationships also internationally, in a similar way that emerging market firms may employ their particular capability to compete in institutionally demanding contexts (Kotabe & Kothari, 2016). Since many ICT and software firms are built around a service concept and some key customers, their needs, and their interests, it could be expected that the firms actively employ digital means and social media to engage customers for co-creating and developing their offerings and, indirectly, for obtaining sales and internationalization (Agnihotri, Kothandaraman, Kashyap, & Singh, 2012; Elo, 2016; Payne et al., 2009). Beyond engaging external actors and stakeholders, social media also allows firms to improve internal communication and cooperation, especially in organizations in the international context, due to its low costs and efficiency (Gronroos, 1994; Liesch & Knight, 1999; Thoring, 2011).

Thus, this study addresses a contemporary start-up in IT business and reflects on its social media strategy development. The goal of this study is to solve a problem raised by a B2B IT company – Shortcut – and that has to do with how B2B small and medium-sized enterprises (SMEs) can embrace social media effectively, especially through Facebook and LinkedIn, to promote online brand awareness and engagement across borders.

The study is organized as follows: first, it discusses theories that provide explanations on respective B2B marketing communication and social media. Second, it presents the selected research approach and logic. Third, it showcases the firm and its strategy development on social media. Fourth, it discusses the findings and presents the conclusions.

2. THEORIES ADDRESSING DIGITAL RELATIONSHIPS IN B2B

Business communication, to customers, partners, and stakeholders, has radically evolved in terms of channels and systems, as virtual and digital applications have entered the field, as is the case of e-businesses challenging brick-&-mortar markets (Brouthers et al., 2016). New business models emerge to serve markets that have previously been too small, too dispersed, or too insignificant to be served. Notably, internet-based systems allow different scaling of such businesses and development of new innovative solutions (Chesbrough, 2007). The case of Thamel.com provides an example of this new dynamism from the grassroots-level, providing culturally customized products and services in the digital environment (Riddle & Brinkerhoff, 2011), which was not possible before. So, we can say that this new age has challenged the way firms position themselves in the market, solving some previous problems related to scale, on one hand, but raising new ones, such as the fuzzing of industry contexts and borders, on the other hand.

As a result of new competitive pressures, communicating effectively through social networks is of growing importance for businesses. Social media and the internet allow participants to act in a new "business-scape" following flows in the media-, techno-, finance-, ideo-, and ethnoscapes (Appadurai, 1990; Powell & Steel, 2011), which is not hindered or restricted by geographies. They allow firms to communicate across borders very efficiently and cheaply (Swani et al., 2017; Vasilchenko & Morrish, 2011). As a result, consumer businesses in particular have rapidly internalized strategies and tools to communicate with consumers and users of social media (Gerlitz & Helmond, 2013). The roles of business actors have changed as well. For example, the rigid seller–buyer divide gets diluted as customers are more integrated, they can be co-developing and creating the products and services in line with open innovation and firm tasks can be distributed across different contexts (Bogers & West, 2012; Gassmann, Enkel, & Chesbrough, 2010; Lee, Park, Yoon, & Park, 2010). Novel actor types, such as platforms, virtual intermediaries, and bloggers, have emerged and challenged ways of doing things within and across businesses and different participants in the economy and society (Chesbrough, 2007; Kenney & Zysman, 2016). These developments can be seen as new types of actors or firms, but they also emerge as market co-creators, shapers, and change agents (Payne et al., 2009; Schumacher & Feurstein, 2007). The distribution of roles and tasks seems to become more diffuse and dispersed, which may cause additional challenges for marketing communications and relationship management (Bollers, 2013; Kotler & Mindak, 1978; Paswan et al., 2011).

Under contemporary circumstances, extant firms and start-ups must face these new, more multilayered demands for organizing their competitiveness (Alcácer et al., 2016; Kumar, Mudambi, & Gray, 2013; Rifkin, 2012). Enterprises active in B2B have partly incorporated new systems and strategies, but there is still a lot of hesitation regarding the potential of social media and the respective cost-benefits (Siamagka et al., 2015). In traditional industries, many managers have been surprised by the complexity of the Like economy and its management (Gerlitz & Helmond, 2013). In the B2B context, there are firms that are not prepared to accommodate new communication tools and strategies related to social media, as they are considered more relevant for consumer businesses. It seems that successful incorporation of these channels in the communication strategies of B2B companies is not as simple as it seems to be for B2C firms.

This sector difference of B2C and B2B in responding to social media can be explained by the magnitude of the communication, differing significantly between mass communication, and more selective key account systems (de Vries, Gensler, & Leeflang, 2012; Lacka & Chong, 2016). As previously noted, B2B companies establish fewer relationships than B2C, but these relationships are more intense and direct, and are based on trust (Lacka & Chong, 2016). More importantly, B2B business relationships are about value-creation processes, profitability, competitiveness, even livelihood, and corporate survival, which suggests a different architecture for the business model (Teece, 2010). This causes these relationships to be highly loaded with expectations concerning reliability, trustworthiness, commitment, accountability, and ethics (Canavari, Fritz, Hofstede, Matopoulos, & Vlachopoulou, 2010; Doney, Barry, & Abratt, 2007; Gilbert, Rasche, & Waddock, 2011; Wu & Li, 2009). However, despite the fact that many B2B firms, especially multinational enterprises (MNEs), can have very limited numbers of direct buyers, their end-customers and users can be numerous and require a social media strategy – at least for their interface with the firm. It has become apparent that sales and marketing communication require approaching social media as one potential tool (Agnihotri et al., 2012). This potential remains to be better understood, especially because its character and usage may differ from B2C businesses (Jussila, Kärkkäinen, & Aramo-Immonen, 2014).

Trade marketing, trade partner, and distributor context represent another more crucial interface between the original seller and the reseller. This nexus of marketing operations, that is, trade marketing, has gained less attention regarding communication, despite its critical role in connecting the company to the markets (Bollers, 2013; Tadajewski, 2009). Especially for communicating with stakeholders and addressing opportunities (Jussila et al., 2014), B2B companies often rely on Facebook and, particularly, LinkedIn (Siamagka et al., 2015), but Twitter is also used (Thoring, 2011). However, country-related differences are notable due to different approaches and regimes (Crampton, 2011; He & Pedraza-Jiménez, 2015). In general, firms use social media channels to promote their brands and engage customers, especially by sharing informational brand content with links for information searches and exploring business opportunities (Jussila et al., 2014; Swani et al., 2017). In B2B businesses, additional value creation for communication, and especially more emotional engagement and relationship building are mainly targeted when using social media (Swani et al., 2017). Social media employment may foster trust building and support business relationship care. Such care is vital for complicated industries, such as IT, and for captive relationships triggering concerns about the possible outcomes (Canavari et al., 2010; Doney et al., 2007; Ibeh & Kasem, 2011; Tadajewski, 2009). Social media seems to affect customer engagement, which in turn is known to improve customer influencer behavior and acquisition of customers, as well as prospects (Kumar, Aksoy, Donkers, Venkatesan, & Tillmanns, 2010).

In terms of geographies, the digital age and its changes facilitate international expansion (Alcácer et al., 2016; Kumar et al., 2013; Vasilchenko & Morrish, 2011). First, it forces even small and domestic firms to face international competition as local competitiveness might no longer be enough (Porter, 2000). Second, it allows any firm to connect internationally more easily than earlier and with lower costs (Johanson & Mattsson, 2015; Johanson & Vahlne, 1990). The internationalization processes of small and medium-sized enterprises have changed over time, and today, a rapid expansion – even virtual expansion – is more feasible than before (Madi, 2016; Madsen, 2013; Ruzzier, Hisrich, & Antoncic, 2006). Thus, the meaning of location as a constraint may require revisiting in many cases (cf. Porter, 2000). Peripheral contexts and small size are no longer automatically impediments for internationalization and developing competitive products and solutions for markets (Silva & Elo, 2017).

3. RESEARCH APPROACH

This is an exploratory study examining a single case company and its emerging social media strategy (Marschan-Piekkari & Welch, 2004). A single case study is considered appropriate as we attempt to understand a complex real-life phenomenon, namely, the intersection of a firm and the role of social media and its application process in the firm strategy, and reflect on the extant views on marketing communication theory (Eisenhardt, 1989). The study analyzes the novelty of the approach in the firm context, the introduction of the new strategy, following its outcomes in a stakeholder-recipient context; thus, it takes an embedded processual logic (Halinen, Törnroos, & Elo, 2013). A part of the study can be considered action research as the case also involves a section where the university–student–firm interface interacts and co-develops the strategy toolbox and social media activities (Johnstone, 2007; McKay & Marshall, 2001).

We have selected purposefully an IT company from a small European country, because such cases are theoretically interesting; there are previous studies explaining IT firm internationalization processes and how they have evolved in a network context (Brouthers et al., 2016; Coviello, 2006; Coviello & Joseph, 2012; Coviello & Munro, 1997; Ibeh & Kasem, 2011). The extant knowledge suggests that the meaning of relationships and the content of these relationships' specific strategies and related communication form the essential elements for international expansion and success. Thus, we contribute to illustrating the workings of the new era on the same firm type that has been previously studied, and focus on examining the communication perspective and the employment of social media in a firm's strategy dealing with its partners and customers and other stakeholders.

The data collection is qualitative and builds on interviews with the firm's management and stakeholders, on ethnographic visiting and observations as well as field notes (Johnstone, 2007; Marschan-Piekkari & Welch, 2004; Silverman, 2006). Beyond this primary data, secondary data have also been collected from company documents, news, internet, and other print and marketing material, and triangulated (Denzin, 2012; Heath, 2015).

The data collection took place between January and November 2017. The first phase of data collection was organized in the firm's facilities, using an interview guide prepared on the basis of the literature review on digital communication in the B2B setting that served in guiding the in-depth discussion. The interviewees include top management, such as the chief executive officer (CEO) of the company, two IT managers, and the chief human capital officer. The data were collected by a native Portuguese team of researchers who acted in the role of an observant researcher and as interviewers, using Portuguese language for the higher quality of research data, its interpretation, and contextual understanding (Kanuha, 2000). The second phase of interviews, in late 2017, focused on the follow-up of the established process and took a more retrospective view in addressing the process. Thus, in terms of time, different sets of references from different parts of the process have been collected to provide a rich data on the activities, outcomes, and perceptions. The data are analyzed using progressive logic, that is, going back and forth between empirical data and theories, and framing it chronologically and processually as a case study (Halinen et al., 2013; Jones & Coviello, 2005; Sinkovics & Alfoldi, 2012).

4. MANAGING SOCIAL MEDIA FOR B2B COMPANIES – SHORTCUT CASE STUDY

Founded in 2001, Shortcut is a Portuguese B2B company that develops customized software for companies and outsources IT services. It is located close to Porto; it has 21 employees, a turnover of 0.9 million Euros, and an Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA) of 57.000 Euros (data of 2016). Shortcut's core product is pplPortal, a human resources management software platform. Shortcut's customers are firms that use the application for their management. Therefore, the company has both the product and service dimension in its marketing communications (Agnihotri et al., 2012). It operates within the Portuguese market, but it also has international operations in Spain, the United Kingdom, Angola, and Brazil. These markets are not all neighboring markets with low geographical and psychic distance; instead, they are foreign markets with notable cultural and linguistic relations, with Portuguese diaspora and social relations, and even colonial ties. This results in the social aspect of marketing and business communications having more impetus originating from inherent behavioral and social expectations (Agnihotri et al., 2012; Madi, 2016). The business model and the product are also service-oriented, which further underlines the role of B2B communication (Doney et al., 2007; Lacka & Chong, 2016; Siamagka et al., 2015).

The strategy of Shortcut is service oriented, it aims to apply know-how and creativity to the development of innovative IT solutions, as well as helping customers to optimize and improve their processes. They support their B2B customers to create value in their organizations and processes. It also outsources ICT services that address the needs of their B2B customers. The corporate objectives and values of Shortcut are defined as the excellence and innovativeness of its service. Here, they focus on the satisfaction and trust of their clients, which are essential for the successful value creation process in these IT sourcing processes (Kotabe & Mudambi, 2009). In addition, Shortcut has a corporate social strategy that supports the well-being of its employees.

4.1. Shortcut's Strategic Social Media Problem

As is the case for many small and medium-sized enterprises and B2B companies, the firm has had difficulties in approaching social media and shaping an appropriate strategy for its digital and social communication needs (Silva, Roxo, & Pereira, 2017). As an IT company, Shortcut felt the pressure of the era and the need to create an online presence beyond just its company website. Therefore, in the early social media introduction phase, it followed the wave of the majority of businesses, and joined Facebook and LinkedIn as a company. Initially, this was an uncoordinated and emerging process where both its Facebook and LinkedIn profiles contained outdated information, and there was no standardization regarding the language or the frequency of posts. There was no one voice policy application or strategy in marketing addressing the important customer relationships or potential customers (Gronroos, 1994; Kotler & Mindak, 1978; Payne et al., 2009). Indeed, in this introduction phase, the firm acknowledged that despite being present on social media, it did not have a delineated strategy that guided its social presence. It mainly shared similar information on both Facebook and LinkedIn, such as photos and news about corporate events and anniversaries. At this phase, Shortcut had 495 fans on its Facebook page, and 908 followers on LinkedIn.

The company recognized the potential and the lack of coherent strategy to exploit the potential. Therefore, it outlined a strategy for the management of its Facebook and LinkedIn profiles to promote growth and expansion and communicate with its customers and stakeholders. This was explained by Shortcut management as follows:

> Social media has mainly 2 objectives for Shortcut: improve the brand reputation in its market and create a reputation among its employees (actual and potential). In order to achieve the first objective we divulge news/articles related to IT, innovation, people management, etc. As for the second objective, besides the just mentioned actions, we also divulge actions that involve our current team members. (Interview, 2017)

4.2. A Toolkit for B2B Companies: Shortcut's Strategy Development

The second phase, referred to as the growth of digital presence, started with strategic steps. It was clear within the management that Shortcut needed to utilize some resources to improve its digital presence. First, it needed one person who was dedicated to this area, who would be responsible for defining the strategy, delineating the intended target, and creating regular and homogenized content. Therefore, the company decided to allocate one person to social media management. The current situation of the company was assessed by a team of management and university students and professors, and, using an action research approach (McKay & Marshall, 2001), a toolkit was then co-developed (see Fig. 1) to assist managers during the strategy delineation.

First, as such strategy is challenging and no prior strategy existed, a first framework was created. Also, in theory literature, there is very little suitable management research on B2B sector providing support. The strategic management of social media is not an easy task, not only because it means that customers and firms are always connected and in potential interaction, but also because a consolidated and tested framework to apply to companies is, as yet, lacking. This critical challenge was faced by the team, composed of company and university members and with the development of a toolbox for the strategy definition. This was based on insights derived from the literature and reflected on the company and as a result, a conceptual model (see Fig. 1) was developed with the goal of solving Shortcut's problem in coping with social media and marketing communication.

The toolkit developed is the part of an iterative process that starts with the delineation of the firm's objectives, and then analyzes the competitors' online presence and segmentation of the target market, assessing and comparing their strengths and weaknesses, and benchmarking the best elements for marketing and customer communication (Levy, 2011; Teece, 2010). This assessment also entails creating content and its respective systems. Finally, after analyzing and comparing results according to the established indicators and elements, the management restarts the cycle by adjusting the objectives, strategies and tactics (Chesbrough, 2007; Kotler & Mindak, 1978).

The five blocks that define the social media strategy in this B2B context are depicted in Fig 1.

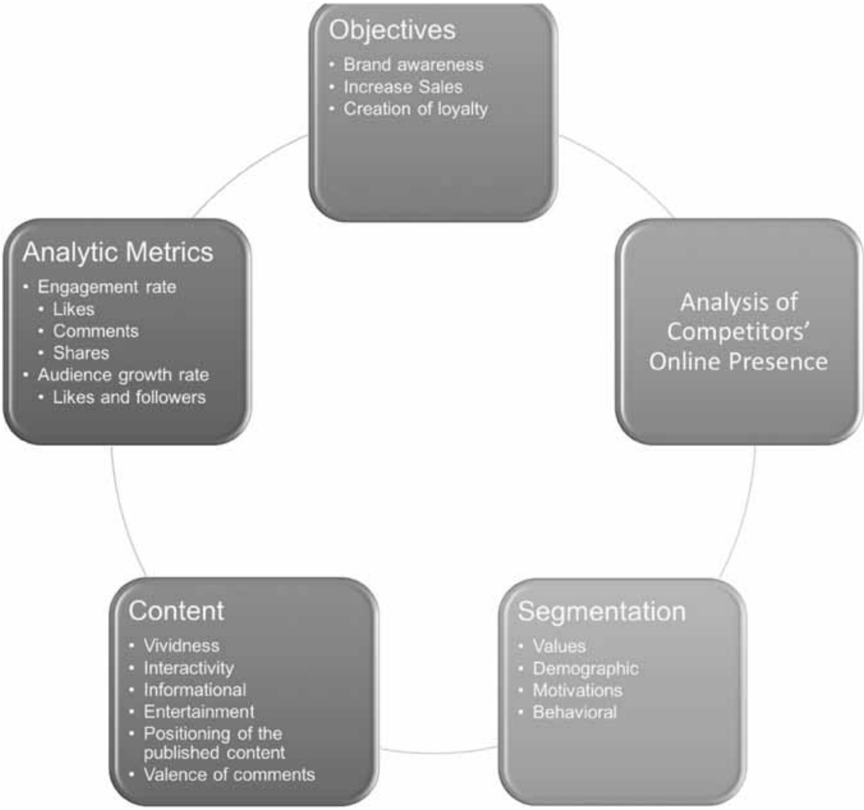

Fig. 1. The Five Blocks of Social Media Strategy. This Is an Iterative Toolkit. after Reaching the Step of Analytic Metrics, the Cycle Starts again with Adjustment of the Objectives.
Source: Adapted from Agnihotri et al. (2012), Coelho, de Oliveira, and de Almeida (2016), de Vries et al., (2012), Levy (2011), and Madi (2016).

4.2.1. Objectives

Objectives help to lay the pathway that the firm should follow. Shortcut set the following goals: increase brand awareness, increase sales, and build stakeholder loyalty. More precisely, an increase in brand awareness can be achieved in various ways, such as by increasing the number of followers/likes of the page, or by increasing the engagement rate with shared content.

Therefore, to reach more users in the network organic strategies can be used, such as:

- increasing the effectiveness of the published content (by focusing on characteristics of the content regarding length, type, and sharing timing, thereby reaching more people);

- growing the size of the network (using a holistic approach that helps to increase the effectiveness of all content published on the page); and
- additionally, paid promotion that increases the reach of publications, beyond organic promotion.

4.2.2. Analysis of Competitors' Online Presence

Analyzing competitors' online presence helps to illuminate how other firms behave in the online environment, thereby providing insights into how the company should approach its own presence in these channels.

4.2.3. Segmentation

In order to influence the intended target consumers in the online environment, the company conducted market segmentation, taking into account the particularities of each social network. Thus, the market can be segmented with consideration of users' motivations to use social networks, demographic factors, values, and behaviors.

Motivations may include socialization (seeking emotional support, belonging, and friendship), entertainment, self-status (expression of one's identity), and the quest for information (exchange of information between the company and consumer). Concerning demographic factors, we can highlight gender and age (differences arise according to whether the target is male or female, and there is also a distinction between users aged under 30 vs over 30).

For Shortcut strategy, the following three segments were constructed based on values, behaviors, and motivations:

- *Self-preservers*: This segment has the highest rate of interaction and is more motivated by information, as well as being older than the other segments.
- *Social-entertainers*: This segment is the most motivated by entertainment, is more active in the network, has the lowest rate of interaction, and is the youngest.
- *Achievers:* This segment is the most goal-oriented and self-focused, and does not have high interaction rates or buying intentions.

4.2.4. Content

Regarding the type of content to be published on social networks, it may convey interactivity, information, entertainment, and vividness. Moreover, two other factors influence interaction: the position of the published content and the valence of users' comments (in response to the content published). Thus, the main factor to keep in mind is that content must be created to meet users' needs and expectations. Therefore, users should be influenced by the company's internal and external information. It should also be noted that published content can contain text, images, or videos, as well as links to other websites.

Vividness is characterized by the presence of images or videos, that is, the more visual features a post has, the more vividness it will portray. *Interactivity* refers to the level of interaction that users can have with the post (e.g., the post might have a link that redirects to another website, thus increasing the level of interactivity). However, there is no evidence that the higher the interactivity level, the more interaction the publication will have, thus suggesting a linear degree of interactivity. *Informational* content is characterized by the sharing of information about brands or products/services. Consumers tend to have a more positive attitude toward posts with a higher informational level compared to those that convey non-informational content, because consumers prefer verifiable brand information and more rational appeals. *Entertainment* posts, on the other hand, involve more fun, fashionable, and flashy features, and enhance users' attitude toward the brand, as well as their desire to visit the brand website. The *positioning of the published content* refers to the fact that the longer the post stays at the top of the page, the more likely it will be to generate higher levels of user interaction. *Valence of comments* refers to the kinds of comments that a post attracts; these may be negative, neutral, or positive. Briefly, such comments affect users' perceptions of the brand, depending on whether they are positive or negative.

This suggests that B2B users, when compared to B2C, are characterized by having a greater perception of risk and tend to look for more information about products/services. They also react more positively toward informative content regarding brands/products than to entertainment content. In professional networks, the information is perceived as more trustworthy than in non-professional ones, which is why these channels are the object of research by potential clients of B2B companies. Thus, in these networks, the shared content must be related to the industry and brand, and these characteristics must be conveyed via more informational content.

4.2.5. Analytic Metrics

The metrics that can be used to assess the results of the strategy implemented in social networks can be divided into two categories: growth rate and engagement rate. The former is defined by the growth in the number of followers and likes of the business profile page, and the latter by the number of clicks, likes, comments, and shares of posts. These data can easily be collected through existing social networking tools.

4.3. Implementation of the Five Blocks of the Social Medial Toolkit

After developing the toolkit, the implementation of the new strategy took place. As previously mentioned, the implementation started with a situation where Shortcut's Facebook profile had 495 followers and its LinkedIn page had 908 followers, while both profiles of the firm contained outdated information without any specific person in charge of social media management. There was also no homogenization of the published content regarding the language or target audiences, which was obviously not appropriate for a company aiming at the international market, no schedule for content sharing, and a lack of coordination of efforts. In short, no strategy existed prior to this development. After the company recognized this gap in its B2B marketing communication strategy, it became evident that it needed to become more familiar with the social media landscape. The strategy and toolkit development and its implementation was put forth in order to solidify and enhance its presence in multiple communication channels in parallel (Owen & Humphrey, 2009; Paswan et al., 2011). In addition, these channels could advance the required trust building, addition of informational and emotional elements as well as the density and strength of the relationships with stakeholders and customers (Canavari et al., 2010; Doney et al., 2007; Sinkovics & Alfoldi, 2012).

During the planning and implementation phase, special attention was paid to the development of informational content in international marketing communication, with attempts to increase its vividness by inserting images and hyperlinks (it was decided not to include videos), and the institutional "fixed information" was updated. These updates pertained to the organic promotion of the profile pages. Classic marketing communication directed toward the target audience was also tested in this B2B context when a paid promotion was conducted on the Facebook page, which involved investing 28 Euros and reached almost 12,000 people, with 120 clicks on the posts. However, it was not possible to validate the relation of this information to the rise in the number of likes on the Facebook profile page; thus, the liking behavior requires additional understanding (de Vries et al., 2012).

Regarding the LinkedIn profile page, the firm did not use any paid promotion. Instead, LinkedIn strategy was about awareness and interest increase and informing the B2B segment about the firm's solutions (Gronroos, 1994). LinkedIn allows for the creation of a company showcase page, which enabled the creation of a LinkedIn profile to promote Shortcut's human resources management software pplPortal. In this social media channel, images and text were adapted from Shortcut's website, with the aim of projecting a coherent image and communication style across the different channels (Banyte et al., 2011; Owen & Humphrey, 2009; Paswan et al., 2011).

Table 1 synthesizes the strategies implemented before and during the period of study (between September 2016 and January 2017). Each strategy is divided into blocks, and some operationalization examples are provided. The company concentrated on two channels: Facebook and LinkedIn. Twitter or other alternatives were not chosen in this phase (Thoring, 2011).

The impact of the aforementioned actions was analyzed using the statistics available on both Facebook and LinkedIn as an additional assessment instrument. Therefore, an overview of the results was obtained regarding the implemented strategies in terms of the variation in the number of followers, engagement rate (here represented by the interaction rate), and content. This is organized according to the strategy changes, chronologically and thematically, using the toolkit elements.

Implementation of the "five blocks toolkit" yielded an increase in the number of followers. More precisely, on Facebook there was a 12.7% increase in followers,

Table 1. Strategies Implemented before October 2016 and between October 2016 and March 2017.

	Strategies before October 2016	Strategies between October 2016 and March 2017
Objectives	Facebook: • Few posts about internal activities. Several were related to anniversaries and special events, containing mainly photos • Repetition of previously shared content with the goal of trying to reach more people LinkedIn: • The page was in English, showing an interest in potential international customers	• Facebook and LinkedIn used to raise online brand awareness and increase the existing number of followers
Analysis off competitors' online presence		• A benchmark study of Shortcut's main competitors (e.g., PHC Software, Arquiconsult, and Hydra IT) was conducted. It became clear that their online communication strategy consisted of sharing content related to internal activities, as well as informational content regarding the industry to which they belong
Segmentation		• The age and gender of the company's customers (males and females aged 30–65 years old) were identified. • This information was complemented with the characteristics of users who have the highest interaction rate in the networks (i.e., self-conservers, who have high engagement, same ages, and are motivated by informational content)
Contents		• Informational content was developed with the use of texts and images, and, where possible, hyperlinks. • As Shortcut did not have enough internal activities to sustain regular posts on company activities, a portfolio of websites related to its industry, the company, and its products was created
Analytic metrics		• The following metrics associated with the delineated objectives were used: • Variation in the number of followers of the profiles pages • Evolution of the engagement rate of the shared publications • Both types of data were collected on a monthly basis

whereas on LinkedIn followers increased by 5% (see Fig. 2). It should be noted that these differences in results might be due to the paid promotion that was conducted on the Facebook page.

The content shared on Facebook was assessed taking into consideration the engagement rate (that aggregated post likes, shares, and comments). In total, 70 posts were published, which can be divided into three categories: information from external sources, information from internal sources, and entertainment (see Fig. 3). A total of 50 posts were from the category of information from external sources, which gathered an average engagement rate of 5%, reaching 4,563 people. There were 17 posts using information from internal sources, and these had an average engagement rate of 6.41%, and reached 26,086 people. Entertainment posts had an average engagement rate of 3.33% and reached 625 people. Therefore, it was proven that informational content yields more awareness in a B2B context than the entertainment content does.

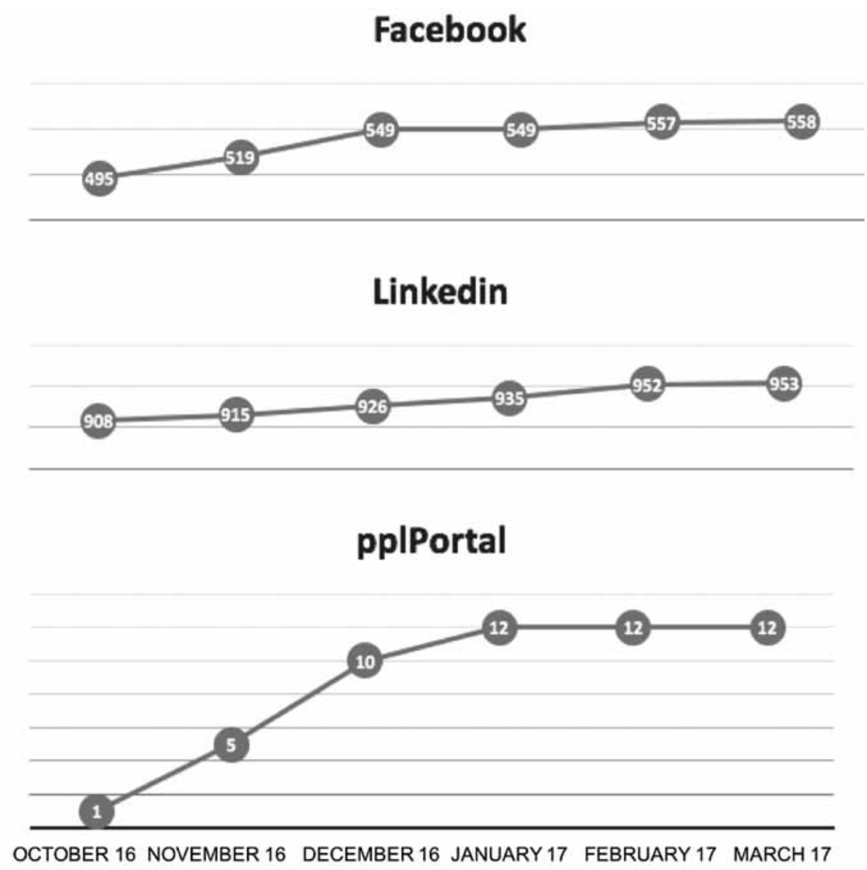

Fig. 2. Evolution of the Number of Followers.

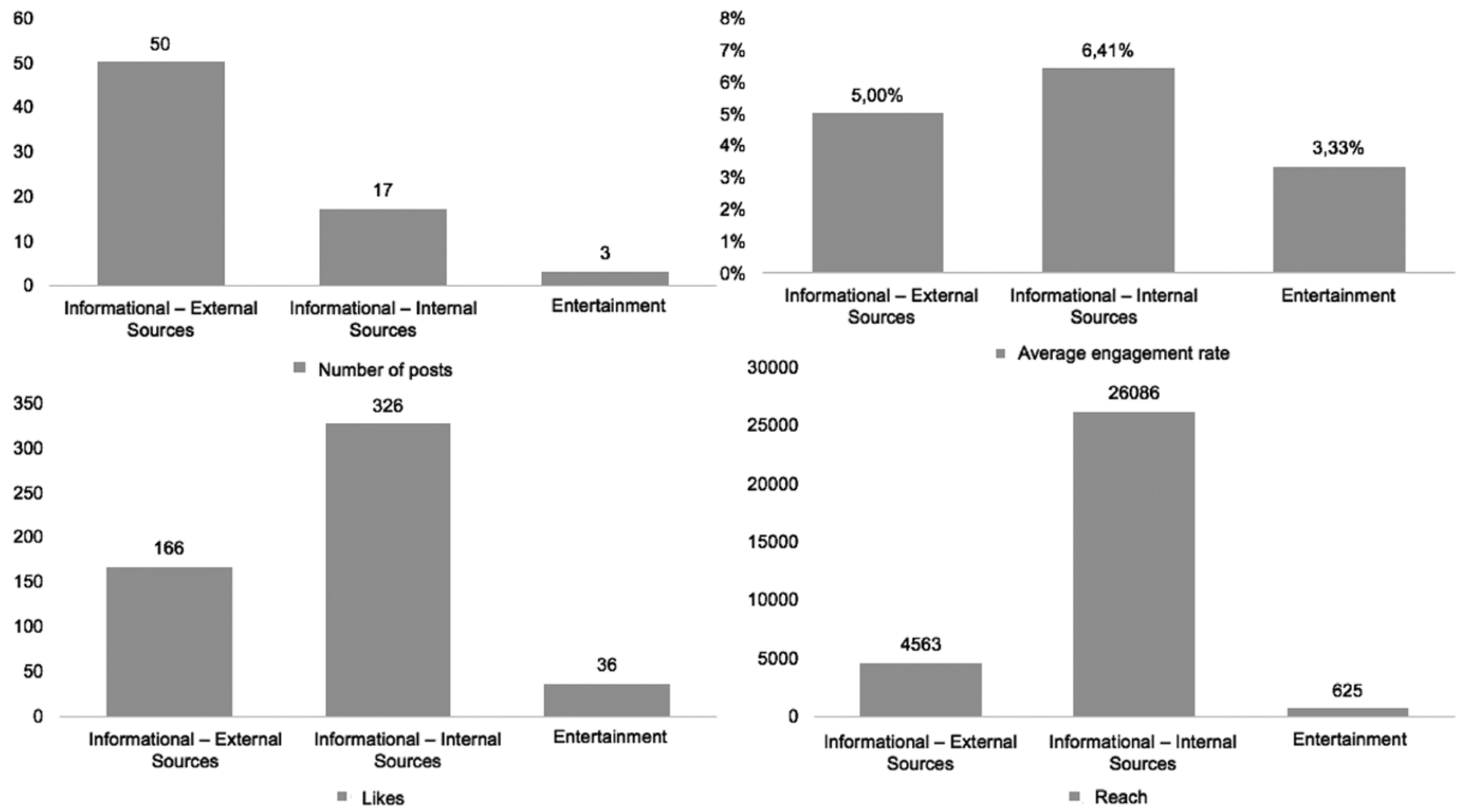

Fig. 3. Final Results of the Strategy Implementation Regarding the Number of Posts, Average Engagement Rate, Number of Likes, and Reach on Facebook.

Regarding the content shared on LinkedIn, and using the same metrics as used for analyzing Facebook, 42 posts were published, which, due to the more professional dimension of LinkedIn, were focused on informational content rather than entertainment. Therefore, here the content was split into information from internal–external sources.

A total of 26 posts comprised information from external sources, which had an average engagement rate of 0.847%, reaching 9,490 people, and 13 posts contained information from internal sources, reaching 8,058 people, with an average engagement rate of 1.09% (see Fig. 4). Similarly to what was found for Facebook, informational content from internal sources outperformed that from external sources.

The results of the first test strategy were positive, and the company acknowledges these outcomes. Therefore, a continuation is expected later:

> After your student left, we didn't have anyone else 100% dedicated to social networks. We feed the social networks more sporadically and in not such an organized manner. On the basis of the experience we have been having now, we are coming to the conclusion how important was the work conducted by XXX[1]: we understand that we need to have a more active and regular presence online, releasing publications and information that is relevant for our clients and for others that may be interested in our products/services. So, this is a topic that we are planning to reintroduce in our activities for 2018. (Interview, 2017)

The evolution of Shortcut's online presence before and after implementation of the five blocks is summarized in Fig. 5.

The company points out the difficulty in addressing the social media strategy and its outcomes from a causality point of view:

> We believe it is not easy to find a direct relation between the two things. However, we believe that our brand awareness improved and that it became easier to promote commercial contacts through LinkedIn, for instance. (Interview 2017)

Concerning the internationalization process, the firm follows a network-enabled internationalization where the international customers possess the initiative and act as reseller-exporters for other markets. Thus, it can be seen as a more passive and reactive internationalization strategy as the business is perceived as "domestic", that is, the internationalization here happens at "home" (Turunen & Nummela, 2016):

> We do not have any office abroad. We have clients in the UK and in other markets such Brazil and Angola but with products that we designed for them to use. But we consider them as domestic clients. They export those products to the international markets after. So, we may say this is more a technological partnership that we have with these clients of us that are doing business abroad. The weight of international direct clients in our sales is purely symbolic (less than 5%). (Interview 2017)

However, the firm actively develops its technological assets and capabilities, also with external partners, and communicates these capabilities in promoting their technological dissemination. This underlines the technological emphasis (cf. product focus) in the marketing communication instead of social emphasis (cf. customer-user focus) (Vandermerwe, 2004). Partly, the blurred boundaries between customer and partner roles explain the shared value creation logic:

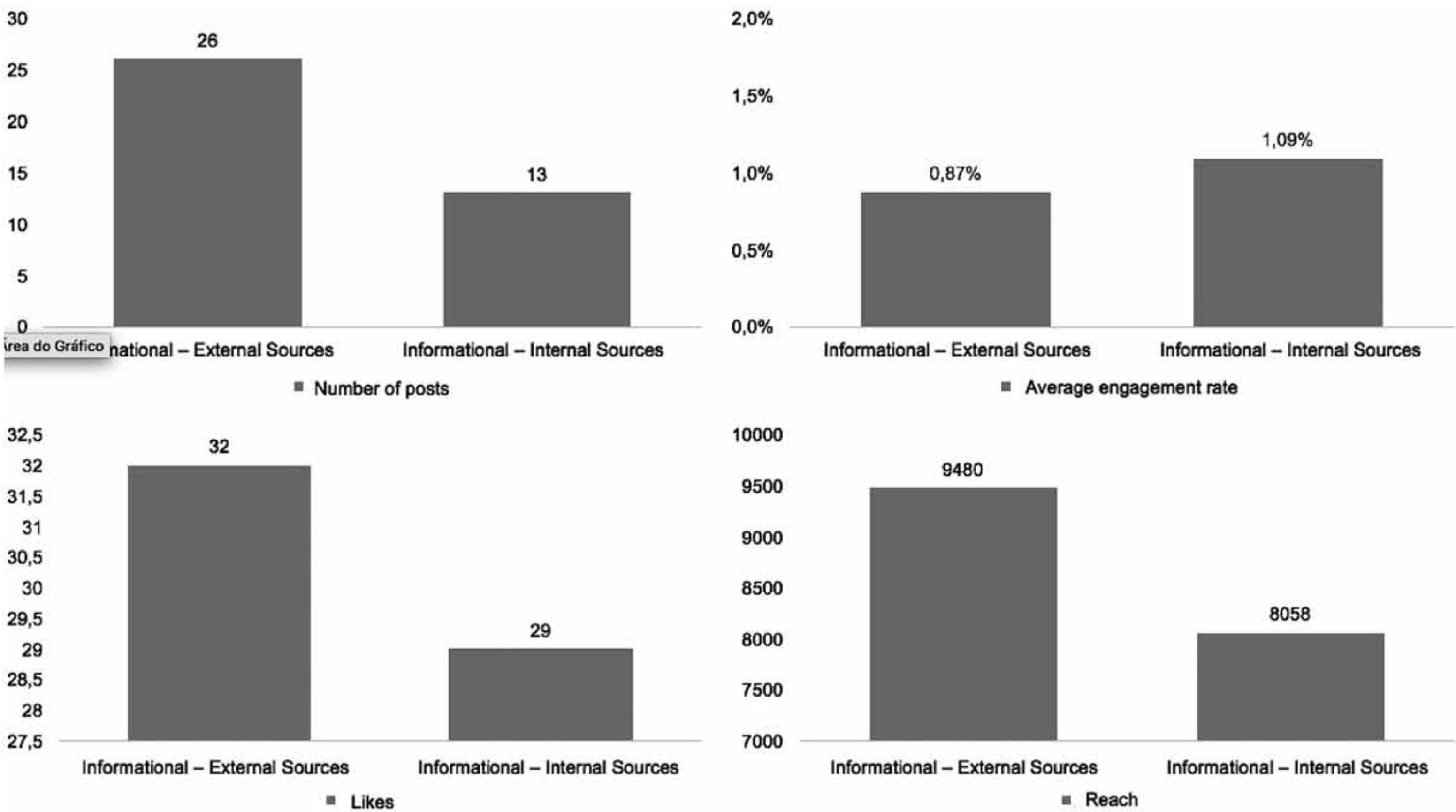

Fig. 4. Final Results of the Strategy Implementation Regarding the Number of Posts, Average Engagement Rate, Number of Likes, and Reach on LinkedIn.

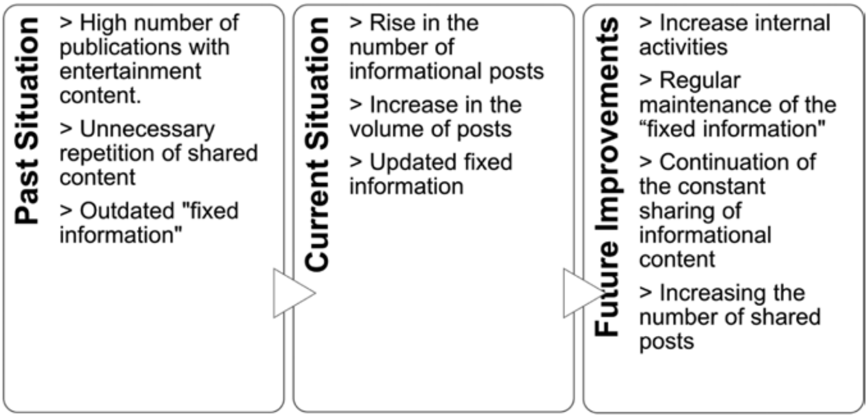

Fig. 5. Evolution of Shortcut's Social Media Presence.

> We do not have any active position in international markets. We have a partnership with INESC (Institute for Systems Engineering and Computers)), associate members of ANJE (National Association of young entrepreneurs) and members/founders of INOVARIA (association of companies for Innovation development located in Aveiro). These entities have been playing important roles in the dissemination of our technological competences. We want to participate in events that promote the contact with potential international clients/partners and therefore we also have our website in English, besides Portuguese. We believe this facilitates the communication process with our potential international partners.

What is surprising is that the developed and tested strategy focused on the "domestic" dimension of communication and not on exploring or informing systematically the potential in a larger context. The potential of the awareness economy and the clickbait mechanisms for sales and expansion were not addressed beyond the home context. This was naturally just the first test phase, but it underlines the gap between communication and internationalization strategy:

> Our social media strategy was targeting mainly national market. This way, we have no direct relation between it and our internationalization strategy. We believe, thought that potential clients coming from the international market result from networking process we are involved in.

5. FINDINGS AND DISCUSSION

The development of the firm from a situation without strategy toward a strategy, and then its testing of the social media toolkit and strategy shows that social media does work in the B2B context. The results were positive. The first strategy step was the development of a social media strategy and then its incorporation into the corporate marketing communication strategy. This strategy consolidation was an important measure for the achievement of these results.

In the beginning, the strategy and the toolkit developed for it delineated the objectives to achieve via Facebook and LinkedIn. These were to increase brand awareness and sales, and to foster building trust and loyalty in customer relationships. Moreover, the analysis regarding the presence of competitors in these networks and the ways in which they operate online provided ideas on benchmarking and best practices. In parallel, it assisted to capture what trends and needs concern stakeholders, which facilitates a better delineation of objectives and continuous strategy adaptation. The process also made identification of the company's target audience and the resulting targeting part of the systematic strategy process. Thus, depending on the demographic criteria, values, motivations, and behaviors, it was possible to create segments with certain characteristics to meet the company's targets (self-preservers, social entertainers, and achievers).

Despite the initial strategy development and testing, the case points out the strategy gap between domestic and international and the lack of international dimension in social media strategy. Although the firm has bilingual communication (e.g., web pages), a systematic employment of communication with customers and partners did not address the potential and the internationalization was practically outsourced to customers acting as resellers and exporters. This strategy has its benefits, such as cost-efficiency and piggybacking in international expansion (Coviello & Munro, 1997; Turunen & Nummela, 2016), but it also brings vulnerabilities in this highly competitive and complex era, such as the high dependency of the firm on these immediate customer-partners.

In terms of marketing strategy, the targeting and positioning (de Vries et al., 2012; Kotler & Mindak, 1978) continued in the process that characterizes the type of content that can be published on the networks, taking into account vividness, interactivity, informational content, and entertainment content (Agnihotri et al., 2012; Coelho et al. 2016; de Vries et al. 2012; Levy, 20122; Madi, 2016) and it is complemented by the position of the published content and the valence of the comments. The final loop involves analyzing and assessing the results of the adopted strategy, which demonstrates whether the objectives have been achieved, or what improvements need to be made. This analysis can be executed taking into account the engagement rate (related to posts) and the audience growth rate (related to the page). Interestingly, the internationality of the "action" was not intentionally integrated, leaving the international potential for clickbait and awareness-building without strategy attention.

In this case, the emerging social media strategy worked positively although there were considerations on its usability in an IT B2B marketing communication context. The way this strategy model has been built and implemented has been co-created and flexible, as it generated a cyclical model easily adaptable for rapid changes. The company can analyze the results achieved and reevaluate its tools and actions on continuous bases. However, the firm – being the producer of the original product and service – needs to pay attention to the network dimension and the ownership of its customer relationships and related communication. Its communication does not address strategically the customers' customers and leaves this communication arena in social media for its partners. As long as the partners follow the strategy of the firms, this is not a threat, but the situation can change rapidly.

Based on the findings, it is recommended that the company takes a larger-scale approach in integrating its networks and customers' customers into its communication strategy. It needs to consider carefully the value creation and service logic and ensure that it is not trapped into a product-focus in its marketing strategy. SMEs suffer not only from various constraints in international competition, such as liability of smallness, newness and foreignness, but also from their immaturity in addressing internationalization (Brouthers et al., 2016; Etemad, 2004; Johanson & Vahlne, 2009). Thus, the firm needs to assess the international market aspect carefully, so as not to under-value the meaning of internationality in its marketing and communication operations and strategy.

It could also invest more in marketing communication using low-cost social media as a regular part of its external marketing communication. The impact of social media can be different from normal marketing communication and the strategy process (cf. segmentation, targeting, and positioning) needs to stay alert and aware of the challenges, whether these relate to internal, external, or stakeholder-related marketing and communication or the type of contents. In addition, the IT firm may benefit by increasing its internal activities so that the content generated by these events can be promoted on social media, thus building more confidence and relationship value, both emotional and informative, with its customers. Shortcut should consider increasing the frequency of its (currently weekly) posts, as well as ensuring continuous application of the proposed toolkit. The strategy toolkit also includes further potential for customer integration and co-creation in diverse related value creation processes (Bollers, 2013; Bruhn, Schnebelen, & Schäfer, 2014; Coviello & Joseph, 2012; Schumacher & Feurstein, 2007).

6. CONCLUSIONS

The study addresses the challenges of the new communication systems; internet and social media in B2B relationships, particularly from the perspective of small IT firms that act both domestically and internationally and need to keep in touch with numerous countries and customers. The inexistent and emerging strategy of this case illustrated well the difference to B2C companies that are more active in employing multichannel marketing communication. Surprisingly, the case illustrates that IT-affine young and dynamic firms are not as involved in employing social media as one could expect. The awareness and like economy applications had shortcomings in their strategy integration regarding business relationships (Gerlitz & Helmond, 2013; Siamagka et al., 2015). This firm focused mainly on the domestic aspect and product information in its communication strategy for social media and did not employ it for internationalization, suggesting that social media can also be seen as a tool for starting a firm's "domestic" internationalization (Johanson & Vahlne, 2009; Turunen & Nummela, 2016).

On the other side of the coin, there is notable potential to be systematically developed as the findings indicate. The development of the emergent strategy and its testing shows that there is low-cost potential for customer relationship building and care. It also assists in assessing targeting and partnering (Banyte et al., 2011; Jussila et al., 2014). Theoretically, the study contributes to marketing communication and relationship management, particularly regarding B2B business internationalization and expansion, and demonstrates potential for applications in trade marketing.

The Shortcut case presents how such B2B companies can employ customized tools and reach their target audience effectively on social media, thereby leveraging their online presence. In this case, a five-block social media strategy toolkit was developed, supported by an action research methodology, as used by McKay and Marshall (2001). This consists of objectives, analysis of competitors' online presence, segmentation, content, and analytic metrics. The case shows how such management tools can assist a small IT firm to proceed in its work serving international customers and communicating with them. Managerially, the usefulness of the model was supported and showed an increase in digital communication and networking via social media. It also revealed that Shortcut's main target is self-preservers (a group that seeks information and shows higher levels of brand engagement).

Additionally, Shortcut used both organic and paid promotion on Facebook, whereas on LinkedIn only organic promotion and the creation of a company showcase page were used (Owen & Humphrey, 2009). The use of paid promotion on Facebook yielded a higher number of followers compared to LinkedIn. Regarding the showcase page, the strategy should be adjusted in the future. Regarding communication content, this depicts several characteristics: informational, entertainment, interactivity, and vividness. Content can be in the form of text, images, videos, and hyperlinks (Siamagka et al., 2015; Swani et al., 2017). The case of Shortcut, as an IT SME that operated at a B2B level, supports the conclusion that such a firm should share more informational content, both on Facebook and LinkedIn, as this is linked to trust building and relationship management (Canavari et al., 2010; Doney et al., 2007; Payne et al., 2009).

Finally, in order to evaluate the success of, and adjust, implementation of the toolkit, firms should constantly check the analytic metrics provided by social networks; especially, the number of followers and the engagement rate, and frequently adjust their objectives and establish new ones. Social media is very dynamic and requires continuous managerial attention.

We consider digital social media as a new dimension of the IT networking that has proven important in internationalization of IT firms (Coviello & Munro, 1997). As this is a limited single case study and only provides some idiographic indications prior to active internationalization, we recommend that future research should address particularly the use of social media in a firm's internationalization process, in gaining new industrial customers, and in serving existing customers on a larger scale.

NOTE

1. The name is removed and replaced with XXX for anonymity.

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PART II

ENTREPRENEURIAL STRATEGIES IN THE INFORMATION AGE

CHAPTER 6

BLOCKCHAIN VENTURES AND INTERNATIONAL BUSINESS

Andre Laplume

ABSTRACT

This chapter examines the implications of blockchain ventures for international business. The author highlights the advantages blockchain technologies can create for firms seeking to access international markets for investors, customers, employees, and suppliers. Overall, the international character of initial coin offerings and their business models suggest several advantages over traditional internationalization methods.

Keywords: Cryptocurrency; blockchain; business model; initial coin offering; international business

1. INTRODUCTION

Born global startups seek, from the start, to gain competitive advantage from using resources and selling products in multiple countries (Chetty & Campbell-Hunt, 2004). Information technology has long been linked to the viability of globalized business models by reducing transaction costs (Cavusgil & Knight, 2015; Iansiti & Lakhani, 2017; Rennie, 1993). This chapter delves into the advantages and disadvantages of blockchain innovations for the internationalization of startups.

Bitcoin's rise led to the proliferation and development of blockchain technologies. The demand for Bitcoin also drove the creation of dozens of cryptocurrency exchanges. The increase in the price of cryptocurrencies caused a whole crypto-mining industry to develop. Since Bitcoin, over 1,800 new cryptocurrencies launched,

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using a process of initial coin offerings (ICOs) and the tactic of crowdsales,[1] where global investors buy new tokens as investments. There has been exponential growth in capital raised via ICOs (US $2 billion in January and February of 2018 alone).

What is interesting is that most of the new cryptocurrencies are not only currencies, but they also serve as a form of equity in a business (Crosby, Pattanayak, Verma, & Kalyanaraman, 2016). The equity's value is determined by the demand for tokens; thus, new cryptocurrencies are tied to business models. Each ICO employs a unique variant of the blockchain technology in order to execute a particular business model. A currency or "medium of exchange" is just one of infinite possible variants. Most of the newer ICOs enact business models that include the exchange of goods and services.

Bitcoin also matters from another perspective, as many ICO inventors buy into ICOs in order to diversify their bitcoin holdings. Consumer awareness of cryptocurrencies has accelerated as bitcoin rose to fame with an exponential price rise (Wang & Vergne, 2017), temporarily giving it a market capitalization of nearly US $400 billion before retreating somewhat. Most of this wealth is likely taxable if it is cashed in for fiat currency, encouraging investors to look for opportunities to spread out their risk. Selling Bitcoins for the tokens of new ICOs has emerged as a popular diversification mechanism.

Next, I will describe the core elements of the technology in some detail. Section 2 contains important material for the novice, but those already informed about the technology might skip to Section 3, which is about the stakeholders that are affected by the technology and the advantages and disadvantages for international business.

2. BLOCKCHAIN TECHNOLOGY

This section lays out the basics of the technology by defining blockchain, a transaction, and wallets as the key components.

2.1. Blockchain: A Shared Ledger

Academic attention to blockchain is growing, with, for instance, Miau and Yang (2018) showing accelerating academic publication of papers examining Bitcoin from 2008 to 2013, then a shift to research paying attention to Blockchain and smart contract techniques after 2016. A blockchain is a list of blocks of encrypted digital ledger information, chronologically ordered and replicated, akin to a distributed database or spreadsheet (Kosba, Miller, Shi, Wen, & Papamanthou, 2016). Blocks of transaction information are added permanently and changes are witnessed and verified by a network of miners. A ledger is akin to a spreadsheet or database that records transactions. For instance, credit card bills and bank statements are derived from credit card company and bank ledgers. The blockchain is like a very large globally distributed spreadsheet or database (there are many copies – each miner has a copy) that stores information about who sent how many tokens to whom, making it possible to ascertain account balances for each individual. A blockchain records the history of transactions with each token. This is different from a bank or credit card company, where usually only one company has access to the ledger.

A blockchain ledger is public, so that transactions can be verified by any stakeholder. The spreadsheet is stored by a large number of miners, which run special software for transaction verification. Miners deploy their computer power mining whichever cryptocurrency offers the highest reward, both in terms of the amount of reward (i.e., tokens allocated by the creators of the cryptocurrency) for mining and the commission fees offered by the sellers of tokens who wanted priority.

Paramerterizing the business model is essential to a good ICO. The business model must append parameters to the bitstring and those parameters must relate to key business information that facilitates a service or product exchange. Investors use Etherium to buy into new ICOs directly via their Ether wallets. "Ether coin" transactions have recently matched volumes of Bitcoin transactions. Ethereum makes it easier to develop applications using blockchain as well as smart contracts. It provides software tools that allow developers to build their own tokens and business models within the Ethereum network (Wood, 2014). Applications built on the Ethereum platform are typically open source, use public decentralized blockchains, create incentives for miners, and publish an agreed-upon protocol for the stakeholders of the startup's business model.

2.2. Exchanging Value

The blockchain is useful for exchanging value rather than just exchanging information (Iansiti & Lakhani, 2017). For instance, it is not possible to send money via an email without invoking a transaction through some third party. All exchanges of money on the internet are facilitated by a third party, a central authority that records transactions in their own proprietary database or ledger. This is problematic because if something happens to the third party, it is not possible to verify that the transaction has occurred. Blockchain outsources this function to software that allows for direct exchanges of value. A blockchain transaction is triggered when two parties initiate an exchange of value. Each party provides a unique cryptographic key (these keys are automatically generated by the wallet software), and the sender specifies an amount to be transferred, along with other details. Together, these keys are used to identify the transaction between the two parties and verify it. Each transaction refers to a previous transaction; therefore, if A sends B five tokens, the transaction will only be allowed if there exists a prior transaction record that assigned A five or more tokens. Therefore, all account balances are derived from the shared transaction history stored in the blockchain allowing for consensus decision making (Davidson, De Filippi, & Potts, 2016). Miners carry out the transactions between senders and receivers of cryptocurrencies by processing equations on computers. Miners are rewarded with commission fees and allotments of the currency being mined.

Each transaction is broadcast to a distributed network that has to agree by consensus that it has occurred (more than 51% of miners from a random sample have to agree that the transaction is legitimate based on the information they have in their local copies of the blockchain), making the blockchain tamper-proof (Davidson et al., 2016). If the verification is successful, a new block is added to the chain creating a permanent record of the latest transactions. Fees are paid by the senders of tokens. Senders decide the fee level depending on how quickly they want their transaction processed. Transactions with higher fees are processes faster than those with lower fees. Some senders use software to estimate fees, others do not. Miners receive the fees in exchange for processing the transactions. The actual process functions as a type of lottery system, whereby those miners that buy more tickets (apply more computers) to mining, have better odds of winning the reward. That miners are internationally distributed guarantees that the viability of the network is not tied to a single point of failure, providing ICO startups with a source of competitive advantage in terms of reduced threat of system disruption.

2.3. Wallets: Decentralized Control

When a user sees their balance in their wallet, they are actually seeing what is recorded in the blockchain stored on miners' computers. Thus, the blockchain is public, and no central authority is in charge of it (Davidson et al., 2016). Decentralized wallets give owners of cryptocurrencies the power to conduct exchanges with others (in any country), which are independent of any intermediaries – that is, directly through an encrypted, yet verifiable internet link. Cryptography allows for decentralized authorization for access to ledger information (Atzori, 2015), across borders. For ICO startups, the ability to conduct business directly with customers provides a competitive advantage by reducing middleman costs, that is, it facilitates disintermediation.

3. BLOCKCHAIN, STAKEHOLDERS, AND BORDERS

3.1. Startup Teams and Founders

Blockchain startups acquire startup capital without giving away control to investors. Avoiding many of the regulations imposed on other means of startup capital acquisition, a blockchain startup has an ICO to receive financial resources from investors in exchange for company tokens. These tokens act simultaneously as investor equity and as the medium of exchange for the startup' goods or services and can be exchanged with low transaction costs (Iansiti & Lakhani, 2017). A crowd-sale is used to sell token to investors all over the world. The global software infrastructure to put out an ICO is becoming increasingly robust and accessible. In many cases, startups use a nearly fully automated process by using providers like Waves to launch their ICOs.

3.2. ICO Startups Costs

There are transparency and authenticity requirements involved in conducting an ICO (Hartmann, Wang, & Lunesu, 2018). Self-regulation mechanisms include providing ratings to ICOs. ICO lists have become one of the most important forms of self-regulation in the industry, similar to ratings agencies (Daines, Gow, & Larcker, 2010). In order to be seen by a sufficient number of potential investors, ICO startup founders must have their ICO listed on the main listing websites. These websites house links to each ICO's White Paper (a.k.a., business plan), and a link to the website of the business and the social media contacts of the founders.

The websites usually house an explainer video that is used to communicate the business model to investors. ICO founders often also hire lawyers to increase trust and legitimize their offering documents for investors. To maintain their credibility, ICO listing sites engage in their own form of due diligence, checking ICO founder references, and evaluating their business models as described in their white papers. Many of the listing sites require an evidence of value generation for investors to consider listing an ICO. Multikey escrow features return funds to investors if targets are not reached, preventing premature, or unsustainable capitalization.

Business founders can waste time and resources starting and promoting an ICO (white papers, websites, and videos) only to have it flop. Startup founders can use packaged services such as Waves, which act as the Kickstarter or Indigogo market-makers for ICOs. These services take the coding out of the process allowing ICO founders to design and launch their tokens using proprietary or open source software solutions.

3.3. Cooperation among Stakeholders

Most blockchain startups need to solve the problem of network effects. They need a critical mass of buyers and sellers adopting the technology. All of these stakeholder groups must be organized within the business model of an ICO startup in order for the tokens to retain value. Most importantly, if the startup's business model does not catch on, all token-holders lose.

A distributed, but identical copy of the history of transactions in the network offers a goldmine of quantitative information that managers and entrepreneurs can use to make sourcing and delivery decisions. For example, rather than a component's history being tracked only in the independent databases of the firms interacting in a supply chain, all of its transactions can be made available to everyone in the network via a shared database (the blockchain). Rather than a prospective employee's resume, a blockchain resume would be available to all who are given access and would be maintained and updated as a result of transactions between employees and employers. The applications are truly infinite. The advantage suggested is that wherever it is applied, blockchain technology has the potential to be disruptive (Nowiński & Kozma, 2017), especially to the extent that it undermines the value of incumbents' vertical integration and related capabilities. While all this might help to overcome network effects, there are no guarantees.

3.4. Solving Temporal Issues

ClickAuto allows for car histories to be stored in blockchain tokens facilitating car resale value assessment. Everything that happens to a car that is relevant to its resale value is recorded in the blockchain and available to anyone that has been granted an access key. Stakeholders (e.g., mechanics) are rewarded for updating the blockchain by being given some small amount of tokens for their effort. Those stakeholders that seek to retrieve history details from the blockchain pay a few tokens for access, by buying ClickAuto tokens with other currencies. By virtue of this time-varying exchange of value, all stakeholders are both rewarded and compensated. As more history searchers are conducted, more tokens are bought and put into escrow. They are then distributed to stakeholders contributing historical information to the blockchain. However, since the recording happens before the requests, the recorders are paid in tokens that will gain value over time, when the network becomes large enough. Many stakeholders are both providers and receivers of history information; therefore, there is a two-sided market that fills on both sides simultaneously. In terms of effects upon internationalization efforts, it is clear that the same model can be applied across geographies, resulting in a global standardization of the process. A car history, medical history, or any other kind of history can become globally harmonized on the blockchain. This can pose a significant challenge to traditional firms that internationalize by customizing their proprietary systems to the special needs of each geography they enter.

4. INVESTORS

4.1. Cryptocurrencies Rise

Cryptocurrencies are controversial because they "create money," a right that has long been granted only to sanctioned organizations, primarily banks, municipalities, states, and national governments. Creating money is also a function of flight reward programs, in-game tokens, and credit cards, but these are taken less seriously as money. Cryptocurrencies allow new currencies to be created by new entrants – they are scarce by design and hold their value via the normal microeconomic laws of supply and demand. ICO companies in-source their financing and exchange activities, removing the need for investment banks to raise capital and for retail banks and affiliates to send and receive payments. Each ICO company raises their own capital directly from investors located anywhere in the internet-connected world. Customers and suppliers can also exchange goods and services directly with no intermediation.

According to historian Roger Lowenstein (2016), traditionally, only monarchs, governments, central and independent banks, and large municipalities have been allowed and are able to create money. In prior centuries, decentralized currencies were the norm and tended to be accepted as mediums of exchange regionally. The further from the source, the more distrust ("not accepted here") behavior was encountered, limiting currencies' useful transaction range. For example, it became a common practice for New York banks to discount San Francisco bank notes and vice versa. New national currencies bring about an era of wide acceptance without discount or confusion within countries. Cryptocurrencies have the benefits of both, that is, they are accepted at par all over the world and allow for privatized money that is customizable to a business model or network economy, reducing the liability of foreignness (Bell, Filatotchev, & Rasheed, 2012).

4.2. Corporate Governance

Agency costs are incurred when conflicting stakeholder interests require expensive monitoring (Dalton, Hitt, Certo, & Dalton, 2007). The classic example is when investors have less information about the firm's activities than its top management. The top management can take advantage of this information asymmetry to self-deal or shirk. Scholars have a generalized agency theory to include interactions among all stakeholders (Hill & Jones, 1992). With blockchain, most or all of the monitoring can be achieved by directly examining the blockchain, which contains information about all transactions. This may lead to a more decentralized form of corporate governance (Wang & Vergne, 2017); perhaps because, the stakeholders are also token holders and therefore investors, helping to align interests in a novel way.

A traditional startup could conceivably exaggerate their revenues numbers to gain favor with investors. A blockchain startup cannot use information asymmetry to exaggerate numbers because all the transactions are published to the blockchain. Since token transactions are tied to business transactions within the startup's business model, network, or ecosystem, the number of transactions and their size is typically fully visible to all parties. The advantage of this approach is that fuller transparency reduces the normal monitoring compliance costs startups incur when they take on investment. An ICO reduces some of the need for corporate governance functions in the organizations using the network providing them with a potential source of advantage. For example, no board of directors is needed to form an ICO, whereas boards representing shareholders are necessary for traditional initial public offerings (IPOs). Also, no preferred shares are issued, meaning that no investor is given a privileged position.

One exception is the practice of pre-sales, where a few large investors are sold the initial round of an ICO, giving it value and legitimacy prior to the crowd-sale to the public. Typically, zero management control is given to investors in ICOs, even during the presale. For new venture founders, dis-involved ICO investors may be desirable equity investors. ICOs allow for global financing from small to large anonymous investors.

4.3. Access to Capital

Venture capitalists invest in early-stage startups that banks will not lend to, taking large stakes in startups and demanding control rights. Even if each takes a smaller stake by forming a syndicate, a lead firm typically takes on control duties (Hellmann, 1998; Sorenson & Stuart, 2001). VCs on the board tend to exercise their power in potent ways, often putting tremendous pressure on startups to monetize early. A major problem with venture capital is that it tends to flow to some regions and not others. Thus, entrepreneurs need to move to where the capital is, or face dim prospects of recruiting VC investments. Some venture capitalists may now prefer to invest in ICOs rather than taking traditional equity positions.[2] They prefer the liquidity offered by the tokens, which can be sold on the open market at any time. Thus, startups financing their ventures via ICOs can still benefit from VC via ICO investment. This can help to reduce the problem of VC geographic clustering by encouraging them to invest in less controlling ways.

Securities laws restrict retail investors from becoming over exposed to early stage ventures. The legal requirement to be an "accredited investor" limits the participation of potential investors because they do not have the qualifying income or capital. This problem is partially alleviated by crowdfunding and equity crowdfunding, which was allowed by the US JOBS Act. ICOs are a form of equity crowdfunding and, therefore, likely to be regulated as such. IPOs provide a means of equity funding for maturing startups (Davila, Foster, & Gupta, 2003). Very few startups go public early as the costs and requirements are so high. With the exception of penny stock firms in specialized industries like mining, startups cannot usually go public until they have reached a considerable size in terms of revenues, at least, and often also profit growth. ICOs are like IPOs without the costs and red tape. Perhaps, most interesting will be the move by financial investment firms, mutual funds, and hedge funds to begin to offer funds that invest in cryptocurrencies to retail investors.

Kickstarter and Indigogo currently offer crowdfunding in the form of pre-buying of products that have yet to be manufactured. Backers of crowdfunded projects do not become equity-holders, shareholders, or owners in any way. For services, these may take the form of memberships, month-free certificates, or discount pricing coupons. At the limit, even a coupon gain a long-term value. For instance, a donor providing a large amount to a crowdfunding campaign might expect to receive in exchange for their donation a perpetual coupon with some capped value that can be traded later to others needing the service. Thus, the need for cryptocurrencies was already predicted by the lacking aftermarket for crowdfunding rewards. No aftermarket also makes valuation difficult as we see next.

4.4. Valuation

Most cryptocurrencies are not backed or redeemable for gold or any other commodity. To manage the startup in a way that is beneficial to stakeholders, especially investors that hold company tokens, it is important that the tokens appreciate in value, or at least retain much of their value over time. The most important way to price a token is to look at the performance of the transactional model underlying the tokens. The more potential for transaction flow-through using the startup's medium of exchange, the more the value of the tokens might be expected to increase. For example, if I need to buy 1% of the tokens to execute my transaction (say buying an expensive service), I need to buy them from someone that is willing to part with them. That individual is likely to be an investor or a supplier that has accumulated tokens. The investor may sell to you if they think the value of the tokens is going to go down, or if they really want to cash out.

In addition to the objective number of transactions using the token, there is also the level of confidence that investors have in the price of the tokens. Valuation is driven by the size and quality of the network using the tokens. The founders can keep a substantial share of the tokens and the proceeds of an ICO. The proceeds to be used to develop the business. The founders' share of the tokens is their reward for initiating the ICO and building the startup into a success. The value of the founders' tokens creates an incentive for them to maintain or growth the value of the tokens by expanding the business and operating it efficiently.

The supply of tokens is not determined by a central bank. Rather, the supply of cryptocurrencies is typically fixed by a computer program that distributes tokens as rewards to miners. In more recent ICOs, a certain number of tokens are often kept by the blockchain startup in order to not only be able to provide incentives for stakeholders, including miners, but also to pay suppliers and employees. As the number of transactions over the network grows, the ICO startup takes an increasingly large number of commission fees. Investors gain liquidity as customers buy tokens and sell them to suppliers in exchange for goods and services. The suppliers then sell or hoard the tokens. When they hoard tokens, they believe their value will increase and contribute to an increase in value as those token are effectively taken out of the liquid supply pool. Investors are happy where there is more demand than supply because it ensures they can liquidate at any time. Liquidity increases the value of the tokens and causes owners to want to hold onto them. ICO tokens gain in value when suppliers and investors prefer to hoard tokens rather than to spend them.

There are various ways to increase the value of tokens. Although increasing the number of transactions using the token is the best way to create an appreciation in price, there are some innovative alternative incentive mechanisms. For instance, every time a transaction occurs between a seller of a token and a buyer, a very small amount of the currency can be burned, theoretically making the rest more valuable as only a limited quantity are issued. This reduces the number of tokens in circulation, which increases the value of each token. This process, which happens automatically across all national boundaries, gives a competitive advantage to ICO startups without relying on the infrastructure and rules of a particular national system.

4.5. Volatility

A small ICO, like a small country's currency, or small company's stock may be more susceptible to manipulation by speculators (Bekaert & Harvey, 2000). George Soros famously bet against the British Pound, a large currency, imagine how much more easily a large investor could corner an ICO's market. Stocks and commodities are also subject to manipulation by speculators, which is why they are heavily regulated, for instance, with insider trading disclosure requirements. There have been several ICO pump-and-dump scams already and these may continue unabated for some time. However, to the extent that ICO's are being regulated as equities, those who break the law with these tactics should be regulated to a lower level over time (Campbell-Verduyn & Goguen, 2017; Kiviat, 2015).

There are many potential security problems with blockchain businesses that can create volatility (Lin & Liao, 2017). For instance, wallet thefts are common, where hackers gain access to the owners' tokens through spoofing and other methods. Spoofers mimic a legitimate website or company emails and eventually seek payments or passwords. Exchanges have also been hacked causing them to lose some or all of their customer's wealth. Many banks, financial institutions, and corporations are also subject to this risk to some extent. A major hack can cause token price fluctuations just as it can rock the value of stocks. The only way to allay this threat is to invest in user security and user training.

One point of stability is that the global reach of ICO increases the chances of global diversification of investors. This has the potential to increase overall liquidity for tokens, in a way that venture capital, angel networks, and regionalized penny-stock exchanges cannot achieve. The result is that less time and energy needs to be extended in order to make sure that short-term liquidity is available to avoid a quick decline in market valuation at the first sign of problems. Investors in different parts of the world use different information to make their decisions and are less likely to converge.

5. CUSTOMERS

There are direct economies as well as indirect economies (Williamson, 1989) created by the increased transaction speed of cryptocurrencies and the transparency of blockchain startups. These economies are particularly valuable in geographic contexts with burdensome regulations, corrupt, or underdeveloped banking and finance sectors. Where there are fewer rules, better banks, and the adoption of new technology, we might expect fewer transaction cost economies from adopting cryptocurrencies.

5.1. Direct Costs

Each blockchain transaction has a cost, because it takes bandwidth and processing power to verify a blockchain transaction. This cost is reimbursed to miners that dedicate their machines through fees tacked onto each transaction. Since most cryptocurrencies provide a reward to miners in the form of allocations of undistributed tokens, miners may be willing to execute the transaction just for the reward. However, when the reward is insufficient, then fees added on by senders help to ensure incentives for miners keep the network humming. The cost of transactions is driven by the volume of trade. In a pinch, where everyone is trying to execute transactions around the same time, fees may need to be very large to attract the attention of miners. At normal times, direct transaction costs are much lower than they would be using fiat currencies.

5.2. Increased Transaction Speeds

There are fewer time delays between sending and receiving funds because even across borders, there are no intermediaries to deal with to complete the transaction. For example, if a buyer used a credit card to pay a seller in another country, the seller does not receive the funds immediately. It takes one to three days for the money to actually change hands using most of the existing services offered today by banks and wire services. With a blockchain transaction, the time needed to complete in international transaction of value is usually less than 10 minutes. But more importantly, for internationalizing firms, customers can pay from anywhere, even without credit card infrastructure. So long as they have access to the internet, they can pay. Blockchain startups thus have an advantage over traditional firms in that they can more readily send and receive global payment, without documentation, because the blockchain is the most important documentation needed and it is available to all network participants.

5.3. Increased Transparency

The blockchain allows buyers and sellers to exchange value with greater ease due to the transparency of the blockchain reducing bargaining costs related to information asymmetry. It is impossible to deny that a transaction has occurred because it is recorded publically in the blockchain. A seller cannot credibly claim never to have been paid if they were, and a buyer cannot win a claim to have paid if they did not. This reduces costs related to dispute resolution as all parties can see the record of all transactions. It also reduces monitoring costs created by the privatization of data by allowing anyone in the network to verify the time and nature of transactions. This is especially important for internationalizing firms because accessing data and collecting penalties across borders and in different languages and technologies is difficult and expensive. ICOs solve much of this by agreeing to a universal/international architecture of payment and information that all of the network participants use.

6. SUPPLIERS

Filecoin raised an ICO-record US $257 million and plans to provide a decentralized cloud storage service that will take the advantage of unused computer hard drive space. In this case, the customers and suppliers can be anywhere in the world and work together with little friction from international borders. This allows the suppliers of computer storage anywhere in the world to access customers anywhere in the world. This case is perfectly born international because suppliers, customers, and investors can be anywhere with little to no negative effect. The only exceptions might be where the internet is not reliable or where transfer rates are too low. Thus, rather than being limited to a domestic supplier or vertically integrated unit, the blockchain painlessly allows for the global distribution of tasks.

Another example is Polyswarm, which aims to create a global market for antivirus and anti-malware code. Polyswarm provides as copy of the virus to the community of fixers who create solutions and present them to customers, who can then use them to fight infections. The best solution is rewarded while those that do not work are not rewarded. This solves some of the problems with incentives for suppliers because it produces a global market for their services.

6.1. Limits to Business Model Globalization

It seems that suppliers offering services are made more accessible to blockchain startups, but those specializing in tangible goods, and local to local exchanges, are not necessarily superiorly affected by the technology. Some ICO business models have local limits to growth. For instance, SnagRIDE sells tokens to investors, then customers who need inter-city ride sharing services buy tokens, and spend the tokens using SnagRIDE's software to hire drivers who pick them up and drop them off in other city. The drivers are paid in token; they can sell their tokens to redeem them for cash or other crypto currencies. SnagRIDE collects a service fee of 12% for facilitating the service via its software. The fee is used to run the company, improved the software, for marketing, and to compensate managers and employees. The rules and regulations in each jurisdiction are likely to slow down the diffusion of SnagRIDE as compared to FileCoin (as previously discussed). But, more importantly, there are localized network effects in play because ride-sharing requires individuals to meet in location.

Similarly, ICO business models often consolidate ad hoc, but local markets. For example, Parkgene allows parking spot owners to monetize them by renting them out to car-owners seeking a place to park. Parkers buy Parkgene tokens and use them to pay for parking spots listed on the website. Parking spot owners receive payment in tokens and can redeem them for other currencies or hold them as investments. The company takes a commission on each transaction. Clearly, since parking is a localized phenomenon, local clustering of supply and demand is needed; thus, business models like theses cannot take full advantage of the global reach of ICOs. Nonetheless, perhaps the more international locations that could form localized networks, the better the odds of at least one or a few localized network adoptions.

6.2. Access to Customers

Another interesting aspect is access to customers from anywhere. According to their white paper, ConnectJob seeks to disrupt freelancer markets like UpWork. Its tokens are used to transact between freelancers and hirers all over the world. Freelancers get paid in ConnectJob tokens and hirers buy tokens in order to pay the freelancers. ConnectJob takes a commission fee for administering escrow, rating, matching, and other services via their software. The more demand for tokens, the higher their value also giving an incentive to hoard tokens. Jobbers adjust their bids based on the current or expected value of the tokens. Once a hirer accepts a proposal, the amount to be exchanged is fixed. This type of business model, but cutting out the need for fiat money exchange, enables a global payment infrastructure for freelancers.

7. COMPETITORS

Many of the advantages ICO companies can be summarized by examining the transaction costs between stakeholders in a blockchain venture (Iansiti & Lakhani, 2017). Nowiński and Kozma (2017) contend that: "blockchain technology can affect and disrupt business models: by authenticating traded goods, via disintermediation and via lowering transaction costs." This disintermediation is often describe as new business models leading to a "digital platform" or "network economy" (Kenney & Zysman, 2016). This is a whole different kind of global competition that incumbents will need to contend with. A global competition between networks rather than just between rival firms. The shared ledger becomes the bus upon which firms cling as modules of the network architecture (Kenney & Zysman, 2016).

7.1. Vertical Disintegration

Decisions about which suppliers and customers to keep inside the firm and which to partner with via market exchange are important for firms' competitiveness (Langlois, 2003) and core decisions in international business (Brouthers & Hennart, 2007). Scholars contend that blockchain decentralizes economic systems resulting in the disintermediation of all the layers of "middlemen" (Ljutic, 2017). Thus, blockchain may favor disintegration, that is, the dissolution of vertically integrated firms, such as an increase in horizontal stratification (many small specialists). By reducing transaction costs created by the integration decisions of incumbents, blockchain favors distributed networks of specialists (Kenney & Zysman, 2016), often new entrants.

7.2. Global Modular Platform Architectures

Some have argued that blockchain business models may foster inter-organizational collaboration and openness (Chesbrough, 2003; Dietz, Xethalis, De Filippi, & Hazard, 2016). The blockchain, being public to the network participants, suggests a shift toward openness, decentralization, self-organization (MacDonald, Allen, & Potts, 2016). The blockchain is the bus in the modular architecture of each blockchain business model. This shift toward modularization of industries threatens to disrupt many incumbent firms (Nowiński & Kozma, 2017). Legacy vertical integration of incumbents puts them at a disadvantage when they are no longer able to control the core technological architecture of the industry (Henderson & Clark, 1990). When databases are hidden inside of vertically integrated firms (e.g., Enterprise Resource Planning software), they are inaccessible to outside stakeholders except in cases where special permissions are granted, top down from the executive management of incumbents. Blockchain frees the data, putting it in view of all of the stakeholders seeking opportunities in the network. It also shifts competition to be network or platform based (Kenney & Zysman, 2016), whereby born global ICO startups compete on a whole new scale. Network competition will be more important than firm-level competition.

7.3. Alignment of Interests

ICOs may help to align the interests of stakeholders in the network, which is an important multinational function (Luo & Park, 2004). By making all token holders into investors, customers, and suppliers because shareholders, even if briefly, creating a new kind of liquidity. What is most interesting about a blockchain startup is that it converts many of its stakeholders into equity holders by creating an incentive for stakeholders to hoard company tokens as investments. To the extent that a token is a store of wealth and a medium of exchange, it functions in a manner that is similar to a currency and stock certificated at the same time. Most interesting is that the blockchain may reduce the need for trust between parties to international transactions (Zaheer & Zaheer, 2006; Zhou, Wu, & Luo, 2007), as safeguards are built into smart contracts and consensus-based permanence within the technology. Since the contract is written into the code, there is less need to write actual legal contracts, and worse, writing them in for more than one jurisdiction. The result is that many pure investors eventually sell off all their tokens, and there is sufficient volume of demand that it does not cause a glut in the market. By contrast, traditional equity can only be destroyed if the firm buys it back from investors, creating a cost disadvantage. Moreover, to make stakeholders into owners usually requires a stock purchase or options program, which is normally paid for with dilution. Thus, once again, we have administrative tasks that are subsumed by the blockchain technology that provide a cost advantage to ICO startups.

8. GOVERNMENTS

For government stakeholders, the issue is how to regulate ICOs, which are inherently international phenomena. Issues around national boundaries, securities regulation, and taxation are heightened by the cross-border nature of ICOs and make them hard to regulate unilaterally.

8.1. Tearing Down Trade Barriers?

Trade barriers are created by the protectionist and strategic policies of nation states (Dunning, 1998). Tariff, quotas, and taxes on imported goods are typically levied in order to protect a local industry or to punish a foreign government or company. Trade barriers can also be imposed by domestic governments, for instance, currency exchange controls. Transactions using cryptocurrencies allow the monetary exchange portion of a transaction to occur across international borders. These transactions circumvent the laws of nation states. In cases where national governments are corrupt, malevolent, or incompetent, cryptocurrencies offer solace. However, this may be temporary as cryptocurrencies are increasingly being subjected to new regulations (e.g., in South Korea and China). It is interesting though that business models that are inherently global will be hard to regulate by national government decree, suggesting the need for international cooperative regulation (Zetzsche, Buckley, Arner, & Föhr, 2018).

8.2. Regulation of Securities

An ICO involves the sale of a security (Bradford, 2012), but these transactions have just started to raise they eyebrows of securities regulators. Discussion in the US points to ICOs being governed under the equity crowdfunding standards (Hornuf & Schwienbacher, 2017). The standards state that if raising more than US $50 million, then the startup must submit Securities and Exchange Commission (SEC) filings, which are expensive. For smaller amounts, equity crowdfunding rules apply. For instance, the JOBS Act requires that firms raising more than US $1 million must submit to a full Certified Public Account (CPA) audit. For raises below a million but greater than $500,000, only a CPA review is necessary. For less than $500,000, there are no requirements. For investors in ICOs, they are capped at $100,000 per year or 10% of their income. Investors with lower incomes are restricted to 5%. Moreover, to encourage diversification, a given investor cannot invest more than 5% of their annual income in a single ICO. Many ICOs did not follow the rules in the early days, and some are now being questioned by the SEC. Overall, however, for most ICOs, which raise less than the thresholds for higher regulation requirements, regulatory costs are lower than for IPOs.

8.3. Taxation Issues

Taxation of profits or capital gains made by investors in cryptocurrencies have become an issue (Kiviat, 2015). In particular, there is a tendency among investors not to cash out tokens for fiat currency because those transactions are likely to be taxable now or in the future. This has led to a large number of investors to hoard coins and diversifying their holdings within the market for ICOs. This means that, for new ICO startups, there is pent up demand for new diversification opportunities. Tokens exists as if in a 401k or other form of tax-sheltered investment medium. Only by converting them into national currencies do they become taxable. This fact describes a separation whereby ICO companies thrive in a tax-sheltered environment. This could change, but has not yet as only a handful of countries have begun regulating this type of trade.

9. CONCLUSIONS

Using a stakeholder perspective, I discussed the implications of blockchain innovation with of focus on international business advantages. I hope that this chapter will be useful for managers and scholars seeking to better understand the phenomenon. Surely, the details offered here will be obsolete within a couple of years because this technology is moving so fast, but hopefully the broader strokes remain relevant for a longer time horizon.

NOTES

1. There are often two rounds, the first being a private sale to large or institutional investors, and the second being to the Internet public.
2. https://www.bloomberg.com/news/articles/2018-03-26/icos-can-wait-venture-capital-surges-into-crypto-startups

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CHAPTER 11

EXPANDING INTERNATIONAL BUSINESS VIA SMART SERVICES: INSIGHTS FROM 'HIDDEN CHAMPIONS' IN THE MACHINE TOOL INDUSTRY

Bart Kamp

ABSTRACT

This study explores whether machinery firms with a 'hidden champions' profile leverage Industry 4.0 practices to roll out smart services; whether this allows them to get a firm grip on their installed base; and whether it allows them to expand their international (service) business. The research is conducted based on exploratory, multiple-case study methods.

The author finds that the implementation of smart services can improve a machine tool builder's hold on its installed base and expand the scope of its international (service) business. However, the study also finds that the ability to capitalise on this potential depends on a series of moderating variables. The study also concludes that there is a risk that smart services do not unlock a strong willingness-to-pay among potential customers.

It, therefore, calls into question several conventional wisdoms, such as the possibilities that Industry 4.0 offers for suppliers operating in business-to-business markets, and the receptiveness to smart services by buyers in such markets. Finally, it highlights the specific liabilities faced by hidden champions with regard to expanding their smart services business.

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The chapter provides practical insights into the hurdles that industrial suppliers must overcome in their attempts to achieve uptake of smart services by customers, particularly within a cross-border context.

Keywords: Smart services; Industry 4.0; international business; industrial marketing; buyer–supplier relationships; hidden champions; servitisation; B2B markets

1. INTRODUCTION

Today, companies with production activities are increasingly encouraged to servitise (Kamp & Parry, 2017) and to do so in a smart manner on the back of Industry 4.0 technologies (Acatech, 2015; Bauer, Schlund, Marrenbach, & Ganschar, 2014). Servitisation refers to the process whereby a manufacturing firm shifts from operating according to a transactional product-centric business model to a relational service-centric approach, seeking to enhance its competitive position by broadening its service offerings and deepening its relationship with customers (Kowalkowski, Gebauer, Kamp, & Parry, 2017).

The term Industry 4.0 or 'advanced manufacturing' refers to a family of constituent technologies that entail the use and coordination of information, automation, computation and sensing activities (Acatech, 2015; PCAST, 2011; Posada et al., 2015). The deployment of these technologies unlocks new ways of manufacturing existing products and making new products (PCAST, 2011). Similarly, it allows manufacturers to make products and manufacturing processes smarter (Davies, Edgar, Porter, Bernaden, & Sarli, 2012) and design knowledge-intensive or smart services that industrial firms can offer to their customers (Acatech, 2015; Carbonell & Rodriguez-Escudero, 2014; Kowalkowski, Kindström, & Gebauer, 2013). Examples of such smart services might include: predictive maintenance solutions, online upgrades, corrective action and repair mechanisms, tools to manage productivity levels and output performance, and systems for monitoring energy/material consumption and idle time of assets.

Against this backdrop, the present chapter analyses the experiences of four machine tool builders with the smart services they have started to offer to their respective international customers.

The remainder of the chapter is structured as follows. In Sections 2 and 3, we put the research mission into a broader theoretical perspective. In Section 4, we outline the research methods that were followed. Section 5 presents the research results and Section 6 discusses those findings and selectively links them back to the existing literature. Section 7 concludes the chapter with a series of final remarks, among others, about the limitations of the research results.

2. THEORETICAL BACKGROUND

Among the studies that analyse the possibilities that Industry 4.0 offers industrial firms to develop and commercially exploit smart services, one encounters many optimistic findings.

First, there is literature that identifies drivers that will incentivise manufacturers to embrace Industry 4.0 concepts for rolling out advanced services (Herterich, Übernickel, & Brenner, 2015; Lee, Kao, & Yang, 2014; Schroeder & Kotlarsky, 2015). By making assets smart and connected, manufacturers can capture insightful data on product use, allowing them to visualise how their offerings are operated within customer-specific contexts (Parry, Brax, Maull, & Ng, 2016). The former can be used as a lever for designing smart services (Auramo & Ala-Risku, 2005; Porter & Heppelmann, 2014), which can help industrial suppliers to strengthen their ties with customers and reap more value from buyer–supplier relationships (Aas & Pedersen, 2011; Kucza & Gebauer, 2011). As such, exploiting the possibilities of Industry 4.0 for the purpose of smart services can allow manufacturing firms to better deal with their 'installed base' (the ratio between 'new order intake' and the accumulated base of products already delivered to the market). For example, in the sense that they will be better able to track and catch up on their product legacy in the hands of users (Ulaga & Reinartz, 2011). Consequently, authors like Porter and Heppelmann (2014) make it seem as if the market potential of smart products and services is there for the taking. Similar optimistic assertions are echoed by other scholars and groups, including Leichsenring Franco, Almada-Lobo, and Sousa (2017) and the High Level Group on Business Services (2014).

Second, many scholars approach the questions of 'how to leverage Industry 4.0 practices for the sake of smart services' and 'what benefits to derive from it' from a supply-side perspective. Accordingly, research focuses on the obstacles that manufacturers need to overcome (Bücker, Hermann, Pentek, Otto, 2016; Koch, Kuge, Geissbauer, & Schrauf, 2014; Schumacher, Erol, & Sihn, 2016) or on how industrial suppliers can get ready for rolling out smart services (Jarrahi, Pezzotta, Cimini, & Gaiardelli, 2017; Rapaccini, Saccani, Pezzotta, Burger, & Ganz, 2013). Meanwhile, the demand side is assumed to be ready for take-off and its receptiveness to smart services is portrayed as an *acquis*.

Finally, whereas previous studies have investigated questions relating to how to organise global service delivery (either bundled with products or not) within multinational enterprises (Kowalkowski, Kindström, & Brehmer, 2011; Kucza & Gebauer, 2011; Zarpelon Neto, Medeiros Pereira, & Borchardt, 2015), they have not tackled these issues within the context of Industry 4.0.

3. RESEARCH SETTING

Against a backdrop of 'services are becoming increasingly important for manufacturing firms' and 'the rise of Industry 4.0 and advanced manufacturing practices as enablers for smart service provisioning', this chapter sets out to explore:

- whether and how offering smart services allows manufacturers to get a firmer grip on their installed base (in the sense of tracking and tracing the assets they have sold and of bonding with the users of these assets); and
- whether and how smart services allow them to expand their international (service) business as a whole.

We argue that the aforementioned questions are of particular importance for companies that:

- operate in sectors were competitiveness depends increasingly on the quality and variety of service offerings (Lay, 2014; Mont, 2002; Vandermerwe & Rada, 1988);
- operate in a market environment where high installed base ratios prevail (Neely, 2007, 2008); and
- are active on an international level and have traditionally faced difficulties regarding the offering and selling of services over large distances, as this tended to be costly and labour-intensive (Zarpelon Neto et al., 2015), particularly while firms had to rely on conventional customer relationship management practices (visits, telephone conversations, e-mails).

Hence, we propose to look at research instances from the machine tool sector. We consider this to be an appropriate research setting, as the industry is seeing:

- an increasing demand for flexible and intelligent production lines that can benefit from Industry 4.0 practices (Acatech, 2013; Navarro & Sabalza, 2016; Posada et al., 2015);
- an increase in the importance of providing services to customers (Acatech, 2013, 2015; Lay, 2014);
- a pronounced installed base ratio of 1:33 (Henkel, Bendig, Caspari, & Hasagic, 2004); and
- substantial and growing cross-border business activity (Lay, 2014), but with uneven development of product and service sales (Freiling, Wassermann, & Laudien, 2012), where product sales lead the way and the commercialisation of services tends to be underexploited due to the liabilities of foreignness and/or smallness (Gaur, Kumar, & Sarathy, 2011).

4. METHODOLOGY

To explore whether the uptake of smart services can allow machine tool builders to 'improve their grip on the installed base' and 'expand their international business', we applied a multiple-case study approach. Compared with single case studies, such a design makes the research findings more robust (Eisenhardt & Gräbner, 2007).

We selected four cases for in-depth analysis using qualitative and inductive/bottom-up research methods (Yin, 2009). This number is in line with recommendations by Eisenhardt (1989) for an exploratory research work. She argues that 'between 4 and 10 cases' is an ideal number for exploratory purposes (Eisenhardt, 1989, p. 545).

The companies reviewed were chosen based on targeted sampling (Yin, 2009). While targeted sampling entails limits on generalisability and external validity, this approach is deemed suitable for exploratory research as it does not aim to establish representative findings for larger-scale populations (David & Sutton, 2011).

We selected machine tool companies with a strong track record in international business. In fact, the companies in question can be considered 'hidden champions'. This means that they are either number one in their field in the European market or among the top three in the world, and that they operate in business-to-business markets that receive only little media attention (Simon, 2009). Furthermore, in line with typical hidden champion traits, the selected companies specialise in machinery for highly restricted user groups as they focus on meeting very specific demands from niche market segments (Leitner & Guldenberg, 2010). In other words, they provide specialty equipment rather than general-purpose machines for all-round use and mainstream buyers.

As research instances, hidden champions seem particularly relevant to the questions outlined in Section 3. First, they represent companies that are highly active in the international business realm, and most of their revenue comes from foreign sales (Kamp, 2017; Simon, 2009). Second, they are known for paying particular attention to customer relationships and providing premium after-sales services to their customers (Simon, 2009). However, they may have traditionally relied heavily on establishing artisanal ties with customers, leading to long-lasting relationships and proximity as a basis for an intimate understanding of customer needs (Simon, 2012; Treacy & Wiersema, 1993). In contrast, in the current context, smart services and online customer care practices are beginning to prevail (Porter & Heppelman, 2014). Hence, the issue of digitalisation and smartisation may be becoming key to sustain international leadership positions (Lin, Shyu, & Ding, 2017).

The companies chosen are all located in the Basque Country, which can be considered the industrial heartland of Spain, as it is home to about 80% of the country's machinery industry. The region is characterised by substantial awareness-raising efforts and development policies around advanced manufacturing and Industry 4.0 (Morgan, 2016), making it plausible that we would find companies with experience in using advanced technologies for the purpose of providing users with smart services (Table 1).

Research on the selected companies consisted chiefly of in-depth interviews (held between the second half of 2016 and the first quarter of 2017) with Chief Executive Officers (CEOs) and directors of service business, and analysis of secondary information sources on the companies in question.

The discussions were conducted in a grounded theory style, giving free rein to the speakers without limiting them through theoretical and closed questions. During these semi-structured interviews, which lasted between 90 and 180 minutes, we 'elicited' narratives from the company representatives, allowing them to express themselves in their own words, rather than forcing them to adopt a theoretical lingo (Strauss & Corbin, 2015). Afterwards, the interviews were transcribed, providing a basis to address the research questions presented in Section 3 (Mayring, 2014). The interpretations per case were discussed with the respective companies to ensure a correct reflection of their experiences. Finally, a comparison of insights was carried out across cases.

Table 1. Case Characteristics.

Paper-Co: 31–40 Meuro turnover, of which 10–15% comes from services **Niche market in which the company holds a leading position:** machines for notching banknotes and security paper **Export ratio:** >90% (worldwide sales) **Management of international operations:** relatively decentralised organisation, with company offices overseas that are key for landing and retaining customers	**Discharge-Co:** 21–30 Meuro turnover, of which ±15% comes from services **Niche market in which the company holds a leading position:** large-sized modular electrical discharge machines based on wire technology **Export ratio:** 81–90% (worldwide sales) **Management of international operations:** relatively centralised organisation, with foreign offices, but clearly directed by the headquarters
Mill-Co: 61–70 Meuro turnover, of which <10% comes from services **Niche market in which the company holds a leading position:** travelling column milling machines **Export ratio:** >90% (chiefly to Europe) **Management of international operations:** relatively decentralised international apparatus, with a strong role for after-sales services for its German subsidiary	**Drill-Co:** 81–90 Meuro turnover, of which <10% comes from services **Niche market in which the company holds a leading position:** flexible crankshaft drilling machines **Export ratio:** >90% (worldwide sales) **Management of international operations:** relatively centralised organisation, with foreign offices, but clearly directed by the headquarters

Source: Compiled by the author.

5. RESULTS

5.1. Experiences with Leveraging New Technological Possibilities to Provide Smart Services

All four companies have experience in equipping machines with sensors, software and other devices with a view to online machine monitoring ahead of predictive maintenance and other kinds of smart services, but only Paper-Co was an established player at the time the research was carried out.

Paper-Co was an early mover when it started offering online support services – for ad hoc interventions – and cloud-connectivity programmes – for real-time remote diagnostics on an ongoing basis – several years ago. Based on several years of experience, the company concludes that the online support services are popular, but the cloud-connectivity programmes are not. Customers almost systematically block the possibility to do machine monitoring in real time, and only provide Paper-Co with temporary access to machine insights when problems arise.

The other case companies have only recently started to experiment with offering smart services.

Discharge-Co considers itself a beginner with regard to marketing service applications to follow up on customers' needs in a smart way. It launched an app that allows users to monitor the state and functioning of their machines, but this has not led to the systematic communication of machining data to Discharge-Co itself. Instead, customers use the app for internal purposes without paying for it. In fact, when the app was conceived, the company offered it to customers to showcase the company's capabilities in this area, rather than pursuing its exploitation for commercial purposes.

Mill-Co can be viewed as a diligent trend follower regarding the introduction of smart services. It has observed a gap between the (advanced) technological readiness of its machines to support smart services and customers' willingness to accept them and, hence, it has only recently started to promote the uptake of smart services. Traditionally, most customers leave the devices that allow online monitoring in offline mode and did not enable Mill-Co to keep track of machining events and developments, but that attitude is changing now. Therefore, the company is now promoting the active use of a wide array of sensors, transmitters and actuators on its machines. Whereas some of them were optional in the past, they now form part of the standard equipment on their latest machines. Additionally, the company offers a series of corresponding diagnostic services with a view to predictive maintenance schemes, energy/material consumption management, and activity/object-based cost accounting, and lets its customers use these at no charge for several months. Afterwards, they can decide whether they want to continue as a subscriber. Furthermore, Mill-Co recently launched a dynamic stabilisation system, which makes it possible to regulate the rigidity of metal machining processes at customer sites via remote control.

For its part, Drill-Co has also been a diligent follower of market trends regarding knowledge-intensive industrial services and it has built up the internal capacity to follow suit. What the company has experienced, however, is that smart services as such are hard to sell, or that services that involve 'overseeing a user's operations and or premises' can meet with resistance among customers. The company concluded that what concerns customers most are cybersecurity issues, as well as data analysis capabilities with a view to machine learning and manufacturing knowledge. Consequently, Drill-Co came out with its own data logger. It also set up a cybersecurity team and a data analysis unit of its own. The company argues that getting involved in these areas serves as a prelude to providing smart services of a more operational nature.

5.2. Assessments as to the Ability of Smart Services to Establish a Firmer Grip on the Installed Base

All four firms acknowledge that smart services are helpful to keep a grip on their installed base. Still, the extent to which smart services actually add to the current ability of firms to keep track of their machine and customer base varies among the case companies.

Paper-Co's lessons to date indicate that smart services have not proven to be an effective instrument for further cementing relationships with customers. At the same time, it argues – as does Discharge-Co – that it generally has a good handle on its installed base already, thanks to proprietary software and electronics embedded in its machines, which facilitate the tracking and tracing of its machine base and foster customer retention. The considerable intellectual property (IP) value of its machines means that in the event of problems, customers are forced to turn to the company. In addition, Discharge-Co's machines run on specific, patented, filters that can only be obtained from the company. These 'adjacencies' enhance locking in customers.

For its part, Mill-Co expects that its patented dynamic stabilisation system will encourage customers to strengthen its buyer–supplier relationships, as it can allow customers to augment machine productivity and reduce wear and tear. In fact, it argues that both this stabilisation system and other smart services it offers may mark a new era in the company's ability to forge ties with customers. Since its machines are used by a wide variety of users – many of which are smaller workshops that typically do not keep a machine builder informed of the status of their machines after the warranty period is over (unless something goes seriously wrong with the machine they purchased) – Mill-Co views smart services as a clear enabler to stay in tune with its user community.

Paper-Co and Drill-Co both operate in a single industry setting, which makes their target market survey-able. It also implies that these companies' grip on their respective installed base was already good. On top of this, Drill-Co managed to launch a machine type that caught on very well in the market and this single machine type consequently represents 80% of the company's turnover, meaning that the company now has a highly uniform installed base.

In contrast to Drill-Co and Paper-Co, Mill-Co and Discharge-Co do not have a uniform user base. Their machines are characterised by more customisation and they end up in a wider variety of end-user environments. This means that their installed base is more fragmented.

As regards customer willingness to 'consume' smart services and accept the accompanying stronger ties and exchange of information with a supplier, the case companies have different experiences.

When dealing with customers that are much bigger than themselves, they find it often very difficult to convince them to engage in online data sharing practices. Cybersecurity fears (as indicated by Drill-Co) are one reason for this, while another is fear of ceding control and providing insights into internal affairs to outsiders (voiced by Discharge-Co and Drill-Co). A further reason is that larger firms generally prefer to either develop their own data analytics capabilities or set up large overarching data-processing structures (such as HANA or Predix), subsequently asking machine builders, for example, to make their equipment interoperable with those structures. Either way, the result is a more limited scope for initiative and action for smart services by machine builders. This kind of situation was reported by Discharge-Co, Drill-Co and Paper-Co.

Only Mill-Co stated that its customers have little problem with allowing it to tap into shop-floor data using online methods, as its customers expect to benefit from the insights this generates. According to Mill-Co, the fact that most of its customers are small and medium-sized enterprises (SEMs) (often smaller than itself) and family-owned has a positive influence on their attitude towards trusting in the machine builder as a trusted specialist. In a similar vein, Mill-Co indicated that customers who understand that a machine manufacturer can support its value-creation processes are more willing to accept smart services from them.

Finally, it appears to be particularly tough to get reciprocal data exchange off the ground in certain sectors: 'It's nearly impossible to get data out of an automotive plant' (Drill-Co); 'Customers in the defence industry are very reticent to have outsiders monitoring machining actions and conditions' (Discharge-Co).

5.3. Expectations Regarding the Impact of Smart Services on International (Service) Business

Looking at the installed base of the case companies from a geographical perspective, we see that more than the others, the customer base of Mill-Co is concentrated within Europe. This offers an advantage when it comes to customer relationship management: the radius within which customers are located is more limited, and the quality of the Internet – which is necessary to provide smart services – is (across the board) better than in many places outside Europe. On top of this, Mill-Co has offices in countries like Spain, Germany and Italy and is, thus, easily able to stay in touch with the lion share of its clientele. The German office in particular provides very extensive coverage of the user network. Despite its good coverage, Mill-Co acknowledges that it has thus far not been able to fully capitalise on the after-sales potential of its installed base. It ascribes this largely to the 'don't call us, we'll call you' mentality that characterises many of its customers. At the same time, it anticipates that if remote monitoring and smart services can be provided in a seamless manner, its user audience will start to show an interest in it. Consequently, Mill-Co expects smart services to generate additional income. It particularly expects such income growth to come from foreign customers with whom it largely maintained an arm's-length relationship and with whom – through smart services – it can now tighten relations. As an outcome of such 'bonding' processes, the company expects that smart services will entice more (international) customers to also acquire more base services and spare parts from it.

The other three case companies have sales all over the world, and some of their machines end up in places where it is only possible to maintain ongoing customer relationships if they have local offices. Given that it is impossible for the case companies to have commercial and service satellites everywhere in the world, this puts a limit on their ability to reap after-sales business opportunities. As a consequence, Paper-Co, Drill-Co and Discharge-Co all view online monitoring and smart service provisioning as a complement and substitute for traditional sales activities. However, they also express scepticism as to whether the added value of smart services can be harnessed everywhere.

For starters, as regards technical constraints to implementing smart services, Paper-Co and Discharge-Co comment that they have multiple machines operating in localities where access to and unhindered use of the Internet are not guaranteed. Obviously, this seriously reduces the possibilities of providing quality online services and carrying out remote-monitoring activities.

Furthermore, Paper-Co's lessons thus far have taught it that it is hard to get customers to use smart services both at home and abroad, and that making them pay for them can prove to be even harder. It attributes this in part to the varying maintenance cultures it encounters among its international clientele. While its machines can have a technical lifetime of 10 years or more, many non-European customers try to maximise the use of their machines within a much shorter time span, and then replace their production lines. These customers prefer to amortise machines quickly and then switch to newer technology, lowering their interest in (advanced) services to keep their machines running longer.

While this may partially be a (paper) sector-specific feature, comments from the other firms would seem to indicate that it also has to do with habits across continents and countries. On the European continent, the appetite for extending the lifetime of machines is rather developed, explaining further why Mill-Co is optimistic about the chances for creating revenue from smart services.

In line with Mill-Co's assertions, Discharge-Co also expects that smart services will allow it to get a better grip on distant customers. It anticipates that such services will likewise help it to gain customers in faraway places. Moreover, the company expects that enhanced service performance may have a spill-over effect into machine sales. In other words, improved service options will allow it to compete for machine orders from potential customers that due to distance and lack of local service staff, would not otherwise consider it as seriously.

For its part, Drill-Co expects that its smart services portfolio will allow it to expand its international service business by (1) deepening business relationships with current customers and (2) serving new customers in altogether different sectors than the one where it is now active (= the automotive industry). At the same time, it can also see itself selling services to new customers prior to selling them machines. This expectation was also mentioned by Discharge-Co.

In a similar vein, both Drill-Co and Discharge-Co stated that smart services could serve to expand their respective installed bases and tap into those of competitors, by first offering smart monitoring and advisory capabilities to users that run machines made by others, before obtaining new machine orders from these users. Paper-Co and Mill-Co, on the contrary, indicated they did not see any value in this kind of piggybacking. For example, due to the unique nature of their competitors' machines and the fact that extending the lifetime of rival machines is not of great commercial interest to them.

Like Mill-Co, Drill-Co believes that customer interest in Industry 4.0 and smart services can lead to more service business with of a basic nature (shop floor trainings, refurbishments, improvements to user manuals, better parts delivery systems, etc.). In fact, it is now seeing a willingness on the part of various customers to accept and upgrade service programmes that it could have already delivered and improved in the past, but which were not requested due to the arm's-length relationship it had with many of them.

Finally, all firms stress the importance of adequate service pricing and of educating customers to pay for services. At present, all companies acknowledge that they face hurdles vis-à-vis pricing and charging for their services. In that regard, Discharge-Co points to an under-appreciation of services among its customers. This causes a fear on the part of machine builders that charging for services will lead to customer churn, since it would mean a break with the past. Similarly, there is the expectation that many of the novel service possibilities will end up being mainstreamed and will become a standard feature in future offerings. Regarding this, Drill-Co asserts that the value of services for business development should be viewed from a holistic perspective: putting revenue generation ahead of forging ties with customers would be a mistake. The company admits that it should handle services in a more business-like manner, charging and administering income from services more systematically, but treating services as a stand-alone profit centre without considering the beneficial effects on product sales and customer loyalty would be short-sighted, in its opinion.

6. DISCUSSION OF FINDINGS

6.1. Leveraging New Technological Possibilities for Smart Services

The findings show that in all four cases, the companies have started to design and offer smart services to their customers. However, the offerings of the respective case companies have achieved different levels of success in the market, and it seems that the timing for launching such services correctly is a key element. Whereas anticipating on market demand did not really generate first-mover disadvantages for Paper-Co (Lieberman & Montgomery, 1998, 2013), it seems that the diligent monitoring of market readiness is providing fast/slow following advantages for Mill-Co and Drill-Co (Markides & Geroski, 2005).

6.2. The Ability of Smart Services to Improve Firms' Grip on the Installed Base

The findings reveal that smart services can play a role in improving the companies' grip on their installed base, although the cases reviewed exhibit rather mixed results and opinions in this regard. Whereas Mill-Co is optimistic about the additionality of smart services for managing the installed base, the others have more reserved expectations and indicate that there are other factors at play. On the one hand, these factors explain why getting a grip on the installed base can be an altogether difficult matter for the companies in question (see, hereafter, under Section 6.2.1). On the other hand, these factors explain why the companies in question already count with a very good grip on their installed base (see, hereafter, under Section 6.2.2).

Altogether, smart services play a role in strengthening companies' grip on their installed base (Wise & Baumgartner, 1999), but above all they improve the possibility to monitor the state and needs of it in real time.

6.2.1 Obstacles to Keeping a Grip on the Installed Base

A first obstacle for industrial suppliers to strengthen their grip on the installed base is that potential users of smart services may not be interested in the advantages they can generate, such as lifetime extension. If users are chiefly focused on amortising capital expenditure over a fixed (short) term and try to maximise the output of the machines during that period, they will be willing to compromise on maintenance rounds and will not be inclined to lower operational expenditure during a prolonged machine utilisation time (Allmendinger & Lombreglia, 2005; Anderson, Narus, & van Rossum, 2006). Additionally, the speed with which production equipment may become outdated influences the interest in opting for lifetime extension. Even if machines can technically hold out for a decade or more, for example, if new machine generations outperform past versions and, thus, raise the productivity or quality bar, it may be counterproductive to hold onto earlier investments. The Paper-Co case in particular sheds light on these issues.

Potential users of smart services may not be interested in providing suppliers with data and insights on machining operations, either because they consider them classified or due to a lack of trust (Gebauer, Fleisch, & Friedli, 2005). Similarly, buyers may prefer arm length's relations with machine builders to avoid dependence and information asymmetry vis-à-vis suppliers (Barney, 1991; Ford et al., 1998).

However, as Drill-Co pointed out, access to data is key to designing knowledge-intensive services. Therefore, customers that deny their suppliers access to data with regard to machining operations can bring this design process to a standstill (Belkadi, Troussier, Eynard, & Bonjour, 2010). Along with Drill-Co, Discharge-Co and Paper-Co also observed this attitude among their customers.

What is more, potential users of smart services may not want to provide data in the ideal format for suppliers and may ask them to adhere to an overarching system. This points to concerns about interoperability and governance between machine builder-proposed data gathering, on the one hand, and data architectures that customers may want to put in place, on the other (Constantiou & Kallinikos, 2015). Instead of accepting every supplier's unique proposition in this regard, customers may prefer to keep the reins in their own hands and expect their respective suppliers to come up with solutions that are compatible with an umbrella platform (Rapaccini, West, & Müller-Csernetzky, 2017). Except for Mill-Co, all the companies mentioned this point.

As potentially obstructing variables of a contextual (institutional) nature, we have identified the following ones:

Concerns about cybersecurity are rather universal, although particularly as regards customers that are located in countries where there may be adverse governmental actions in Internet traffic (Brouthers & Nakos, 2004). Particularly, in those settings, the issue of data leakage and cybersecurity is of clear concern (Gooris & Peeters, 2016; Strange & Zucchella, 2017).

Additionally, Internet quality can vary across the globe and in places where good quality is not assured, the viability of smart services is clearly curtailed. This form of institutional uncertainty (Erramilli & Rao, 1993) can form a significant barrier, as the case companies report deficiencies in the condition and functioning of the Internet infrastructure in several parts across the globe.

6.2.2. Facilitators to Keeping a Grip on the Installed Base

Next to the factors that can complicate a company's grip on its installed base (see Section 6.2.1), our study also revealed mechanisms that can allow machine builders to develop a good control of their machine and customer base (irrespective of and prior to the smart services strategies they are now unfolding). In this regard, we can specifically point to the following factors:

The first is the intellectual property (IP) value of the machines that are supplied, since this affects the substitutability of both the machine and the Original Equipment Manufacturer (OEM) behind it. Generally speaking, the higher the IP value, the lower the substitutability of a machine and its manufacturer (Brouthers & Nakos, 2004). Notably, Discharge-Co and Paper-Co have leveraged this form of asset specificity.

The second would be the use of complementary accessories and replenishables, as shown by Discharge-Co. This is another mechanism that can create customer lock-ins and thus represents a form of adjacency strategy (Zook & Allen, 2010).

A third facilitator relates to the way that companies dealt with after-sales service operations in the past. If a firm built up a good track record in terms of customer-care all along, making use of an extensive service network to do so, this obviously improves its basis for management of the installed base. This is clearly the case at Mill-Co and helps to ensure that customers do not hive off. Instead, companies that followed a transactional product sales logic and now want to catch up with their installed base, will obviously have to make up the lost ground before they can reap the benefits of a smart services strategy (Finne, Brax, & Holmström, 2013).

A further catalyst would be the uniformity of the installed base that a company must deal with (Neely, 2007). In the present context, we can talk of uniformity in terms of four dimensions. It can refer to the variety of machine types that a company sells. The more compact this range is and/or the more a company has a cash cow that creates a uniform installed base, the easier it becomes to market a coherent service offering. This has been the experience of Drill-Co, and to a lesser extent, Paper-Co. Uniformity can also refer to the variety of sectors in which the machines built by a company are deployed. If the machines in question are utilised within a single sector (which is high in the case of Drill-Co and Paper-Co), this makes it possible to get a good handle on the user base, while also avoiding too much customer fragmentation. Similarly, it enhances the OEMs' ability to become a sector specialist and be an expert on its customers' machining activities. Thirdly, it can refer to the geographical concentration of the user base (particularly, the case for Mill-Co). Having the installed base on one continent, as opposed to a global distribution of machines and customers, obviously facilitates the ability to follow up with customers. Finally, uniformity can refer to similarities in the ways in which the machines are used at customer sites. Selling machines that are used for process operations rather than object-oriented applications facilitates the design and scaling up of smart services since it increases the extent to which common user patterns can be discerned. This situation applies chiefly to Paper-Co and Drill-Co.

6.3. The Impact of Smart Services on International (Service) Business

The cases reveal how smart services can facilitate the development of international business by industrial companies. When summarising the findings, we observe that smart services can create business additionality in a number of ways.

6.3.1. Exploiting the Current Captive Market and Deepening Current Customer Relationships

First, smart services can open up ways to address currently unmet demands and lift value provisioning for customers to a higher level, as these services can involve previously unavailable solutions. As such, they can help to retain customers that develop an interest in smart services and who would leave if a machine builder does not offer specific services. To a greater or lesser extent, all the companies analysed expect this retention effect to materialise. Concerning the speed with which current customers will start consuming smart services, the companies are not unanimous, and Paper-Co in particular declared that this may take time. Hence, the degree to which smart service offerings will translate into revenue creation and business growth may vary.

Second, smart services can strengthen the relationship with current customers, as they may serve to lock them in and generate spill-over effects in the form of purchasing more of a machine builder's base services, such as spare parts delivery, repair and training, as well as refurbishment. These effects may follow from a more embedded relationship with customers through the deployment of smart services and can generate a preference for a one-stop shopping by customers. In their search for integrated solution providers, they may opt for suppliers that can provide smart services and contract conventional services from them. This final point was made by Drill-Co.

The latter can especially represent a gain when dealing with customers who tend to stray after the warranty period is over and who then request this kind of services from other providers. Such trickle-down effects on sales of basic and intermediate services, as well as recovering 'customers on the loose', were reported by Drill-Co and Mill-Co. Drill-Co in particular made it clear that this represents a curious side effect of the growing interest in concepts like Industry 4.0 and smart ways of doing business. In Drill-Co's view, these concepts pave the way for a rapprochement of industrial customers towards firmer buyer–supplier ties, although this may initially manifest itself in the form of requests for services that do not involve a high level of information technology (IT) content. As such, there may be a time lag between the appearance of smart services and their widespread deployment (Strange & Zucchella, 2017).

6.3.2. Landing New Customers in Existing Markets Through More Competitive Offerings

Smart services can also be instrumental in capturing new customers. This can happen in two complementary ways. One: offered in combination with a machine as a product–service system (Sassanelli, Seregni, Hankammer, Cerri, & Terzi, 2016; Tukker, 2004). In such scenarios, smart services can have a positive influence on the sales probability of the underlying machine, as noted by Mill-Co. Two: as a value proposition in their own right. The latter point was made by Drill-Co and Discharge-Co, expressing their conviction that their smart service offerings can produce situations in which users first try out the company's services and later purchase a machine. The expectation that smart services can form a prelude to product sales means that the typical sequence described by Freiling et al. (2012) can thus be inverted. Both firms also asserted that this can allow them to piggyback on rival firms' installed base. They foresee opportunities to provide smart services around competitor machines operated by firms that are not among their current customers, but that can be added to their portfolio, first by supplying services to them and later through the possible sales of new machines. This kind of customer capturing can also create new paths to internationalisation (Bharadwaj, Sawy, Pavlou, & Venkatraman,, 2013; Terpstra & Chwo-Ming, 1990).

6.3.3. Exploring New Markets and Diversifying Current Customer Relationships

Smart services can help to open up new markets, in either a geographical or a sectoral sense.

First, they can make it possible to land contracts in locations and on continents where companies do not have their own sales and service offices, as smart machine applications can compensate for the proximity deficit and facilitate services either online or via intermediaries that make use of augmented reality devices. This was indicated by Discharge-Co in particular. Should this materialise, the effect of smart services on creating new commercial possibilities can accelerate their pace and scope of international expansion (Forsgren & Hagström, 2007).

Second, smart services can make it possible to penetrate new sectors by means of selling smart services to customers who are not potential buyers of the production equipment the companies manufacture. This was something that Drill-Co considered possible and could also give rise to a form of internationalisation through diversification (Hashai & Delios, 2012).

6.3.4. Generating Value from Service Business Development

Based on our case findings we contend that newly developed service business activity may not translate into an equal level of new revenue creation. There are a series of factors that can prevent service provisioning from becoming a cash generator. For one, it may be related to the fact that firms often struggle with pricing services correctly, offering services for free, rather than for a fee (Witell & Löfgren, 2013). The supply side may feel uncomfortable charging for services, fearing that customers will not understand. It may also be due to treating services as a cost centre and not as a revenue centre (Lerch & Gotsch, 2014). Companies can also develop the habit of selling goods or product–service systems in an 'all-in' manner, with services included, meaning that fees for services are not charged separately and income related to service provisioning is not registered as such (Malleret, 2006; Rapaccini, 2015; Ulaga & Reinartz, 2011). Finally, if a supplier has traditionally used services as a pre-sales weapon, and at a certain point begins promoting smart services, the intended user typically reacts in a defensive manner (Saccani & Perona, 2014).

Hindrances to monetising the value of services were especially articulated by Discharge-Co, Drill-Co and Paper-Co. Conversely, the Mill-Co case was more optimistic in this regard.

All things considered, capturing value from smart services is not self-evident. In fact, whereas offering smart services looks to have a promising future, the level of income that providers can obtain from these may not always be proportional. As such, it may form a contemporary variant of the Solow Paradox (Acemoglu, Autor, Dorn, Hanson, & Price, 2014).

Table 2. Impact of Smart Services on a Firm's Product/Market Possibilities.

	Existing Market	New Market
New offerings	Uptake of smart services among captive customers (current users of the respective case companies' machines). Piggybacking on the installed base of rival firms by offering smart services around their machine bases (current non-users of the respective case companies' machines).	Providing smart services to new customers in new market areas, both in the form of geographic expansion and sectoral diversification.
Existing offerings	Additional consumption of base and intermediate services by users of smart services.	Following on from obtaining new customers in new locations (geographical expansion), but from the traditional sector(s) served by the company; such customers can also provide demand for base and intermediate services.

Source: Compiled by the author.

6.4. Interpretation of the Findings in the Light of Hidden Champions' Specific Features

An established leadership position in a global niche market is the result of a rigorous and focused strategy centring on a highly restricted product–market combination. While this is a great accomplishment, from the cases that we analysed for the present chapter, we have ascertained that this posture can also be accompanied by specific liabilities.

6.4.1. Use of Complementary Assets

The narrow focus of these firms on their value proposition and their stick-to-your-knitting attitude (Hilz, 2013; Simon, 2009; Venohr & Meyer, 2007, 2009) can produce organisational structures in which there is but little room for fringe activities and limited slack capacity to diversify overnight. Therefore, if the target market starts to broaden its demand specifications, companies with a hidden champion profile may find it hard to instantly accommodate such changes. This may be due to their limited size, the fact that they outsource only selectively and may act as *Einzelgänger* (Simon, 2009), and the strong manufacturing culture that often characterises them. The last means that whereas product development and production excellence are normally of a high standard, transforming into a full-service company – particularly, when this entails digitalisation and smartisation of service components – may require considerable organisational and cultural change. In the cases we studied, we have found that several of the firms need to shore up their big data analysis skills (specifically, Paper-Co, and to a lesser extent, Discharge-Co and Mill-Co), which arguably also requires changes in their organogram. Similarly, the firms in question have typically been operating without a dedicated service department in their organisations, meaning that service sales was the responsibility of general account managers or the sales force (who tend to prioritise machine sales, which trigger higher sales bonuses). This is also an (organisational) point of attention for them. In general, hidden champions may be good at coming to market first or convincing lead users with strong value propositions. However, once the market scales up (and goes from a true niche market for insiders to something more general) and complementary assets that ensure the possibility of reaching a wider audience start to count more, these firms may have more trouble keeping a grip on the growing market (Chiu, Lai, Lee, & Liaw, 2008; Lieberman & Asaba, 2006; Markides & Geroski, 2005). As for the context that we investigated, we have also seen how technologies and practices that invade both the manufacturing and customer care routines (cf. Industry 4.0 and servitisation) and do not emerge from the machining context itself (which these firms dominate very well) can act as disruptive forces and change the rules of the game (Acatech, 2013, 2015; Christensen & Raynor, 2003). In other words, they can alter what determines a company's competitiveness.

6.4.2. Centrality of Supplied Assets in the User's Value-Creation Processes

Another liability that may accompany the focus strategy followed by hidden champions is that the products (in this case, machines) they supply also fulfil a niche role within their customers' value-creation processes and production lines. As a consequence, their machinery can either be used for stand-alone operations, or it may play a minor or perhaps subservient role in an overall machine park in which other assets occupy a pivotal position. This can also have a negative impact on the role of hidden champions in their customers' digital transformation and smartisation processes. When customers consider propositions from machine and/or IT suppliers for data analytics and digitalisation processes, it is likely that providers of specialist equipment will be asked to adhere to protocols and platforms proposed by actors with a bigger stake in the customers' operations (Kamp, Ochoa, & Diaz, 2016). This is particularly notable in the case of Discharge-Co and Drill-Co. Only Mill-Co reported that its machines typically take central stage in its customers' production operations and these customers, therefore, grant them more leeway in customer data capturing and smart service initiatives.

7. CONCLUDING REMARKS

Based on the findings obtained, we argue that the relationship between smart services and international business development is neither direct nor causal, as several intervening variables or contingencies were found to moderate this association. Many of these intervening variables are associated with demand-side factors, and as such, the impression that can be derived from multiple studies (Acatech, 2015; Porter & Heppelmann, 2014) that smart services are subjected to a market pull may be delusive. Consequently, our findings indicate that there is a risk of being overly optimistic about the possibilities for industrial companies to develop a lucrative international business on the back of smart services. As such, the technological changes unfolding under the umbrella of 'Industry 4.0' present not only opportunities, but also challenges for established firms (Tulder, Verbeke, & Piscitello, 2018), including those with a hidden champion profile.

The companies reviewed can be considered 'internationally-oriented niche firms' (Toften & Hammervoll, 2009), and for this kind of niche operator, a focused strategic posture and equivalent positioning in international specialty markets make sense. However, just as unrelated diversification or overdiversification can have negative repercussions on the overall performance of firms, particularly smaller ones (Bengtsson, 2000), so too can a narrow or static definition of 'the company's core business' and 'the resources and skill sets subsequently required' (Barney, 1991). Internationalised firms of this kind thus need to strike a balance between staying focused and must incorporate new (technological and service) elements into their market propositions (Din, Dolles, & Middel, 2013).

Clearly, the insights that are derived from the research undertaken come with several limitations. First, the study was exploratory in nature and conducted on a small sample of firms from a single sector. Second, the kind of issues examined require a longer time frame to produce exhaustive assessments. For this reason, conducting an applied longitudinal analysis of the questions addressed in this chapter might be a worthy subject for future research.

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CHAPTER 12

ADDITIVE MANUFACTURING AND GLOBAL VALUE CHAINS: AN EMPIRICAL INVESTIGATION AT THE COUNTRY LEVEL

Filippo Buonafede, Giulia Felice, Fabio Lamperti and Lucia Piscitello

ABSTRACT

Additive manufacturing (AM) has the potential to transform the organisation of all the activities carried out by firms. The growing diffusion of these technologies is increasingly challenging multinational enterprises to reinvent their businesses. Accordingly, many scholars argue that AM may reduce countries' participation in global value chains (GVCs) or, at least, affect GVCs' geography, length and further developments. However, so far, the lack of available data on the real worldwide diffusion of these technologies has precluded the possibility to study this phenomenon from an empirical standpoint.

This study investigates AM technologies, with a particular focus on their possible impact on GVCs, in the framework of the current debate in international business. In order to examine this relationship and overcome the lack of adoption data, the authors identify a potential proxy of AM diffusion – that is, patenting activity. Coherently, the authors employ this proxy and a country-level measure of GVC participation (i.e., the Share of Re-Exported Inputs on Total Imported Inputs) to empirically investigate the role of AM in influencing countries' participation to GVCs. This country-level analysis is focussed

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on three specific industries and the aggregate economy in 58 countries for the period 2000–2014.

The results show that AM decreases a country's participation in GVCs, both at the country level and, in particular, in the sectors which are more likely to be affected by AM technologies. This evidence suggests that this phenomenon might be induced by a decreasing reliance on intermediates processed abroad, hence an increasing importance of domestic goods, manufactured via AM.

Keywords: Additive manufacturing; 3D printing; global value chains; patents; technology diffusion; GVC participation

1. INTRODUCTION

There has been a growing attention towards the rise of new techno-economic paradigms during the last decade. Amongst such innovations, additive manufacturing (AM) technologies are now deemed as the most likely to entail a transformation in the structures and processes that have ruled international business (IB) for decades. Thanks to its flexibility, high-customisation potential and cost savings, AM is believed to have the potential to revolutionise the way existing global value chains (GVCs) organise production processes. Consistently, several questions have recently been brought up around the role AM may play in affecting the traditional dynamics, which drives the activities of multinational enterprises (MNEs), the span and the geography of their operations.

Even if AM has been traditionally investigated by scholars in engineering studies, recently, this topic has begun to attract also the interest of economists. This has fed a rising debate around the multitude of implications these technologies encompass for firms in different manufacturing sectors, focussing on the implied change in firms' performance, production processes and employment. Nonetheless, the potential effects deriving from the widespread adoption of AM devices have received only marginal attention in the field of IB (Alcácer, Cantwell, & Piscitello, 2016). In particular, mostly theoretical consideration and few evidence have been put forward on the transformation of the length and geography of GVCs' activities (e.g., Laplume, Petersen, & Pearce, 2016).

Within this context, the following chapter aims to provide some empirical evidence on the relationship between the adoption of AM and a country's involvement in GVCs. Namely, after presenting a brief overview of the history of AM, its features and applications in Section 2, Section 3 presents a survey of the literature on the main channels relating AM and GVCs. Then, Section 4 presents a descriptive evidence on the two main sets of data used in this work. In Section 5, we develop an econometric analysis at the country level, investigating the relationship between the patenting activity in AM technologies, and the countries' participation in GVCs, in the period 2000–2014. Finally, Section 6 presents our results, showing a negative relationship between countries' patenting activity in AM and their participation in GVCs. These findings seem to confirm the shortening of the GVCs in some impacted industries. More specifically, the technology is found to negatively affect intermediates trade in the industries involved in the production of fabricated metal products, machineries and equipment. Furthermore, the supporting evidence of this impact is found also when inspecting the whole economy. Section 7 draws the concluding remarks of this study.

2. AM TECHNOLOGIES AND THEIR APPLICATIONS: THE STATE OF THE ART

AM is defined as 'the process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies, such as traditional machining' (ASTM International, 2012). The term *3D Printing* is commonly used as a synonym for AM. However, the latter is much broader, as it refers to any professional production technique clearly distinct from conventional manufacturing methods based on subtractive processes (Laplume et al., 2016).

AM first appeared in 1983, going into commercial use in 1988. During the '90s and until the early 2000s, these technologies have been used in many industries, but the application was limited to the rapid manufacturing of prototypes. Technology development was confined to the research and development (R&D) departments of a few firms (e.g., 3D Systems, zCorp, Stratasys and Objet Geometries) whilst the larger use of AM is a more recent phenomenon, mainly attributable to the launch of an open-source 3D printer project called *RepRap* in 2005. The project led to the commercialisation of a 3D printer able to self-replicate its components, hence driving down costs (Pearce, 2015; Bowyer, 2014; de Jong & de Bruijn, 2013; Jones et al., 2011; Sells, Bailard, Smith, & Bowyer, 2010). After the expiration of the core patent for the technology used in the *RepRap* in 2009, the adoption and diffusion of AM strongly increased, also thanks to the decreasing market cost of printers.

The flexibility of AM opens up to several applications in different industries. In fact, moving well beyond the immediate use in prototyping, these technologies possess the potential to revolutionise the manufacturing world. As one of the core technologies of the fourth industrial revolution, AM is gathering the attention of leading companies worldwide – for example, Mercedes-Benz, General Electrics, BMW and Nikon (Vanian, 2016). Even governments are considering implications and benefits of AM adoption in their industrial development agenda. Examples of this attempt are *America Makes*[1] in the US, *China Manufacturing 2025*[2] in China, *Industrie 4.0*[3] in Germany and *Piano Nazionale Impresa 4.0*[4] in Italy.

In practice, AM requires three basic ingredients: (i) a digital model of the object developed using a Computer Aided Design software or a 3D scanner device; (ii) the feed material to be used in the manufacturing process – for example, polymers, composites, metal powders, ceramics and functionally graded materials; and (iii) the AM device/3D printer. With regard to the third element, the device should be selected considering the type of process to be employed and the material used. The standards provided by ASTM International identify seven different process categories (see Table A1 in Appendix, for a description of the seven AM processes, range of materials available and the subsets of specific technologies).

The literature on AM focusses on three main applications for these technologies. First, the *Rapid Prototyping* consists in the rapid creation of prototypes for aesthetic/functional studies. The speed of the prototyping phase reduces both costs and complexity faced by firms during the new product development process, thus accelerating the jump from the design to the production stage. Second, the *Rapid Tooling* (RT) applies AM technology in the fast and cost-effective fabrication of moulds and dies for long-term use in traditional manufacturing processes. Substituting mainstream tooling techniques (e.g., plastic injection moulds) RT reduces overall production costs, especially in niches markets characterised by great product variety. Finally, the *Direct Manufacturing/Rapid Manufacturing* (DM/RM) represents the most disruptive application of AM. Differently from the two previous applications, DM implies the use of 3D printers for long-term production of finished products/components, enabling firms to completely reshape their manufacturing processes. However, implementation costs are not yet competitive compared to traditional techniques, especially in case of mass production. Moreover, many criticalities related both to produced objects and raw materials needs to be overcome before seeing DM become the mainstream production paradigm.

3. AM AND GLOBAL VALUE CHAINS

GVCs flourished in the '80s, when MNEs intensified international fragmentation of their activities mainly to exploit scale economies and reduce production costs, in particular labour costs.

The information and computer technology (ICT) revolution, allowing to manage complexity at distance, and to coordinate geographically dispersed activities, together with the continuous reduction in transport costs made it technically possible and economically profitable to split production stages across several countries, including developing ones (Baldwin & Lopez-Gonzalez, 2015). More recently, the Internet revolution – fostering instant and free information exchange – has opened up a whole set of new business opportunities, pushing towards higher geographic dispersion of MNEs' networks. Modern MNEs act indeed as institutions orchestrating international networks composed of different entities (Alcácer et al., 2016). As a matter of fact, Chen and Kamal (2016) show that the adoption of ICTs is positively associated with a greater likelihood of geographically dispersed in-house production, as measured by increases in intra-firm trade shares.

However, some scholars (e.g., Laplume et al., 2016) argue that AM may challenge this trend. In fact, AM may decrease the role of scale economies in several sectors and, being a capital intensive technology requiring skilled labour, its adoption might reduce the incentives for a country to participate in traditional GVCs, thus eventually changing the current geography of GVCs.

Henceforth, a short and not-exhaustive survey on the main channels linking the adoption of AM technology and GVCs is presented.

3.1. AM, Economies of Scale, Production Stages and GVCs

Since the second industrial revolution, the dominant production model has been based on specialisation and economies of scale. Accordingly, players who can produce the best part at the lowest cost become market leaders. In fact, the cost structure of conventional manufacturing processes is largely shaped by tooling expenses that are amortised over production runs (Atzeni & Salmi, 2012; Ruffo & Hague, 2007). As AM processes do not require tooling, cutting implements, moulds or dies, such scale economies are absent. Hence, these technologies may disrupt traditional competitive dynamic, replacing economies of scale with economies-of-one (Petrick & Simpson, 2013): flexibility, speed and complexity-for-free, typical of AM, allow to provide custom-made products with constant unitary costs.

For instance, the quest for scale economies in the manufacturing of goods like domestic appliances, apparel and laptops – typically produced in GVCs (Piore & Ruiz Duràn, 1998; Hobday, 1995) – has strongly reduced the scope for producing in close proximity to end-users. In fact, in order to exploit economies of scale, production processes are split and confined to large and centralised manufacturing plants producing intermediate goods and components, often placed in different countries to leverage differences in the factors' costs.

However, since AM allows fewer production stages, potentially requiring production activities and other tasks to be closely coupled (Rezk, Srai, & Williamson, 2016), it may reverse the trend towards fragmented and globally dispersed supply chains (Alcácer et al., 2016; Laplume et al., 2016). Consistently, the wide-scale adoption of AM devices would enable the decentralisation of manufacturing to points of consumption (D'Aveni, 2015; Petrick & Simpson, 2013), moving operations closer to the customer (Magnus, 2016) and, in turn, better understanding their needs. Eventually, the technology may push MNEs to pursue more local adaptation and sourcing, thus implying a reshape of GVCs of several goods towards shorter, more regional – or even local, independent and customs-tailored value chains. All this may bring to the proliferation of horizontal foreign direct investments (FDIs) and the reshoring of many activities to the advanced economies.

However, the peculiar characteristics of AM are not relevant in all production segments. In fact, AM seems more likely to be adopted in sectors, or industry segments, in which consumers asking for customisation and characterised by fast-changing preferences require quick responsiveness. Conversely, in most industries, economies of scale continue to be more profitable than AM (Kianian, Tavassoli, & Larsson, 2015). Thus, standardised goods' production, traditionally leveraging on economies of scale, will not be likely impacted in the near future. In fact, according to Laplume et al. (2016), the real impact AM might have on scale economies should be examined through a comparative analysis of the minimum efficient technical scale (METS), the core parameter characterising such production paradigm. Considering manufacturing of highly customised goods – that is, those potentially impacted by AM – a large product variety can be achieved via: (i) use of specialist machines producing modularised components – for example, in automotive; and (ii) use of generalist machines, like 3D printers, directly producing custom-tailored products – for example, in aerospace. Thus, if the cost of AM devices is low enough to justify buying one to print a single high-value product/component, thus creating substantial investment returns (Pearce, 2015), METSs become lower for AM relative to those for traditional subtractive technologies, which require high production volumes to justify their costs. In this case, scale economies may be eroded by 3D printers' diffusion. Therefore, the impact of AM on GVC participation might be strongly heterogeneous across sectors.[5]

3.2. AM, Skill Intensity and GVCs

Existing GVCs are based on a design-build-deliver model in which roles and responsibilities of the various participants are well established and orchestrated by MNEs (Petrick & Simpson, 2013; UNCTAD, 2013). Specifically, designers develop products trying to optimise a trade-off between satisfaction of customer's needs and production efficiency. As mentioned in Section 3.1, operations are oriented to minimise costs through the achievement of economies of scale and save on factors' costs. Finally, falling transportation costs as well as lower trade barriers allow to split the generation of value added along extended (i.e., global) supply chains (Gereffi, 2014; Baldwin, 2013; Gereffi, Humphrey, & Sturgeon, 2005; Sturgeon, 2002).

Goods are produced in low-wage countries as exploiting lower labour costs significantly offsets the added costs of shipping and transportation (Petrick & Simpson, 2013). Around this point, a debate is flourishing on the potential effects of the international fragmentation of production on the sectoral composition of advanced economies – that is, on its role in downsizing of the manufacturing sector (Baldwin & Lopez-Gonzalez, 2015) – and, in particular, in displacing low-skilled labour in high-income countries.

Nonetheless, several aspects such as the increasing attention for the *made-in* factor, the increasing wages in emerging economies, hardness in achieving high quality in low-wage countries and, amongst them, the emergence of new process innovations – for example, AM technologies (Kianian et al., 2015) – are likely to have an opposite effect.

In traditional manufacturing, the most valued workers are the tool and die makers. In the 3D world, these production jobs may be replaced by pre- and post-processing operators (Ben-Ner & Siemsen, 2017; Kylau, Goerlich, & Mitchell, 2015; Stahl, 2013). Moreover, AM would require other types of jobs such as designers, engineers, technicians and software programmers, on both the development and the application side of the technology. Basically, looking at production factors encompassed by AM technologies, a change in their relative composition is likely to be experienced: on the one hand, additive processes are relatively less labour intensive and more capital intensive (Rehnberg, 2015); on the other hand, they are more skill intensive. AM technologies enable fewer skilled workers to produce more of highly complex parts, cutting assembly times and reducing labour costs, ultimately raising labour productivity (Abeliansky, Martinez-Zarzoso, & Prettner, 2016; Kylau et al., 2015; Cautela, Pisano, & Pironti, 2014). However, future effects on labour market – for example, proliferation of new job figures, short- and long-run adjustments in developed economies, geographical concentration of activities – are controversial (Abeliansky et al., 2016; Kilkenny, 2014; Stahl, 2013).

Nevertheless, it is very likely that productivity gains enabled by AM and the need of skilled labour make labour costs a less relevant driver in the location decision when these technologies are employed, allowing to place operations even in high-wage regions. In other words, the use of AM devices fosters a need for high-skilled labour, thus reducing the incentives to look for low-wages locations.

In addition to this, on the operational side, a distinction should be made. If AM is employed in labour-intensive manufacturing processes, this certainly implies a reduction in the quantity of manpower required, so reducing the need to locate these activities in low-wage countries. However, in cases of application in already highly automated operations the impact coming from the use of AM is rather low (Laplume et al., 2016). Hence, only when considering the first scenario AM technologies entail the potential to bring back some activities of the value chain that long ago have been relocated in emerging countries (*The Economist*, 2012). Obviously, this reshoring trend implies an increase in the labour force related to AM – for example, 3D goods producers, 3D renovation and repair jobs, and material recycling jobs. Again, the impact of AM adoption will be very heterogeneous across sectors.

Moreover, AM may imply important changes also on the organisational side. Organisations can be substantially smaller and more geographically dispersed, thus implying changes in the distribution of occupations and, consequently, in managerial competencies, entrepreneurship and skills needed (Ben-Ner & Siemsen, 2017).

To conclude, it is nevertheless worth noting that the growing importance of ICT technologies pushed towards the creation of knowledge clusters also in low-wage countries, pursuing specialisation purposes and attracting investments by MNEs – for example, Bangalore and Shenzhen. Similarly, it will be likely to see centres of excellence for AM spreading out in collaboration with university and public administrations in the coming years (Rehnberg, 2015; Kilkenny, 2014). In fact, AM requires the assimilation of novel knowledge and skills, a key factor to fully exploit its potential (Jiang, Kleer, & Piller, 2017; Mellor, Hao, & Zhang, 2014). When these AM-related competences are acquired, actors can leverage them to access other GVCs where previously there was no access (Rehnberg, 2015; Gereffi, 2014). For example, Airbus made its aerospace technologies adoptable in many different industries: thanks to AM, they succeeded in becoming vertically integrated along the entire value chain, from design to serial production (Mellor et al., 2014).

4. DATA AND DESCRIPTIVE STATISTICS ON AM PATENTING AND GLOBAL VALUE CHAINS

4.1. AM in Patents Data

In order to measure AM adoption, we rely on patent data. In particular, we follow Abeliansky et al. (2016) in defining patenting activity as an indicator of the level of diffusion, coherently performing a primary data collection of patent data on AM.[6] Specifically, we refer to the United States Patent & Trademark Office (USPTO), which is arguably the reference office for the breakthrough technologies[7] (Cantwell, 1995).

To collect the most complete set of patents on AM technologies, we searched both granted patents (i.e., patents on hold), and patent applications (i.e., all patents that are submitted to USPTO for approval). These two categories of patents reside in two distinct databases: if the patent is still on the process of approval, it is stored in the Patent Application Full-Text and Image Database (AppFT); after being granted, the patent is transferred into the Patent Full-Text and Image Database (PatFT) (US Patent & Trademark Office, 2017). Specifically, accepted applications go through an examination process delivered by specific technology centres having charge of the invention-related technology. The examination involves the inspection of the application for compliance with legal and originality requirements. This is done by checking through the United States and foreign patent documents and available literature. Only after this process, which lasts from one to two years, a patent is granted. In other words, until the examiner's approval, the subject of the application cannot be considered an innovation or 'sufficiently different from what has been used or described before' (US Patent & Trademark Office, 2018). However, by publishing the application on the AppFT, the patentee receives the right to obtain a reparation in case of a third party's infringement of the published application claim before the patent is granted (US Patent & Trademark Office, 2018).

The AM technology terms we used in search queries on both databases are shown in Table 1.

The total number of patents resulting from these queries amounted to 3,565 (1,084 granted patents and 2,481 patent applications) for the period 1986[8]–2017. A notable part of this work included examining each patent and eliminating those

Table 1. AM Technology Terms Searched in USPTO Databases.

Broad Terminology	*Technology Families*	*Specific Technologies*
	Vat photopolymerisation	Stereolithography
		Digital light processing
		Continuous liquid interface production
AM	Powder bed fusion	Selective laser sintering
		Selective laser melting
		Direct metal laser sintering
3D printing	Material extrusion	Fused deposition modelling
		Fused filament fabrication
	Material jetting	Multi-jet modelling
		Poly-jet matrix
	Binder jetting	
	Sheet lamination	
	Direct energy deposition	Laser metal deposition
		Laser engineered net shaping

which were not specifically referred to AM. After this screening process, we kept 2,623 patents, eliminating 26.4% of the sample. To provide a glance on the ferment around the technology, we plotted the results of our retrievals, separately, using publication date (Cantwell, 1995). The distribution of patents on hold (601 occurrences) and patent applications (2,022 occurrences) is illustrated in Fig. 1. Volumes and trends of patenting activity around AM are consistent with those presented in previous studies (Abeliansky et al., 2016; D'Aveni, 2015; Wohlers Associates, Inc., 2014).

Locating a patent can be a complex task (Jaffe, Trajtenberg, & Henderson, 1993).[9] Following the extant literature, we adopted the *Inventor Country* principle (Bergek & Bruzelius, 2010; Cantwell & Piscitello, 2000). However, the inventors of a patent are usually more than one, and they do not necessarily have the same country of residence; therefore, this principle is not unique and three main criteria are used to define the inventor country. The official trade statistics of the USPTO and a consistent group of notorious researchers[10] use the *First Inventor Country*, because the first inventor is, namely, the 'primary' or 'priority' inventor (Bergek & Bruzelius, 2010; Stolpe, 2002). Being the most used in the extant literature, we used the *First Inventor Country* principle.[11]

To provide the most accurate measure of innovation activity on AM as a proxy of technology diffusion, we consider only granted patents. Our analysis encompasses data up to October 2017. To that date, we count 601 granted patents and 19 inventor countries. As Fig. 2 illustrates, 70.5% of observations belong to the US alone, with 424 observations. For a better graphical representation, in Fig. 2, we decided to not show countries with less than five granted patents during the period 1986–2017 – that is, Denmark (1), Australia (2), Belgium (2), Russian Federation (3), France (4), Netherlands (4) and Singapore (4). The data in Fig. 2

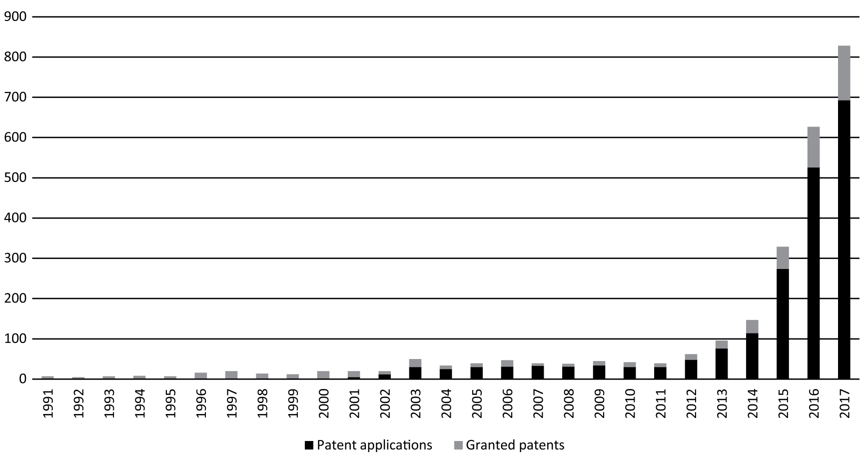

Fig. 1. Distribution of Granted Patents and Patent Applications on AM.
Source: Authors' elaborations on USPTO data.
Notes: Years previous 1991 are not shown due to graphic reasons.

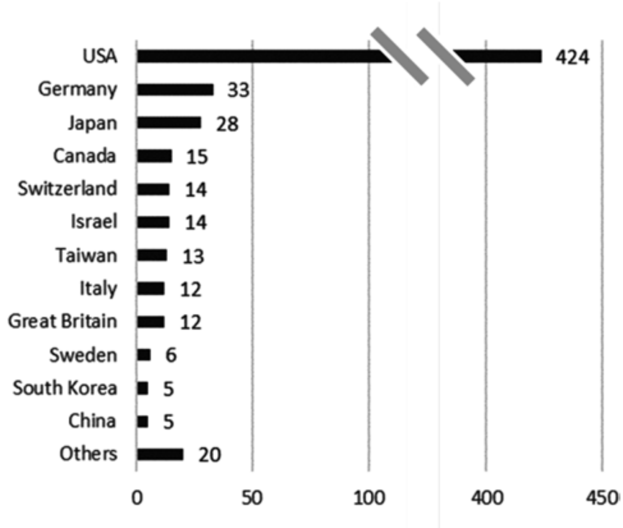

Fig. 2. Cumulated Number of Granted Patents on AM, by Country, over the Period 1986–2017.
Source: Authors' elaborations on USPTO data.
Notes: *X*-axis scale has been cut due to graphic reasons.

show that the biggest innovators are the United States, Germany and Japan. This confirms their acknowledged attitude to behave as constant innovators, as Taglioni and Winkler (2016) and the Organisation for Economic Co-operation and Development (OECD) (2015) define these three countries as 'knowledge centres' over the *hi-tech* sectors.

Fig. 3 reports a comparison between the US and the other inventor countries. First, we observe that the United States have been the engine of patent creation in this field for a long initial time span, and that the contribution coming from other countries have become significant only starting from late 1990s, growing moderately until 2010. Second, we observe a strong increase in the overall patenting from 2012 on, for both the United States and the other countries. This is mostly due to the growing attention that the technology has gathered in recent years, to the investment programmes on Industry 4.0 (of which AM is one of the core technologies), which had taken place in most developed and developing countries, and, finally, to individual firms' decisions to invest and innovate in this field.

Focussing on AM knowledge creation taking place in countries other than the United States, Germany and Japan were, on average, constant patent creators. Notably, Switzerland was quite active during late 1990s, whilst its knowledge production was almost absent during 2000s. Italy and Israel have been quite productive starting from 2012 onwards; Taiwan has started patenting on AM just from

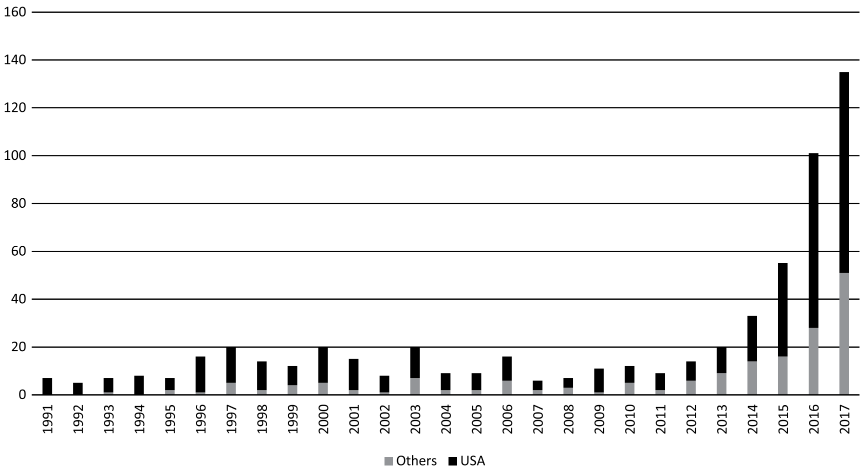

Fig. 3. Comparison between United States and Other Countries in Patenting Activity on AM.
Source: Authors' elaborations on USPTO data.
Notes: Years previous 1991 are not shown due to graphic reasons.

2016, but outpacing the other analysed countries, this probably signalling that the technology is receiving much attention in the country and configuring Taiwan as a late innovator.

4.2. GVCs Indicators

In order to analyse the GVC participation, we rely on two indicators provided by the Trade in Value Added (TiVA) database (OECD). This database tracks the contribution of 58 countries in bilateral trade for each sector through 46 indicators of trade in intermediates and in value added for the period 2000–2014.[12]

The two indicators are the *Share of Re-Exported Inputs on Total Imported Inputs* and the *Foreign Value Added in Exports as a Share of a Country's Exports.*[13] TiVA indicators represent the inheritance of previous works (Koopman, Wang, & Wei, 2014; Johnson & Noguera, 2012; Hummels, Ishii, & Yi, 2001). They are a powerful and widely used tool to track GVC participation (Taglioni & Winkler, 2016).

The *Share of Re-Exported Inputs on Total Imported Inputs* can be seen as an enhancement of the Vertical Specialisation (VS) measure by Hummels et al. (2001) who aimed at measuring the growth of fragmentation of production. In particular, the *Share of Re-Exported Inputs on Total Imported Inputs* only accounts for intermediate exports rather than all exports. The *Foreign Value Added in Exports as a Share of a Country's Exports* it is also a further refinement of the VS measure by Hummels et al. (2001), since it is computed in value-added terms instead of in gross terms. In conclusion, for both indexes, the higher the value the higher the degree of participation to GVCs.

We consider the total economy and three industries which, according to Laplume et al. (2016)[14] are amongst the most likely to be impacted by AM:

- CTOTAL: the whole economy of the country.
- C28: fabricated metal products except machinery and equipment. This sector is being impacted by AM, since it is employed in the production of complex metallic components. This technology provides, in fact, a high finishing quality and high versatility.
- C29: machinery and equipment not elsewhere specified. This sector includes also the production of AM devices. Since some models of 3D Printers allow to replicate more than 50% of their own components, this sector is likely to deploy this technology in the production process.
- C34: motor vehicles, trailers and semi-trailers. This sector includes a big part automotive sector. In particular, thanks to its ability to produce integrated sub-assembly, AM reduces the assembling time. For this reason, the technology is likely to being adopted in this industry.

Fig. 4 shows the relative positioning of the analysed countries according the two TiVA metrics used to measure GVC participation. To provide a better clue, each country has been shown as a bubble reporting the size of its gross domestic product (GDP). At the aggregate level, for the whole economy – that is, CTOTAL – we can see that a low *Share of Re-Exported Inputs on Total Imported Inputs* (see Fig. 4 lower-left quadrant) can be explained through an upstream position in the GVC: Saudi Arabia, Colombia, Peru, Brazil and Australia are, in fact, big producers and exporters of natural resources. A second reason for low levels of *Share of Re-Exported Inputs on Total Imported Inputs* is the magnitude of an economy. The big players are those countries with the highest level of population, GDP and intellectual property rights (e.g., the United States and Japan). Conversely, high levels of *Share of Re-exported Inputs on Total Imported* indicate the embeddedness into a GVC, and this is the case of all the manufacturing-intensive countries located in the low-value-adding part of the GVC, such as Estonia, Malaysia, Cambodia, Thailand, the Slavic countries and Mexico.

Looking at *Foreign Value Added in Exports as a Share of a Country's Exports*, countries involved in the middle of GVC and countries with a low internal final consumption tend to perform best in this indicator (see Fig. 4 quadrant upper right). On the contrary, big final markets and exporters of natural resources tend to have a lower *Foreign Value Added in Exports as a Share of a Country's Exports*, because they do not focus on processing intermediate imports.

In general, Figure 4 shows that the two indicators capturing the level of a country's involvement in GVCs are, as expected, positively related.

5. EMPIRICAL EVIDENCE

This section provides a preliminary investigation on the relationship between a country's activity in the process of new AM technologies' creation and its

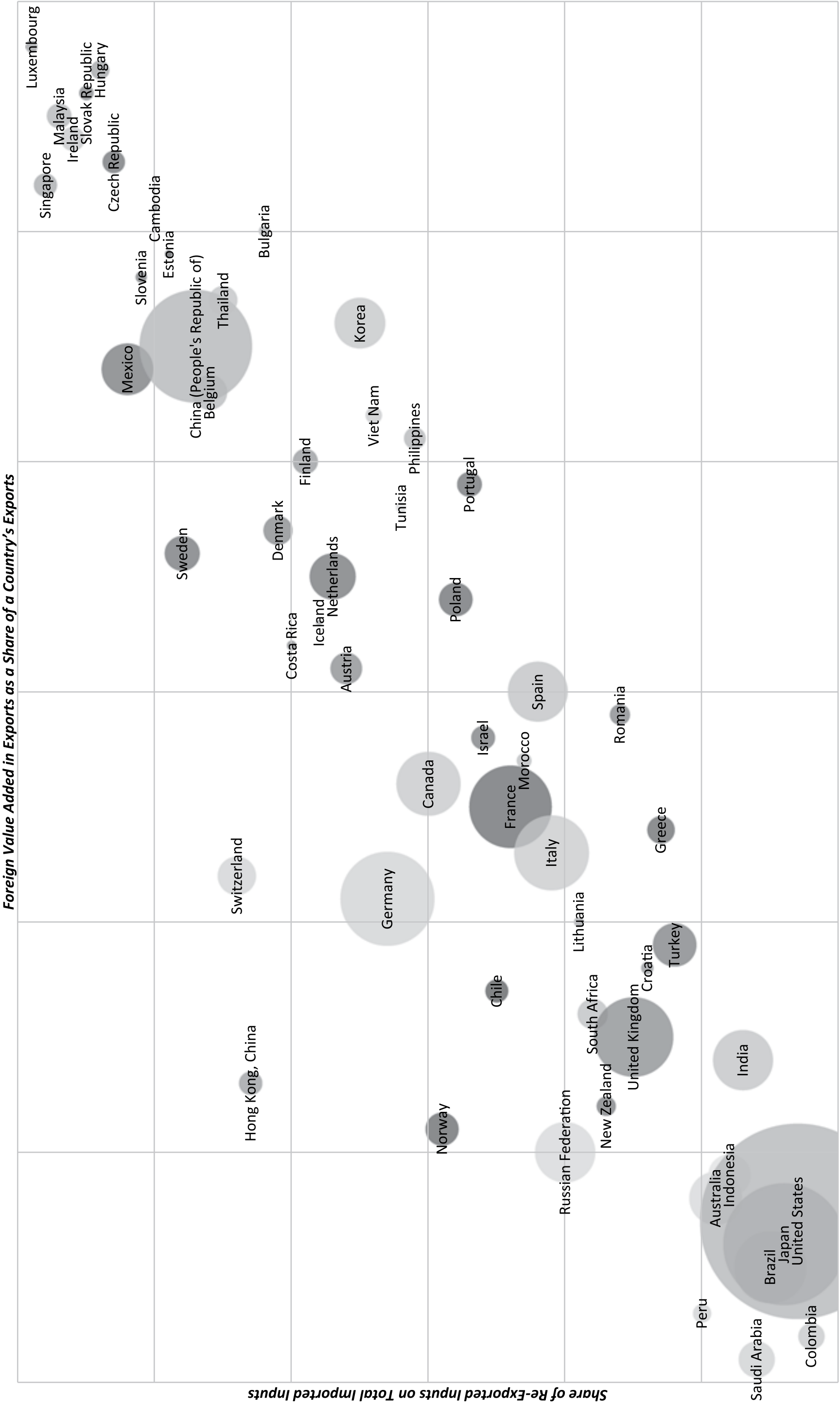

Fig. 4. Countries' Relative Positioning in GVC Participation.
Source: Authors' elaborations on TiVA data.

participation to GVCs. As highlighted in Section 3, the literature points out the existence of several channels linking AM technologies with involvement in GVCs, in general, predicting that AM technologies are likely to reduce the degree of international fragmentation of production and, therefore, the creation of GVCs (Laplume et al., 2016). Nevertheless, effects going in different directions also emerge. In the end, what prevails is an empirical question.

5.1. Data, Empirical Strategy and Methodology

In the following analysis, the proxy of GVC participation used as dependent variable is the *Share of Re-Exported Inputs on Total Imported Inputs,* from TiVA database, computed for the three industries of interest, and the aggregate economy, as described in Section 4.2. The summary statistics of the dependent variables are reported in Table A3 in Appendix.

To account for the ferment around new technology in the field of AM – that is, the main explanatory variable of interest in this analysis – patent data as described in Section 4.1 are employed. This variable is a count variable; however, including this proxy in the models as a pure count when inferring potential interactions with GVC participation could lead to non-representative results due to the yet highlighted peculiarity of data. Hence, following OECD guidelines for constructing patents' indicators (OECD, 2005), the adopted proxy is *AM patent as a share of the population* (expressed in millions), in order to standardise for country size.

The main explanatory variable (i.e., the AM proxy) is included in an empirical model where other potential determinants of GVC participation have been considered, following the previous literature. A first one is the extent of *property-rights protection*, measured by an index built by researchers at the Fraser Institute using data from the International Country Risk Guide. This index ranges from 1 to 10 and provides an internationally comparable measure of the overall security of property rights and the quality of the legal structure (Caselli & Coleman, 2001). Protection of property rights is clearly positively affecting both the patenting activity of a country in all technologies, amongst which AM, and its attractiveness as a partner in GVCs, this way working as a potential confounding factor in the analysis of the relationship between the two.

A second factor potentially affecting GVCs participation is a country's degree of connectivity, measured by the number of *fixed broadband subscription* retrieved from the World Development Indicators database of the World Bank. This variable aims at capturing the extent to which a country is facilitated in the exchange of information (e.g., trade and financial data and technology transfer) with other countries within the GVCs. All else being equal, we expect that a higher degree of digital connectedness makes it easier for a country to being highly involved in global production networks.

Population and *GDP per capita*, both retrieved from the World Development Indicators database of the World Bank, have been included to control for country size and level of development, respectively. Indeed, both these variables are likely to affect simultaneously a country's participation to GVCs and its patenting activity; therefore, omitting them from the analysis could potentially generate a spurious correlation between AM patenting and participation to GVCs.

Furthermore, Taglioni and Winkler (2016) identify three main country-level characteristics that are likely to influence the degree of participation to GVCs: the level of tertiary education, the geographical distance from 'knowledge centres', and the logistic performance. Specifically, they find that the share of workers with tertiary education is positively correlated with GVC participation. Hence, following their findings, we included the *gross tertiary enrolment ratio* – that is, a variable accounting for the level of skill intensity of a country. Data on tertiary education, collected by the United Nations Educational, Scientific and Cultural Organization (UNESCO), have been retrieved from the World Development Indicators database of the World Bank.

Concerning a country's geographical closeness to major knowledge centres, Taglioni and Winkler (2016) identify the United States, Germany and Japan as major knowledge centres because they score highest in the network analyses determining the centrality of value added outflows[15] and find that they are positively correlated with GVC integration.[16] We rely upon data on geographical distances between each country's capital and the capital of the closest amongst the three knowledge centres. Data come from the CEPII's GeoDist database (Mayer & Zignago, 2011). However, since time-invariant nature of distance measures is not consistent with the inclusion of fixed effects, the inverse of distance, weighted by the GDP of the correspondent knowledge centre, has been computed. The resulting measure represents a *weighted proxy of geographical proximity*.

Finally, logistic performance represents a country infrastructures' efficiency and capillarity in terms of lead times, quality and traceability. The indicator proposed by Taglioni and Winkler (2016) is the Logistic Performance Index[17] (LPI), computed and published by the World Bank. However, for the time interval considered here, LPI data are available for a few years only. Hence, we consider two different set of proxies for the logistic performance of the country. The former consists of three variables retrieved from the World Development Indicators database of the World Bank: *railway total coverage* expressed in km, measuring the capillarity of a country internal transport infrastructures; the number of *registered air carrier departure* with international destinations and the *container traffic in ports*, both accounting for the level of development and efficiency of logistic infrastructures related with international exchange of goods. The latter is made up of four variables encompassing the *investment in logistic infrastructures* – that is, *roads*, *railways*, *airports* and *ports* – expressed *as a share of GDP*. The ITF Transport Statistics database of the OECD reports these data as yearly total amount invested in new logistic projects, expressed in €. GDP shares have been computed using US$/€ exchange rates from the Penn World Table 9.0 (Feenstra, Inklaar, & Timmer, 2015) and GDP from the World Development Indicators database of the World Bank.

The empirical analysis consists in estimating a fixed effect model for each of the three specific industries which, according to Laplume et al. (2016) are most likely to be affected by AM technologies (see Section 4.2), and for the aggregate economy.[18]

Hence, the estimated model has the following formulation:

$$GVC_{it} = \alpha + \beta AM_{it} + \gamma X_{it} + \eta_i + \sigma_t + \varepsilon_{it}$$

where GVC_{it} is the proxy for GVC participation – that is, *Share of Re-Exported Inputs on Total Imported Inputs*, computed for the three industries and for the aggregate economy; AM_{it} represents the main variable of interest – that is, *AM patent as a share of the population*[19]; X_{it} represents the vector of the other time-varying variables potentially affecting GVC participation as listed above; η_i and σ_t are country and time fixed effects; and ε_{it} is the idiosyncratic error term.

The empirical strategy implemented is the following: for each of the four industries/aggregate, three different specifications of the fixed effect model have been estimated. The first one includes all the aforementioned variables as determinants of GVC participation – that is, property-rights protection, fixed broadband subscriptions, population, GDP per capita, tertiary education, weighted geographical proximity, except for the two sets of variables proxying the logistic performance. The second specification adds to the analysis the first set of logistic variables, whilst the third specification comprises the second set of logistic proxies. So, the first specification of each fixed effects model represents the baseline model.

The results of the merging of the different datasets is an unbalanced panel for the period 2000–2014 for 57, 46 and 27 countries, for the baseline model, the second and the third specification, respectively. Summary statistics and correlation between the explanatory variables are reported in Table A4 in Appendix; variables and data sources are reported in Table A5 in Appendix.

6. ECONOMETRIC FINDINGS

Results are reported in Table 2. In general, all the specifications for all sectors and for the aggregate show a negative relationship between the proxy of AM technologies and the index of GVC participation. There are nevertheless differences in the magnitude of the coefficients and in the level of statistical significance.

The first three columns show results for the industry producing fabricated metal products except machinery and equipment – that is, C28. Column (1) shows the baseline specification of the model without accounting for the effects of logistic performance on GVC participation. Columns (2) and (3) in Table 2 show the estimates for the specifications including the two different sets of logistic performance proxies described in Section 5.1. In the baseline model, the *AM patents* proxy variable shows a negative relationship with participation in GVCs, statistically significant at the 5% level. In particular, a 1% increase in *AM patents* seems to be associated with a 0.68% drop in the re-exported inputs share of intermediate imports. The proxy used could also account for unobserved characteristics related to AM, such as country-level adoption of the technology. In such case, this result would suggest that AM technologies, due to their peculiar features, are indeed associated with a reduction in the flow of intermediates traded

Table 2. Determinants of GVC Participation and Effects of AM Patenting Activity.

	C28			C29		
	(1)	(2)	(3)	(4)	(5)	(6)
AM patents (% of population)	−0.679** (0.266)	−1.139** (0.462)	−1.153*** (0.378)	−0.613** (0.253)	−1.302*** (0.371)	−0.656* (0.373)
Property-rights protection	−0.154 (0.103)	−0.011 (0.058)	−0.035 (0.081)	−0.031 (0.090)	0.002 (0.080)	−0.125 (0.096)
Fixed broadband subscriptions	0.010 (0.014)	0.004 (0.017)	0.002 (0.025)	0.042* (0.021)	0.022 (0.025)	0.017 (0.034)
Population	−1.226** (0.502)	−0.539 (0.532)	−1.055* (0.612)	−0.755* (0.444)	−0.676 (0.560)	−1.124** (0.497)
GDP per capita	−0.606*** (0.139)	−0.828*** (0.164)	−0.422* (0.234)	−0.449** (0.188)	−0.591*** (0.208)	−0.447 (0.315)
Gross tertiary enrolment ratio	0.195* (0.106)	0.329** (0.128)	0.312** (0.136)	−0.066 (0.131)	0.170 (0.173)	0.344** (0.149)
Weighted geographical proximity	0.653 (0.833)	0.151 (0.720)	−0.036 (1.137)	0.667 (0.945)	0.355 (0.936)	0.028 (0.846)
Railway total coverage		−0.049 (0.129)			−0.178 (0.209)	
Registered air carrier departures		0.031 (0.067)			0.022 (0.051)	
Container port traffic		0.045 (0.052)			−0.018 (0.036)	
Investments in roads (% of GDP)			−0.004 (0.030)			0.028 (0.033)
Investments in railways (% of GDP)			−0.025 (0.020)			−0.039 (0.025)
Investments in airports (% of GDP)			0.002 (0.012)			0.002 (0.015)
Investments in ports (% of GDP)			−0.015 (0.017)			0.001 (0.019)
R^2 within	0.264	0.455	0.455	0.305	0.440	0.511
Number of obs.	688	446	305	688	446	305
Number of groups	57	46	27	57	46	27

Table 2. *(Continued)*

	C34			CTOTAL		
	(7)	(8)	(9)	(10)	(11)	(12)
AM patents (% of population)	−0.115	−0.570	−0.466	−0.210	−0.427*	−0.583***
	(0.200)	(0.437)	(0.290)	(0.216)	(0.249)	(0.185)
Property-rights protection	−0.126	−0.016	−0.188**	−0.097	−0.043	−0.120*
	(0.091)	(0.091)	(0.088)	(0.061)	(0.049)	(0.059)
Fixed broadband subscriptions	0.050**	0.058*	0.033	0.002	−0.003	−0.005
	(0.021)	(0.031)	(0.033)	(0.011)	(0.014)	(0.021)
Population	−0.545	−0.351	−0.360	−1.088***	−0.764*	−1.048**
	(0.484)	(0.785)	(0.463)	(0.403)	(0.407)	(0.481)
GDP per capita	−0.326*	−0.443*	−0.389	−0.295**	−0.406***	−0.124
	(0.181)	(0.246)	(0.304)	(0.145)	(0.151)	(0.198)
Gross tertiary enrolment ratio	0.061	0.176	0.293**	0.059	0.194*	0.267**
	(0.130)	(0.211)	(0.135)	(0.098)	(0.105)	(0.098)
Weighted geographical proximity	−0.193	0.232	−1.024	0.661	0.073	0.293
	(0.683)	(0.956)	(0.643)	(0.688)	(0.585)	(0.771)
Railway total coverage		0.304			0.074	
		(0.277)			(0.132)	
Registered air carrier departures		−0.021			−0.009	
		(0.072)			(0.029)	
Container port traffic		0.009			0.008	
		(0.109)			(0.029)	
Investments in roads (% of GDP)			0.038			0.003
			(0.032)			(0.020)
Investments in railways (% of GDP)			−0.041**			−0.029**
			(0.019)			(0.012)
Investments in airports (% of GDP)			0.006			−0.007
			(0.013)			(0.012)
Investments in ports (% of GDP)			−0.001			0.008
			(0.016)			(0.012)
R^2 within	0.145	0.240	0.396	0.244	0.404	0.480
Number of obs.	688	446	305	688	446	305
Number of groups	57	46	27	57	46	27

Notes: C28 is the industry producing fabricated metal products except machineries and equipment; C29 is the industry producing machineries and equipment; C34 is the industry producing motor vehicles, trailers and semi-trailers; and CTOTAL is the aggregate economy. The dependent variable is the *Share of Re-exported Inputs on Total Imported Inputs* for each industry/aggregate. All variables are expressed in natural logarithmic form, hence figures reported are expressed in terms of elasticities. Explanatory variables are lagged with respect to the dependent variable by one year, except for *AM patents (% of population)*. Standard errors are controlled for heteroskedasticity and clustered at country-level (i.e., groups). Coefficients for country and year dummies are not shown.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

and finally being accounted as inputs for industry C28. As for the other variables, in line with what suggested by Taglioni and Winkler (2016), *gross tertiary enrolment ratio* is positively related with a country's degree of participation to GVCs, even if only weakly significant. Results in specifications in columns (2) and (3) confirm a negative relationship of AM with GVC participation, which is larger in magnitude and increasingly statistically significant by adding the different sets of proxies for logistic performance (5% and 1 %, in columns (2) and (3), respectively). In fact, the coefficients almost double in both the second and the third specifications, implying that a 1% increase in innovative ferment causes around a 1.14% decline in the involvement in GVC-related trade. This is possibly due to the different sample of countries considered, as discussed in the end of this section. Also, the positive relationship of education on participation to global production networks increases, as the *gross tertiary enrolment ratio* becomes statistically significant at the 5% level and in both specifications the coefficients increase by about 50%, determining that a 1% increase in tertiary education implies about a 0.32% increase in participation. In all the three specifications of the model for industry C28, *property-rights protection*, *fixed broadband subscriptions* and *weighted geographical proximity* appear to be not significantly related with GVCs participation, whilst *population* and *GDP per capita* are always negatively and in most of the cases significantly related with GVCs participation. This confirms that larger countries are less opened and, therefore, are also less likely to be involved in GVCs, whilst low-income/low-wage countries are more likely to be involved in GVCs, since cost advantages are still one of the main drivers of international fragmentation of production.

Results are confirmed when looking at estimates for the sector producing 3D printers (i.e., the industry producing machinery and equipment not elsewhere specified, C29), as reported in columns (4), (5) and (6) of Table 2. Also in this case, the *AM patents* variable is significantly (5%, 1% and 10%, in columns (4), (5) and (6), respectively) and negatively associated with GVC integration. However, it shows variability in the magnitude of the related effects: when adding the first set of logistic performance variables the coefficient of *AM patents* more than double compared to the value in the baseline specification. The impact goes from around a 0.61% to a 1.3% fall in participation. However, the estimated coefficient in column (6) is close to that of column (4), possibly highlighting some industry-level characteristics related with the introduction of the second set of logistic proxies and the associated sample reduction. Concerning all the other explanatory variables, results remain similar to those of the models for industry C28, even if tertiary education appears to be less relevant.

Columns (7), (8) and (9) in Table 2 report estimated coefficients for the models analysing industry C34, producing motor vehicles, trailers and semi-trailers. In the case of the automotive sector, *AM patents* does not show a statistically significant impact. This result holds along the three different specifications of the model. Moreover, also the other variables are less or not statistically significant, although maintaining the signs coherent with the previous discussion. These results seem to suggest that the automotive sector implies some sort of industry-specific dynamics and possibly deeper background linkages with other industries, making it impossible to assess the presence of a relationship between AM and motor vehicles' production with the adopted AM proxy.

Finally, results obtained for the 'base-case' models testing potential impacts on the aggregate economy (i.e., CTOTAL) confirm the consistency of results obtained through all the other specifications in the different industries. Specifically, estimated coefficients' signs and significance associated to *gross tertiary enrolment ratio* variable, *population* and *GDP per capita* controls are coherent with previous findings. Notably, it can be observed that *AM patents* is not significant in the baseline specification reported in column (10); whereas, it becomes negative and statistically significant in the specification in column (11) and in column (12), at the 10% and 1%, respectively.

It is worth noting that sample reduction triggered by the inclusion of the two different set of logistic performance's variables might play a role in driving the changes (i.e., increases) in significance of the *AM patents*' coefficients shown in the different specifications for some industries. This might be the case, given the peculiar concentrated distribution of data on our proxy for AM patenting activity, already discussed in Section 4.2. Hence, to check for robustness of the results to the different subsamples, the first and the second specification of the model for each industry/aggregate has been tested also on the smallest sample of countries of the third specification. Results are broadly confirmed, this suggesting that the differences in the results of the three specifications are not driven by changes in the sub-samples. Furthermore, each model specification for each industry/aggregate has been tested excluding the United States, since as shown in Section 4.1 AM-related patent are strongly concentrated in the United States. Also in this case, previous results are confirmed.[20]

7. CONCLUSIONS

The analysis in this chapter represents a first attempt to provide some evidence on the relationship between AM technologies and a country's participation in a GVC. Previous literature has highlighted different channels through which the adoption of these new technologies may affect firms' decisions on whether and how to produce abroad, as a consequence affecting the international fragmentation of production at the sectoral and country level. In particular, AM technologies may reduce firms' incentives to offshore phases of the production process since these technologies reduce the scope for exploiting economies of scale and for (labour) cost-saving strategies. Whether, and to which extent, AM technologies will lead to a potential restructuring and shortening of GVCs is likely to be strongly heterogeneous across sectors, depending on the adoption and diffusion of these technologies and, therefore, on the characteristics of the sector.

Due to lack of direct information on AM adoption, we build a measure based on patent data, *AM patent as a share of the population.* We estimate a fixed effects model where the relationship between AM adoption and GVC participation, measured by the *Share of Re-Exported Inputs on Total Imported Inputs,* is analysed controlling for the other main determinants of GVCs participation highlighted by the previous literature (i.e., property-rights protection, fixed broadband subscriptions, population, GDP per capita, tertiary education, geographical proximity and logistic performance). We consider the whole economy and the three main sectors which are more likely to be affected by the AM technology according to previous contributions (i.e., fabricated metal products, machinery and equipment, motor vehicles, trailers and semi-trailers).

In general, we find the evidence of a negative and statistically significant relationship between AM adoption and GVCs participation, this suggesting that AM technologies may reduce the incentives to locate abroad some phases of the production process. In particular, our results show that AM adoption and GVC participation are negatively and significantly related in all the specifications in the two industries of fabricated metal products and machinery and equipment, whilst the relationship is not statistically significant in the sector of motor vehicles, trailers and semi-trailers. As for the whole economy the relationship is confirmed to be negative, but not always significant, this depending on the set of controls included.

Our results represent a starting point, calling for further investigations. In particular, on the one hand, it would be of fundamental importance to extend the work by using other indicators of AM adoption allowing to better capture the diffusion of AM in several sectors and economies, not necessarily by patenting and producing these technologies. On the other hand, the analysis should be extended in order to consider other indicators of GVCs participation in order to capture changes in countries' position in the GVC and in the length and geography of the GVCs.

NOTES

1. America Makes is the United States leading and collaborative partner in AM and 3DP technology research, discovery, creation and innovation. Structured as a public–private partnership, its aim is to increase the US global manufacturing competitiveness. https://www.americamakes.us/.
2. China Manufacturing 2025 is a comprehensive plan including several different industrial policies focussed on the restructuring of the Chinese manufacturing industry making it more competitive and productive using advancement in production technologies. http://www.europeanchamber.com.cn/en/china-manufacturing-2025.
3. Industrie 4.0 is a German strategic initiative aimed at establishing Germany as a lead market and provider of advanced manufacturing solutions. https://www.gtai.de/GTAI/Navigation/EN/Invest/industrie-4-0.html.
4. Piano Nazionale Impresa 4.0 is an inclusive and organic set of industrial policies focussed on the provision of tools and incentives to Italian manufacturing firms, in order to boost productivity and competitiveness on the international manufacturing landscape. http://www.sviluppoeconomico.gov.it/index.php/it/industria40.
5. Moreover, it is worth noting that many activities impacted by AM technology (e.g., design and rapid prototyping) have never been located in emerging countries.
6. Previous studies dealing with patent data on AM (e.g., Abeliansky et al., 2016; Bechtold, 2015; D'Aveni, 2015; Wohlers Associates, Inc., 2014; Zhang, 2014) rely on data retrieved from secondary sources.
7. Additive Manufacturing is officially considered one (Benson & Magee, 2015).
8. The PatFT contains patents granted from 1970 on; however, the first granted AM patent dates back to 1986. Hence, we consider only the period from 1986 on.

9. To deal with this problem, the literature has developed three main attribution principles: *Assignee Country* principle – that is, the headquarters location of the applicant organisation or the country of residence of the applicant; *Priority Country* principle – that is, the country where the application was filed for the first time; and the *Inventor Country* principle – that is, the country of residence of the inventor (Bergek & Bruzelius, 2010; Grupp & Schmoch, 1999).

10. Pari Patel and John Cantwell, amongst the others.

11. Other diffused criteria are the *Majority Counting* principle – that is, the patent is assigned to the country where the majority of inventors come from (Jaffe et al., 1993); and the *Fractional Counting* principle – that is, the patent is 'split' amongst the inventor countries basing on the share of inventors of each country (Bergek & Berggren, 2004; Stolpe, 2002; Grupp & Schmoch, 1999).

12. The original TiVA database report data for the period 2000–2011 for 62 countries. To extend the time interval, the OECD, through the process forecast estimation of national supply–use and input–output tables was able to provide TiVA estimates for more recent years – that is, from 2012 to 2014, for 58 countries.

13. See Table A5 in Appendix for details on TiVA indicators.

14. The authors use the ISIC Rev. 4 classification, we adopted the corresponding ISIC Rev. 3 classification, in accordance with TiVA. The concordance table is shown in Table A2 in Appendix.

15. Notably, even if following a different logic, data on AM-related patents analysed in Section 4.1 seem to suggest that also for these technologies United States, Germany and Japan feature as core centres of knowledge creation.

16. The authors' finding is in line with the view according to which a country's geographical proximity to technology centres has a positive influence on the import of more technology-intensive inputs. This, in turn, may imply an increase in their GVC integration in the sense that greater access to technology enables them to participate in more GVCs, requiring them to import more GVC inputs (Taglioni & Winkler, 2016).

17. The indicator is a score, based on surveys, and it is the result of a combination of six components: (i) efficiency of customs and border clearance; (ii) quality of trade and transport infrastructure; (iii) ease of arranging competitively priced shipments; (iv) competence and quality of logistics services; (v) ability to track and trace consignments; and (vi) frequency with which shipments reach the destination within scheduled or expected delivery times.

18. Potential unobserved country heterogeneity implies that a simple OLS regression with year dummies would not be appropriate. Since the Wooldridge test, which is the panel data equivalent of the Durbin–Watson test (Wooldridge, 2002) indicates the presence of temporal autocorrelation, time fixed effect have also been included in order to clean the results from the effect of aggregate time-series trends. Moreover, as the Wald test reveals the presence of heteroskedasticity, in order to improve the efficiency of the estimators, White's heteroskedastic robust standard errors have been used so to reduce other possible problems related to heteroskedasticity. Finally, Hausman tests have confirmed the validity of using a fixed effects model instead of either Random Effects or Pooled OLS regression models.

19. In the estimated fixed effects models AM patents (% of population) variable has not been lagged since it is built with data on granted patents, hence representative of an activity started between 1 and 2 years before. Coherently, the variable can be considered as naturally lagged.

20. Results of the robustness checks are available upon request.

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APPENDIX

Table A1. Description of the Seven AM Processes, Range of Materials Available and Subsets of Specific Technologies.

AM Process	Description, Material(S) Used and Specific Technologies
Vat photopolymerisation	Process in which liquid photopolymer in a vat is selectively irradiated by UV rays, causing the feedstock to undergo chemical reactions, becoming solid. The vat photopolymerisation process is applied to three specific technologies: Stereolithography Apparatus (SLA), Digital Light Processing (DLP) and Continuous Liquid Interface Production (CLIP)
Powder bed fusion	Process in which thermal energy sourced by a laser or an electron beam selectively fuses regions of a powder bed consisting of different possible materials. The most commonly adopted technologies are: Selective Laser Sintering (SLS), to manufacture plastic parts, and Selective Laser Melting (SLM)/Direct Metal Laser Sintering (DMLS) applied to the production of metallic products
Material extrusion	Process in which a filament of material, typically thermoplastics, is heated and selectively dispensed through a nozzle. The main technology adopting this AM production process is the Fused Deposition Modelling (FDM), also referred to as Fused Filament Fabrication (FFF)
Material jetting	Process in which droplets of liquid photopolymer or melted wax are selectively deposited layer-by-layer and irradiated to cause a chemical bonding reaction. The most common technology associated to this process is Multi-Jet Modelling (MJM)/Polyjet Matrix (PJM)
Binder jetting	Process in which a liquid bonding agent is selectively deposited to generate a chemical/thermal reaction to bind powder materials. This is the sole AM process in which two distinct materials are necessary for the creation of the final object, and the only technology applying this process is the Inkjet Z Corporation (Zcorp)
Sheet lamination	Process in which sheets of material are bonded together via thermal reaction/ultrasound to form the final object. Feedstock sheets can be rolls, granting a continuous flow, or discontinued sheets fed sequentially. This process finds its application in the Laminated Object Manufacturing (LOM) technology
Direct energy deposition	Process in which focussed thermal energy is used to fuse metallic/ceramic powders or wires by melting as they are being deposited. The reference technology for this production process is the Laser Metal Deposition (LMD)/Laser Engineered Net Shaping (LENS)

Table A2. Concordance Table between ICIO, ISIC Rev. 3 and ISIC Rev. 4 Classifications.

ICIO 34 Industry List (TiVA 2016)		ISIC Rev.3	Approx. ISIC Rev.4
12	Fabricated metal products except machinery and equipment	28	25
13	Machinery and equipment n.e.c.	29	28
14	Computer, electronic and optical products	30, 32, 33	26
15	Electrical machinery and apparatus n.e.c.	31	27
16	Motor vehicles, trailers and semi-trailers	34	29
17	Other transport equipment	35	30
18	Manufacturing n.e.c.; recycling	36, 37	31, 32, 33
19	Electricity, gas and water supply	40, 41	35, 36
20	Construction	45	41, 42, 43
21	Wholesale and retail trade; repairs	50, 51, 52	45, 46, 47, 95
22	Hotels and restaurants	55	55, 56
23	Transport and storage	60, 61, 62, 63	49, 50, 51, 52, 79
24	Post and telecommunications	64	53, 61
25	Finance and insurance	65, 66, 67	64, 65, 66
26	Real estate activities	70	68
27	Renting of machinery and equipment	71	77
28	Computer and related activities	72	62, 63
29	Research and development	73	72
	Other Business Activities	74	69, 70, 71, 73, 74, 75, 78, 80, 81, 82
30	Public admin. and defence; compulsory social security	75	84
31	Education	80	85
32	Health and social work	85	86, 87, 88
33	Other community, social and personal services	90, 91, 92, 93	37, 38, 39, 59, 60, 90, 91, 92, 93, 94, 96
34	Private households with employed persons	95	97, 98

Source: OECD TiVA database.

Table A3. Summary Statistics of the Dependent Variables.

Variable	Number of Obs.	Mean	Standard Dev.	Min Value	Max Value
Share of Re-exported Inputs on Total Imported Inputs (IMGRINT_REII, CTOTAL)	870	3.718	0.392	2.621	4.513
Share of Re-exported Inputs on Total Imported Inputs (IMGRINT_REII, C28)	870	3.573	0.531	1.456	4.413
Share of Re-exported Inputs on Total Imported Inputs (IMGRINT_REII, C29)	870	3.710	0.427	1.783	4.488
Share of Re-exported Inputs on Total Imported Inputs (IMGRINT_REII, C34)	870	3.754	0.497	2.110	4.592

Source: OECD TiVA database.

Notes: Values are expressed in natural logarithmic form.

Table A4. Summary Statistics and Correlation Matrix of the Explanatory Variables.

Variable	Number of Obs.	Mean	Standard Dev.	Min Value	Max Value	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
[1] *AM patents (% of population)*	870	0.00353	0.0214	0	0.326	1													
[2] *Property-rights protection*	844	1.814	0.318	0.633	2.263	0.139	1												
[3] *Fixed broadband subscriptions*	827	13.766	2.313	3.258	19.116	0.0937	0.251	1											
[4] *Population*	870	16.811	1.634	12.547	210.339	−0.00139	−0.290	0.443	1										
[5] *GDP per capita*	870	9.983	0.790	7.227	11.491	0.156	0.663	0.303	−0.442	1									
[6] *Gross tertiary enrolment ratio*	794	−0.772	0.607	−3.741	0.130	0.101	0.303	0.411	−0.274	0.687	1								
[7] *Weighted geographical proximity*	870	21.680	0.902	19.651	23.832	0.0538	0.170	0.289	−0.0836	0.398	0.319	1							
[8] *Railway total coverage*	715	8.732	1.382	5.617	12.339	0.0737	−0.0665	0.532	0.729	0.00309	0.128	0.191	1						
[9] *Registered air carrier departures*	838	11.786	1.515	6.581	16.128	0.107	0.286	0.642	0.665	0.256	0.153	0.135	0.676	1					
[10] *Container port traffic*	712	14.860	1.500	9.558	190.458	0.155	0.242	0.554	0.613	0.114	−0.0701	0.0106	0.469	0.741	1				
[11] *Investments in roads (% of GDP)*	582	−5.685	0.728	−8.252	−3.676	0.0452	0.167	−0.0947	−0.150	0.197	0.0797	0.00253	−0.0625	0.00330	−0.0668	1			
[12] *Investments in railways (% of GDP)*	535	−6.656	0.854	−10.104	−4.855	0.0204	0.306	−0.0245	−0.114	0.331	0.0668	−0.0606	−0.143	0.0914	0.167	0.174	1		
[13] *Investments in airports (% of GDP)*	502	−8.585	1.282	−13.988	−6.166	0.0924	0.380	0.0347	0.0243	0.398	0.0342	0.195	0.116	0.389	0.154	0.351	0.322	1	
[14] *Investments in ports (% of GDP)*	427	−8.595	1.733	−13.816	−5.440	0.102	0.131	0.0512	−0.0827	0.0773	0.558	−0.0880	−0.0977	−0.0417	0.0697	0.244	0.247	0.198	1

Notes: Values are expressed in natural logarithmic form.

Table A5. Variables Data Sources.

Variable	Source	URL
IMGRINT_REII 2000 – 2011 (for each industry/aggregate)	OECD	http://stats.oecd.org/Index.aspx?DataSetCode=TIVA_2016_C1
EXGR_FVASH 2000 – 2011 (for each industry/aggregate)	OECD	http://stats.oecd.org/Index.aspx?DataSetCode=TIVA_2016_C1
IMGRINT_REII 2012 – 2014 estimates (for each industry/aggregate)	OECD	http://stats.oecd.org/Index.aspx?DataSetCode=TIVA_2016_C1
EXGR_FVASH 2012 – 2014 estimates (for each industry/aggregate)	OECD	http://stats.oecd.org/Index.aspx?DataSetCode=TIVA_2016_C1
AM patents	USPTO	http://appft.uspto.gov/netahtml/PTO/search-bool.html
Property-rights protection	Fraser Institute	https://www.fraserinstitute.org/
Fixed broadband subscriptions	World Bank	https://data.worldbank.org/
Population	World Bank	https://data.worldbank.org/
GDP per capita	World Bank	https://data.worldbank.org/
Gross tertiary enrolment ratio	World Bank	https://data.worldbank.org/
Distance between capitals	CEPII	http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=6
GDP	World Bank	https://data.worldbank.org/
Railway total coverage	World Bank	https://data.worldbank.org/
Registered air carrier departure	World Bank	https://data.worldbank.org/
Container port traffic	World Bank	https://data.worldbank.org/
Investments in roads	OECD	https://data.oecd.org/transport/infrastructure-investment.htm
Investments in railways	OECD	https://data.oecd.org/transport/infrastructure-investment.htm
Investments in airports	OECD	https://data.oecd.org/transport/infrastructure-investment.htm
Investments in ports	OECD	https://data.oecd.org/transport/infrastructure-investment.htm
US$/€ exchange rate	Penn World Table	https://www.rug.nl/ggdc/productivity/pwt/

PART IV

INDUSTRY 4.0

CHAPTER 13

AMAZON AND ALIBABA: INTERNET GOVERNANCE, BUSINESS MODELS, AND INTERNATIONALIZATION STRATEGIES

Xinyi Wu and Gary Gereffi

ABSTRACT

In the digital economy, what are the strategies of multinationals from developed countries and emerging markets? How do regulations in the home country affect their growth? Recent digital multinationals in diverse national and institutional contexts raise questions that require new approaches in international business (IB) studies. This chapter examines two leading firms in the global e-commerce industry: Amazon and Alibaba. We compare their digital capabilities and physical asset-building strategies over the past two decades and we connect the Internet governance environment in the United States and China with their business models and internationalization patterns. We argue that despite the platform and global nature of Amazon's and Alibaba's activities, the recent moves of governments across the world to regulate Internet governance poses an important challenge for digital multinationals. This research features a comparative analysis of two prominent digital multinationals and identifies a promising area for future IB strategy studies.

Keywords: Amazon; Alibaba; e-commerce; digital economy; business models; internationalization strategies; Internet governance

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1. INTRODUCTION

There is a growing concern among nations about the power of digital corporations. As the Internet-based digital economy becomes universally accessible, the ability of a government to monitor, control, or stop digital activities is severely undermined. Although the infrastructure of the Internet and human beings who operate it are subject to legal jurisdictions, information flowing across borders via the Internet is difficult to control. Participating in international business via the Internet requires governments to adopt international laws and regulations that challenge their sovereignty, whose essential attribute is control over physical space and the objects within it (Hathaway, 2014). In this respect, digital corporations pose threats to "informational sovereignty" and related issues of national security and citizen privacy (Perritt, 1998).

Such concerns have elevated Internet governance as a critical public policy item. According to the Working Group on Internet Governance[1] (WGIG) (de Bossey, 2005), there are four areas that are central to governing the Internet: (1) issues related to the infrastructure and management of critical Internet resources; (2) issues related to the use of the Internet; (3) issues that are relevant to the Internet but exert impact on a much wider scale; and (4) issues related to the developmental aspects of Internet governance, including capacity building in developing countries. Later, Yang and Muller (2014) added a fifth area based on their observation of Internet governance in China: (5) content regulation, a central focus of China's legal, technical, and self-regulatory Internet mechanism.

All these issues matter to international business in the information and digital age. But the exact nature of such influence is a surprisingly understudied topic. While there has been a great deal of publicity about the digital economy and the suite of advanced technologies that underpin it, recent reports offer more questions than answers about how the global economy and strategies of leading Internet-based firms interact with national efforts to regulate and govern the Internet (Baur and Wee, 2015; Bughin et al., 2017; Mussomeli et al., 2016; Rüßmann et al., 2015; World Economic Forum, 2016; Schwab, 2017).

In 2015, four of the top 100 digital multinationals were headquartered in developing countries: Alibaba (China), Tencent (China), Cnova (Brazil), and Grupo Televisa (Mexico). According to the United Nations Conference on Trade and Development (UNCTAD), among the top 100 digital multinational enterprises (MNEs), 13% of digital affiliates are based in developing and transition economies (UNCTAD, 2017b, pp. 8-11; UNCTAD, 2017c). Although developing countries are still at the initial stage of homegrown digital multinationals, their emergence gives rise to questions that haven't been fully addressed. For example, in the international business (IB) literature, the difference in internationalization strategies between multinationals from developed and developing countries has been noticed (van Tulder, 2010). Multinationals from BRIC countries (Brazil, Russia, India, and China) in particular have received attention because of the role that their home country environment, especially domestic market size and national political agendas, played in shaping their strategies and success (van Tulder et al., 2016). However, we know very little about the difference between strategies among digital multinationals.

In the early 2000s, there was speculation about how the rise of the Internet might affect the governance structures of global value chains (Gereffi, 2001a, 2001b), which were receiving considerable attention since network-based production was becoming the predominant organizational form for globalized industries. The central argument was that alongside the producer-driven and buyer-driven value chains, which had been linked to the phases of investment-based and trade-based globalization, respectively, the emergence of the Internet in the mid-1990s could potentially give rise to an e-commerce revolution based on `infomediary-driven' value chains that could apply to both business-to-business and business-to-consumer transactions in global industries. Given the transforming power of the Internet, in-depth research is needed to find out how it affects the strategies of digital multinationals from developed and developing countries.

This chapter will focus on two e-commerce companies, Amazon (United States-based) and Alibaba (headquartered in China). These firms exemplify the most financially successful advanced economy MNEs and emerging market MNEs (EMNEs), respectively, and their home countries represent distinct Internet governance models (Eichensehr, 2014). The interaction between Internet governance in the United States and China and the business models and international strategies of Amazon and Alibaba will lay the groundwork for the broader implications of these two cases.

The remainder of this chapter is structured as follows. Section 2 reviews relevant IB literature and conceptual frameworks on the digital economy to provide a background for the empirical analysis. Our comparative case study methodology is explained in Section 3. The findings in Section 4 focus on several topics: the digital capability and physical asset-building practices of Amazon and Alibaba over the past two decades; the international expansion of Amazon and Alibaba with an emphasis on the Southeast Asian and Indian markets; and the trends in Internet governance and home country politics in the United States and China, together with recent policies and regulations in Europe and India. Section 5 concludes and suggests directions for future IB research on multinationals in the digital economy.

2. CONCEPTUAL FRAMEWORK

This section draws complementary insights from two strands of literature. On the one hand, as the digital economy evolves, it has triggered research interests in companies with digitalized characteristics and successful business models. On the other hand, the recent surge in MNEs from emerging markets has encouraged IB studies to compare the features of internationalization strategies of MNEs from emerging versus advanced economies. Thus, we present the current literature in two strands: the role of international business in both the digital economy and emerging economies. We briefly elaborate on their connections to our case study of Amazon and Alibaba, highlighting the insufficiency of current frameworks.

2.1. Firm Typologies and Business Models in the Digital Economy

While the ability of the digital economy to bring economic growth and social changes has attracted enormous attention, there is no consensus on how to understand its scope (Brynjolfsson & Kahin, 2000; G20 DETF, 2016; OECD, 2013). Different typologies have been developed to describe and analyze the components and structure of the digital economy. For example, Bukht and Heeks (2017) mapped the digital economy by classifying businesses into three layers of varying scope: core, narrow, and broad. The core scope is the "digital sector," including hardware manufacture, telecommunications, information services, and software and information technology (IT) consulting. The narrow scope is the "digital economy," consisting of digital services, platform economy, sharing economy, and the gig economy. A broader scope called the "digitalized economy" encompasses the core and narrow scopes; it refers to a range of extensive digitalized activities such as e-business, e-commerce, industry 4.0, and the algorithm economy. The United Nations Conference on Trade and Development (UNCTAD) (2017a) categorized MNEs in the digital economy into two groups: digital MNEs and information and communication technologies (ICT) MNEs (Fig. 1). ICT MNEs create a foundation for the digital economy since they provide the enabling infrastructure for various digital activities. Above ICT MNEs are digital MNEs, characterized by the central role of the Internet in their operation and delivery. Digital MNEs are further divided into four categories based on their functions, including e-commerce, digital content, digital solutions, and Internet platforms.

Although Bukht and Heeks and UNCTAD developed their typologies based on different criteria, central to their argument of the digital economy is the division between the ICT sector and the digital sector, which informs the equally fundamental roles that physical assets and digital capabilities play in shaping business competitiveness in the digital economy. However, the classification of digital MNEs remains inconclusive. In practice, companies always have businesses across diverse sectors of the digital economy and multiple sources of revenue. For example, although Amazon started its business as an online bookstore in the 1990s and most of its revenue is still generated by its e-commerce business, Amazon Web Services (AWS) is taking an increasingly significant part of its total revenue (nearly 10% in 2017). Also, AWS is growing at an annual rate of 43%, a figure much higher than Amazon's North American sales (33%) and international sales (23%). Since AWS falls into the category of digital content, we question whether it is justified to classify Amazon as merely an e-commerce company.

Thus, there is a need to revisit the definitions of e-commerce and Internet platform. According to UNCTAD (2017a), Internet platform includes: (1) companies providing digital services through the Internet and cloud-based platforms, search engines and social networks; and (2) sharing-economy platforms, such as transaction platforms (eBay) and open-source platforms (Red Hat). Alibaba integrates

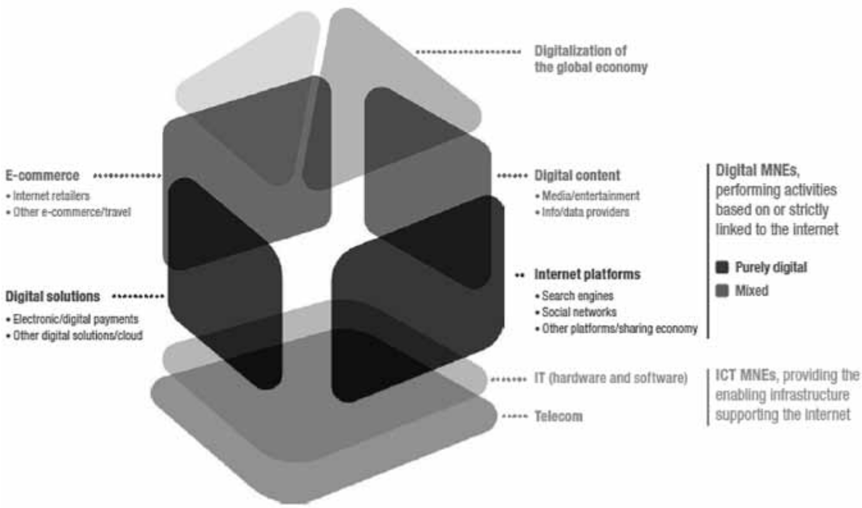

Fig. 1. The Structure of the Digital Economy.
Source: UNCTAD (2017a, p. 167).

most of the features of Internet platforms. For example, within its consumer-to-consumer (C2C) site Taobao, Alibaba provides its search engine for users to find the product or service they need. Thus, it builds a network between buyers and sellers and serves as a platform where they make transactions – similar to the function of eBay. In this case, Internet platform and e-commerce activities are roles adopted by a single firm, rather than two distinct groups of companies.

For Kenney and Zysman (2016), the platform is a pervasive attribute underpinning the structure of a digitally based economy, rather than a subcategory. They labeled today's transformation as "platform economy," with an emphasis on an increasing number of economic, political, and social activities enabled by diverse digital platforms and the growing power of platform owners. For example, Kenney and Zysman regard Amazon as an operator of various platforms: Amazon.com is a retail platform, which connects sellers and buyers; AWS is a platform for platforms, which provides infrastructure and tools to build other platforms; and Amazon Mechanical Turk is a mediating platform, which enables companies to crowdsource specific tasks and build a modern putting-out system.

Some scholars argued platform refers to an intermediary connecting markets of users and relying on technology/information to facilitate value creation through network interactions (Parker, Van Alstyne, & Choudary, 2016). According to Zeng and Glaister (2016), Internet Platform Companies (IPCs) are established primarily to provide infrastructure, information, and technology that enable direct transaction or value creation over web-based virtual platforms by linking different groups of users to extract revenues from the transaction. IPCs differ from traditional companies in fundamental ways. In the traditional manufacturing and professional service company, a firm's ability to generate supernormal economic returns is mostly determined by a firm's internal resources and its supply-side efficiency. In contrast, the IPCs' value is mainly driven by network externalities where the value to users largely depends on the number of others using the same goods or services. For example, the Internet platforms that establish two-sided markets that link e-commerce consumers with small- and medium-sized apparel manufacturers transformed the governance structure and upgrading patterns in China's apparel value chain, which was traditionally a buyer-driven chain led by large retailers and branded manufacturers (Li, Frederick, & Gereffi, 2018). Also, the "asset-light" nature of Internet platforms has reduced transaction costs for physical assets management; thus, they can internationalize at a higher speed by relying on local providers for business adaptation and focusing on efficient operational integration (Kenney & Zysman, 2016; Parente, Geleilate, & Rong, 2017).

Libert, Beck, and Wind (2016) classified companies into the following four business models based on the way they create value:

- *asset builders* – deliver value through physical capital, such as manufacturers and traditional retailers;
- *service providers* – deliver value through human capital (skilled people), such as consulting firms and financial services;
- *technology creators* – deliver value through intellectual capital, such as the Internet and pharmaceutical companies; and
- *network orchestrators* – deliver value through network capital or relationships.

Based on their research on the S&P 1500 index over a 40-year time horizon, Libert et al. (2016, p. 15) concluded that network orchestrators, on average, grew revenues faster, generated higher profit margins, and deployed assets more efficiently than companies using the other three business models. This superior financial performance derives from the fact that network orchestrators can create connections between other asset types and thus gain a platform advantage.

Many scholars agree that successful digital companies are dependent on the network effects they create. According to Singh and Kundu (2002), e-commerce corporations (ECCs) are defined as "organizations that from inception are engaged in electronic commerce and derive significant competitive advantage from the use of network resources resident in virtual networks of commercial collaborative alliances." They emphasized the network-based advantages in the success of ECCs – the value of the network to each of its members is directly proportional to the number of other network users. Thus, the value of a company website increases as the number of Internet visitors increases. Brouthers, Geisser, and Rothlauf (2016) argued that creating and capturing the value of networks is central to ibusiness companies, who use the Internet and other computer-based IT systems to allow users to interact with each other.

In sum, these business typologies and models provide a useful framework to examine the activity and competitiveness of Amazon and Alibaba. However, there are limitations. For example, UNCTAD narrowed the scope of e-commerce down to "only full online and online-born commerce." The e-commerce channel of traditional businesses is excluded, even though it is growing quite fast. Although there is a massive gap between internet retailers and traditional retailers, the line between them is becoming blurred given the convergence of online and offline businesses. For example, Amazon has acquired the chain grocery store, Whole Foods, and Wal-Mart's e-commerce sales in 2017 amounted to $11.5 billion (Irwin, 2017). An underlying assumption of Libert et al. (2016) is that the four types of companies are different and a given company can fit into only one type. Thus, Amazon would be defined as a network orchestrator because it is an e-commerce company like eBay. However, Amazon creates value in multiple ways. Besides network orchestrator, it also has the features of asset builder (e.g., logistics infrastructure), service provider (AWS), and technology creator (apps developer for Amazon Prime).

While Amazon and Alibaba began as e-commerce companies, in reality their business models have expanded beyond internet-based activities and become more complex. Therefore, Libert et al. (2016) neglected the possibility that companies are a mixture of multiple business models and the value created by each model changes over time. To fill these gaps, our case study of Amazon and Alibaba will examine their digital capabilities and physical assets to present the scope of e-commerce business in the real world. Moreover, we will utilize platform theory to explore the competitiveness generated by networks, technologies, services, and assets in Amazon's and Alibaba's business models.

2.2. Internationalization Strategies and Home Country

Internationalization theory is often regarded as the dominant theory of IB studies on MNEs, emphasizing internal organization, network capabilities, alternative governance choices, and interdependencies between geographically dispersed economic actors. These factors together lead to the efficient governance of transactions and effective matching of firm-specific advantages (FSAs) to its environment (Buckley & Strange, 2011; Kano, Verbeke, & van Tulder, 2016). Although internationalization theories have been heavily influenced by developed country MNEs from the United States, Western Europe, and Japan, there has been an interest in the experience of developing country MNEs to enrich the IB literature. Different from their counterparts in developed countries, it is argued that economic and political factors play equally important roles in their international growth.

On the one hand, Verbeke and Kano (2015) have found that FSAs are based on such common elements as entrepreneurial agility, flexibility/responsiveness, and experience in operating in challenging environments. Also, brand and technology, when present, may not have been developed through traditional means of advertising and in-house research and development (R&D). Joint ventures between developed economy and emerging economy MNEs remain an essential vehicle for trade name and technology know-how acquisition by EMNE partners.

On the other hand, they use international expansion as a springboard to: (1) acquire strategic resources to compensate for their capability gaps; (2) overcome catch-up disadvantages; (3) exploit market opportunities in other countries; (4) alleviate institutional and market constraints at home and bypass trade barriers into advanced markets; and (5) better compete with global rivals after strategic asset acquisition. In other words, they systematically and recursively use international expansion to equip themselves to compete against global rivals, reduce vulnerability to weak or lagging home institutions, and fortify their ability to build new competitive advantages, domestically and internationally (Bae, Purda, Welker, & Zhong, 2013; Liang, Lu, & Wang, 2012; Luo & Tung, 2007).

Scholars have been describing this group of non-developed country MNEs in different ways, such as Third World multinationals, developing country multinationals, and emerging market multinationals. Most recently, a subgroup – BRIC multinationals – has been a hot spot. It is not only because of the presence of a number of prominent MNEs from this subgroup, but also because of the distinguishable characteristics of their home countries, such as the size of the domestic market, the influence of national policy and government involvement, that lead to more reliable generalizations with theoretical and practical implications (Wells, 1983; van Tulder, 2016; Verbeke & Kano, 2015).

Chinese MNEs, in particular, have been noticed given the significant influence of their home country. Luo, Xue, and Han (2010) integrated two seemingly paradoxical views – institutional escapism and governmental promotion – in explaining the international expansion of Chinese MNEs. The Chinese government's decision to "go global" certainly incorporates a political dimension and appeals to national interest and the need to increase the efficiency of Chinese companies and the economy. China's political leaders realized that a globalization agenda would materially facilitate China's rise and fortify its influence, regionally and globally, over the structure and protocols governing well-established multilateral institutions and the world economy. This generates "government-created advantages" for the internationalization of Chinese MNEs, which complement China's natural endowments and for the most part improved Chinese MNEs' international competitiveness (Ramamurti & Hillemann, 2018).

Concerning the digital economy, some have argued that government control in China to curb the power of foreign digital MNEs has saved domestic digital companies and even stimulated local competition and innovation (Wadhwa, 2018). However, Chinese state-owned enterprises (SOEs) and private-owned enterprises (POEs) have different relationships with the government, and thus distinct internationalization paths. As a direct beneficiary of government assistance, Chinese SOEs establish relationships and networks in foreign markets through financial support and administrative privilege. In contrast, Chinese POEs (which make up the vast majority of digital economy firms in China) generally do not have such close linkage to the government. Two institutional hazards, the overprotection of SOEs and the uneven development of domestic industries in favor of sectors with strong SOE involvement, largely reduced the domestic market of POEs and forced them to internationalize (Wei, Clegg, & Ma, 2015).

While previous studies provide some insights into the motivations and strategies of Chinese MNEs, most of them draw evidence from firm-level case studies of leading manufacturing, oil, and electronics companies, primarily focusing on characteristics and motivation for foreign direct investment (FDI), location, and entry mode choices (Luo & Lemanski, 2016; Silva, 2016; Yorbana, 2016). However, Chinese digital MNEs are also becoming key players in the global economy. Two out of four EMNEs in the Top 100 digital MNEs, Alibaba and Tencent, are Chinese-born but few studies have addressed their internationalization patterns or compared them with their counterparts in developed countries. In our study, we will first briefly present the Internet governance status in the United States and China, and then explore the applicability of current internationalization theories to analyze the influence of the domestic regulatory environment on Amazon versus Alibaba.

3. METHODOLOGY

This research looks at the interaction between regulatory context, business models, and internationalization patterns of leading digital multinationals from developed versus emerging economies. Amazon and Alibaba are chosen because of their position as leaders and competitors in the global e-commerce industry. On the list of top 100 digital MNEs (UNCTAD, 2017b), Amazon ranked first under the e-commerce category as a global leader with Alibaba ranked second based on their sales in 2015. Fig. 2 presents key statistics and facts of Amazon and Alibaba obtained from their 2017 annual reports.[2] In 2017, Amazon had \$177.9 billion[3] in revenue with 566,000 employees, a 56% annual growth rate, and a 3.9% return on assets. Alibaba had \$22 billion in revenues with 50,092 employees, a 56% annual growth rate, and an 11.9% return on assets.

Besides differences in company size and profitability, Amazon and Alibaba have distinct distributions of revenue. In its annual report, Amazon divides its sources of revenue into three categories: North America (\$106.1 billion); international (\$54.3 billion); and AWS (\$17.5 billion). Alibaba listed revenues from China commerce (\$17.5 billion), international commerce (\$1.94 billion), cloud computing (\$0.97 billion), digital media and entertainment (\$2.14 billion), and innovation initiative and others (\$0.44 billion). Their financial success outweighs whether they are from developed or emerging economies. More importantly, we ask how they are similar and how they are different.

The case study method is employed to accomplish various goals, such as providing a description, testing existing theories, and generating new theories (Eisenhardt, 1989). First, we want to determine the usefulness of theories on the digital economy and IB to gain insights into these two companies. We identified several relevant approaches such as UNCTAD's digital economy structure and Libert et al.'s four business models in the literature review section. On the one hand, they provide conceptual frameworks to organize and analyze the empirical research on Amazon and Alibaba. On the other hand, this process could help us understand the weaknesses of each framework and how to improve them to reflect

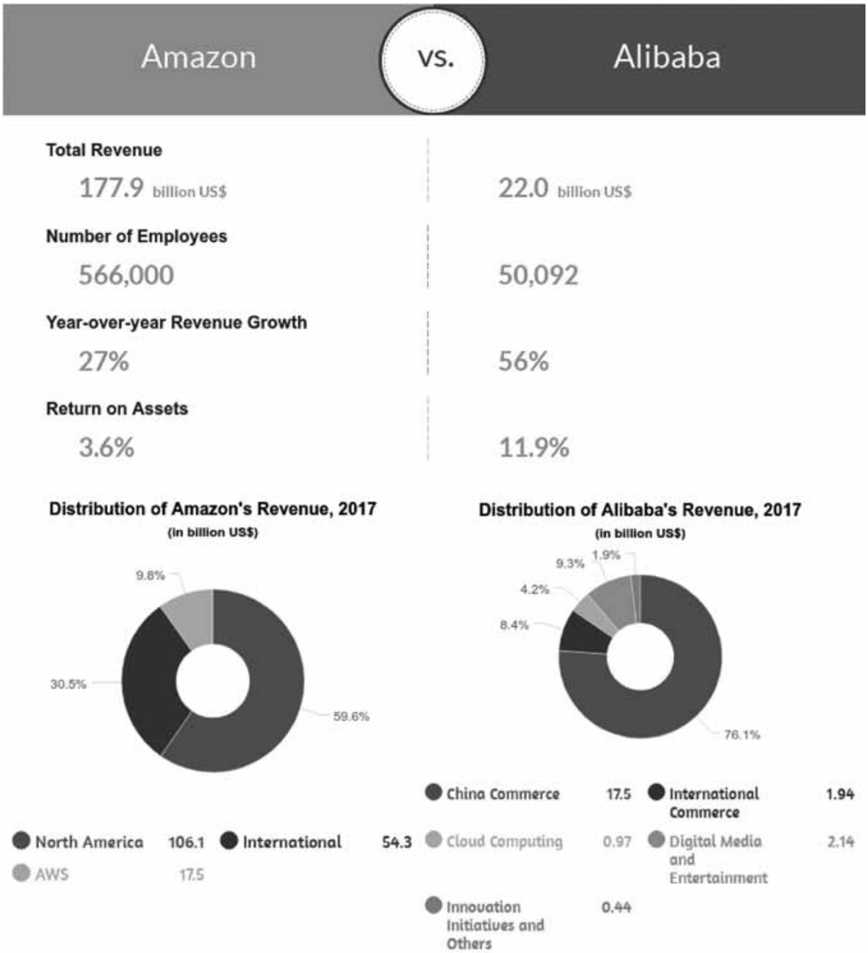

Fig. 2. Statistics and Facts on Amazon and Alibaba, 2017.
Source: Amazon 2017 Annual Report; Alibaba 2017 Annual Report.

the reality of the digital economy. We expect the characteristics of Amazon's and Alibaba's growth and international expansion to reflect the features of their home economies strongly.

Second, we present real-world details of these two companies to better understand their growth trajectories. The six most commonly used sources of evidence in doing case studies are: documentation, archival records, interviews, direct observations, participant observation, and physical artifacts (Yin, 2017, p. 117). In our study of Amazon and Alibaba, the documentation and archival records are highly complementary. Therefore, the information in our study includes sources such as company annual reports, market research databases (e.g., Statista and Ychart), specialized institutions (e.g., eMarketer), and mass media (e.g., *New York Times* and *Wall Street Journal*). Although efforts have been made to ensure the accuracy and reliability of the data from which we draw inferences, alternative explanations and interpretations of the data are possible. Therefore, we focused on qualitative analysis when comparing Amazon and Alibaba and used statistical data as a supplementary method.

4. FINDINGS

We divide our findings into three broad categories: the platform business model, the internationalization strategies of Amazon and Alibaba, and internet governance in the home country (the United States and China, respectively).

4.1. Platform Business Model: Digital Capability and Physical Assets

What makes Amazon and Alibaba the biggest e-commerce companies in the world? To answer this question, we need to realize that Amazon and Alibaba are not merely Internet retailers that deliver a remarkably diverse array of products and services. Amazon functions as a platform company by utilizing its e-commerce sites, AWS, and infrastructure together. A substantial amount of its revenue is created by providing consumers with technological service and physical assets. Its cloud computing business, AWS, has served its own computing needs and those of other companies since 2004 and it has become the largest cloud-computing service provider with a 47% market share (Coles, 2017). The more Amazon invests in AWS, the more appealing it becomes for companies and programmers.

Similarly, the philosophy of bringing connections is central to all of Alibaba's business. Since it started its first e-commerce site, Alibaba.com, an English-language global wholesale marketplace in 1999, its mission has been connecting and facilitating cross-border trade among small businesses; its logistics network, Cainiao, provides a platform for delivery companies to connect with each other and with customers; and finally, Ali Cloud is designed to optimize the connecting process and economic returns. Its ultimate goal is building a network platform where the more sellers use the e-commerce site, the more buyers it attracts and the more data and revenue they generate.

The success of Amazon and Alibaba relies on their platform business model, featuring the network effects generated by bringing their digital capabilities and physical assets together. Based on public information from their websites and annual reports, Fig. 3 adapted the typology offered by UNCTAD (2017a, p. 165) to give a full presentation of the digital and physical dimension of Amazon's and Alibaba's business models. On the one hand, the digital dimension is divided into three parts: e-commerce, digital content, and digital solutions. As noted before, the boundary between each segment is flexible, and specific products or services could be featured by two or three functions. For example, Amazon's AWS provides both data analysis and digital assistance to business, so it is put in the overlapping areas of digital content and digital solution. This is mainly because both Amazon and Alibaba encourage innovation in their new business areas to add to profits. Also, they need to keep attracting new customers for more traffic and data

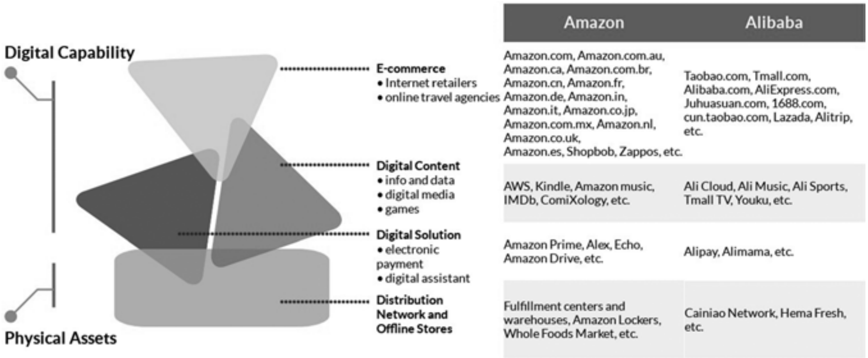

Fig. 3. Amazon's and Alibaba's Digital Capability and Physical Assets.
Source: Authors.

collection on their e-commerce sites. E-commerce is put at the top of the structure for two reasons: (1) Amazon.com and Alibaba.com are the starting point of these two companies; and (2) e-commerce still represent the most significant source of each company's revenue, and thus it is the core of their business models.

"Internet platform" is not included as part of Amazon's and Alibaba's digital capability for two reasons. First, according to UNCTAD, Internet platforms mainly refer to search engines and social media. Amazon and Alibaba fail to attract enough users for these products to become a mainstream feature of their business models. This is not surprising if we look at the fierce competition in their home markets. In the United States, the search engine and social media platforms are dominated by Google and Facebook, respectively; in China, they are controlled by Baidu and Tencent. Thus, it would be hard for latecomers to be competitive enough to take a significant market share. Rather, we identify "platform" as a fundamental characteristic of their business model, and it would be misleading to objectify this term with certain products of Amazon and Alibaba. Their physical assets are a separate and significant dimension. We argue that even in the digital economy, the platform business model does not exclude the value generated by physical assets. The success of e-commerce is largely due to satisfying consumers through speed and convenience, which depends on well-functioning and enabling physical assets.

Just as the digital economy needs IT hardware like laptops and smartphones as a carrier for digital activities, Amazon and Alibaba need distribution capabilities like warehouses and logistics to deliver the physical products purchased online. In fact, Amazon's business model could not succeed without heavy investments in its fulfillment centers and warehouses, which serve not only Amazon's own inventory, but also third-party sellers that listed products with more than \$23 billion value in 2016, about twice as much as two years earlier.[4] The increasing investment in fulfillment centers, together with its acquisition of Whole Foods Market, shows that Amazon is determined not to be a purely digital company.

At the same time, Alibaba, known for being asset-light, has been investing in warehouses in China's and international free-trade zones (Reuters, 2017) and the offline grocery chain Hema Fresh since 2017 (Najberg, 2017). For Amazon and Alibaba, being a platform business means more than minimizing physical assets. The future of their e-commerce business focuses on how they bridge the online and offline retail worlds.

4.1.1. E-Commerce

E-commerce can be classified based on the participants in the transaction. First, B2B happens where both the transacting parties are businesses, including manufacturers, traders, retailers, etc. Second, B2C is where businesses sell electronically to end-consumers. Third, C2C examples could be found in auction sites like eBay.

Both Amazon and Alibaba provide platforms for all these activities. Their development trajectories and achievements differ, however. Since it started as an online bookstore in 1994, Amazon.com has been a B2C-focused website. Now, people can also find portals for B2B (Amazon Business) and C2C (sell on Amazon) on Amazon.com, but B2C remains its core business. The merchandise option extends from books to nearly everything – millions of electronics, apparel, accessories, auto parts, home furnishings, beauty aids, toys, etc. According to eMarketer (2017), about 44 cents out of every dollar spent online in America flows to Amazon. Besides North America, Amazon has successfully transferred the B2C model to other countries through Amazon International websites. This practice will be discussed further in Section 4.2.

In 1999, Alibaba started with a B2B website, Alibaba.com, a global wholesale marketplace that connects Chinese manufacturers with overseas buyers. At that time, the Internet was becoming popular in China, and China's low-cost manufacturing started to attract foreign buyers and investors. Today, Alibaba has created a portfolio of platforms covering every dimension of e-commerce – C2C (Taobao.com), B2C (Tmall.com, Juhuasuan.com), and B2B (Alibaba.com) as well as travel agencies (Alitrip). Together they account for 86% of Alibaba's annual revenue in 2016. Besides the domestic market, Alibaba is attempting to attract international customers through Aliexpress.com and Lazada. Although international sales only accounted for 8% of Alibaba's revenue in 2016, the growth potential is enormous.

4.1.2. Digital content

The sources of Amazon's and Alibaba's revenue in their annual reports are divided into three segments: domestic commerce, international commerce, and cloud-computing service. In its report, Amazon states that these segments reflect the way Amazon evaluates its business performance and manages its operations. Although the value generated by cloud computing was small compared to their total revenue, 3% for Alibaba and 9% for Amazon, its presence in the annual reports give us a glimpse of the strategic importance of AWS and Ali Cloud to Amazon and Alibaba, respectively. Launched in 2006, AWS offers a broad set of global computing, storage, database, and other service offerings to developers and enterprises of all sizes. Because its revenue was not published until 10 years later, the public did not know whether AWS was making a profit before then. In April 2015, when Amazon first announced that the gross sales of AWS amounted to $4.7 billion in the previous fiscal year, its stock price skyrocketed, and its market cap quickly surpassed Warren Buffett's Berkshire Hathaway and became the fifth largest company by market cap (Carter, 2017). Thanks to AWS, the annual revenue of Amazon in 2015 first exceeded $100 billion, two decades after the establishment of Amazon. This speed is impressive compared with Wal-Mart, which took 35 years to achieve $100 billion in sales.[5]

In 2009, Ali Cloud, a data-mining and information-management company catering to e-commerce businesses, was established to serve Alibaba's own computing needs and those of other companies. The large pool of data generated by over 400 million users shopping on its websites that are being stored and analyzed by Ali Cloud is advantageous to Alibaba in many ways. One of the most successful applications of Ali Cloud is pay-for-performance advertising. When certain keywords are searched, sellers can bid for a high ranking among the search results and advertisers can bid for space to recommend their products. Today, when customers open the website, they will be greeted with a homepage covered in tailored personal recommendations based on their browsing history, purchase history, and best guesses of what will interest them based on data from thousands of other similar shoppers' profiles stored in Ali Cloud. With its US-rivals such as Microsoft Azure and Amazon AWS being restricted from operating in China because of the regulatory context (which will be discussed in Section 4.3), Ali Cloud retains a considerable business advantage in an environment with few competitors.

This leads to a virtuous circle – greater scale creates more value, more value attracts more customers and sellers, who in turn create greater scale. Yong Zhang, chief executive of Alibaba Group, said the online sales data and consumer footprints in the digital world allowed entrepreneurs to not only "better meet demand," but also "create new demand" (Meng, 2017). This process is described by Alex Yao, a JP Morgan analyst, as "expanding from traffic monetization to data monetization," which is bringing important changes not only to the core business function, but also the nature of competition within the e-commerce industry (Kim, 2017). The financial outcome of data monetization has yet to be determined, but it is reasonable to link Amazon's and Alibaba's top performance in the industry to their cutting-edge data and cloud technologies.

4.1.3. Digital Solutions

In 2017, the estimated active users of voice-enabled assistant devices in the United States was 60 million, and 70.6% of them use Amazon's Echo (eMarketer, 2018). Through the Echo speaker, customers can use Alexa, an artificial intelligence (AI)-driven voice assistant, to order goods from Amazon as well as control household appliances. While still far from mass adoption, consumers are becoming increasingly engaged with the virtual assistant technology. eMarketer (2018) predicted that as prices decrease and functionality increases, consumers are finding more reasons to adopt these devices. This market will have over

75 million users by 2019. Amazon gave much credit to Alexa for its dominance in the US market. Seeing the potential of the application of voice assistants in e-commerce, Jeff Bezos stated that Alexa's results far outpaced its internal projections and that Amazon would "double down" on its investment in this arena (Poletti, 2018).

In 2004, Alipay was launched as a third-party online payment platform, a key strategic move for Alibaba to win the e-commerce market. Online credit and debit payments were not popular among China's sellers and customers in the early 2000s. In 2002, Chinese banks set up a payment card network named Union Pay, which was intended to become the "Chinese Visa and Master Card." However, the banks were reluctant to deal with small transactions involving distance-selling since they considered them too risky and small to yield sufficient revenue. Also, online sellers and buyers with relatively low deal volume were unwilling to pay the high transaction fees, and Chinese consumers distrusted credit cards. In this context, Alipay formed partnerships with leading Chinese banks and signed a long-term agreement with China Post, the state-owned postal service, allowing consumers to deposit cash locally and replenish cash accounts like a bank. Today, with 450 million registered users, Alipay handles more than 50% of China's online transaction payments. Beyond the Chinese domestic market, Alipay is competing for the global mobile payment market with PayPal and Apple Pay. Alipay could become a primary tool by which Alibaba expands its impact and increase its presence across Asia and the United States.

Two aspects of Amazon's and Alibaba's physical assets are noteworthy: first, the distribution network infrastructure, including Amazon's warehouses and two-day delivery service, as well as Alibaba's Cainiao Logistics; and second, their offline stores, including Amazon's acquisition of Whole Foods Market in North America and Alibaba's Hema Fresh stores in China. These phenomena are not mentioned in UNCTAD's discussion of the digital economy, but digital giants like Amazon and Alibaba are bringing transformative changes to traditional express and retail industries, which are becoming an integrated part of the digitalized economy.

4.1.4. Logistics and delivery

Amazon's business model features heavy reliance on physical assets. In a letter to stakeholders, Amazon's CEO, Jeff Bezos, emphasized AWS, Amazon Marketplace, and Amazon Prime as three pillars of the company's success (Bishop, 2016). As discussed earlier, AWS and Marketplace refer to digital content and e-commerce, respectively. The third pillar, Prime, is a service whose membership customers have access to free limited-time guaranteed delivery and free access to online entertainment resources including music, books, and movies. Prime membership subscribers totaled more than 100 million in 2018, and they contributed more than $6 billion every year to Amazon's revenue (Wingfield, 2018).

The secret to the success of Amazon Prime is its extensive logistics infrastructure: warehouses and fulfillment centers (FC) where Amazon stores and distributes most of its inventories; Amazon Prime Air, a drone-based delivery system that provides 30-minute delivery service; and Amazon Lockers where customers can self-pick-up packages in nearby kiosks at their convenience after placing orders online. Given the combination of fast delivery, product diversity, and competitive price, it is not surprising that Prime can retain old customers and attract new ones and that Amazon's investment in logistics has been increasing by 30% annually since 2013 (MWPVL, 2018).

The tradition of emphasizing physical assets in Amazon's business model can be traced back to 1994 when Amazon first started its business as an online bookseller. To store its products, rather than outsource the FC as other Internet retailers did in the 1990s, Amazon built a vertically integrated network of facilities that would hold its inventory and use it to assemble and ship orders shoppers submitted through Amazon's site. The establishment of storage infrastructure laid the foundation for the later expansion to other business. Today, while Amazon still offers millions of books, other items – such as electronics, apparel and accessories, auto parts, home furnishings, health and beauty aids, toys, and groceries – contribute more than two-thirds of sales.

Starting with two FC centers in Seattle and Delaware, Amazon built 51 FC and sorting centers in the United States and more than 140 worldwide by 2017. Most of them are located outside major urban areas and provide a low-cost alternative regarding land value and real estate taxes to that associated with traditional brick-and-mortar stores operated by retail chains. The percentage of the total population in the United States that live within 32 kilometers (km) of Amazon's FC increased from 26% to 44% between 2014 and 2016 (Kim, 2016). It is estimated that although the FC network expansion from 2006 to 2018 has resulted in a loss in revenue of around \$9.6 billion, it will reduce the average shipping distance from the FC to the consumer by around 290 km by the end of 2018. This would result in between \$5 and \$13.3 billion in savings on shipping costs and an increase in profit margins of up to 14% (Houde, Newberry, & Seim, 2017).

Alibaba owns a logistics company called Cainiao Network (formerly known as China Smart Logistics), a company formed by Alibaba in partnership with four other major Chinese package-delivery companies in 2013. Cainiao Network can support the delivery of 47 million packages per day, and it covers 224 countries and regions globally and 2,800 districts and counties in China (Alizila, 2016). However, rather than deliver packages itself like Amazon's delivery network, Cainiao Network operates a logistics data platform that uses data insights and technology to improve the capacity and capabilities of its package delivery partners, whose philosophy is analogous to that of Alibaba's e-commerce business.[6] Another difference between Amazon Prime and Cainiao Network is that the latter does not have a membership program with exclusive benefits, so it is not as effective in cultivating loyal customers, although it requires much less financial investment to provide fast delivery.

4.1.5. Offline Stores

In Amazon's largest acquisition to date, Amazon gained an instant bricks-and-mortar presence when it bought Whole Foods Market in a \$13.7 billion deal in

2016. By early 2018, Amazon had changed Whole Foods in several critical ways, including price cuts of up to 50% for fresh food, free two-hour delivery for fresh food via Prime Now service, and the sale of Amazon's Echo device within Whole Foods stores (Valinsky, 2018). These moves appear to benefit both sides. Whole Foods has been struggling for years to be price competitive as grocery stores focus on healthy, organic, and locally sourced products. When Whole Foods made significant investments in lowering prices and building out its private-label brand, customers responded by shifting to lower-priced retailers. Amazon has brought lower prices to Whole Foods by using its scale and efficiencies to pass cost savings to consumers. On the flip side, Whole Foods gives Amazon access to more than 450 physical pickup points and distribution centers for both grocery and non-grocery items throughout the United States. Thus, the combination of Amazon and Whole Foods Market's stores creates a promising outlook for more than the grocery segment alone. It underscores the potential for a hybrid, offline–online retailer that gives consumers a seamless experience and allows companies to capture the maximum operational benefits across both physical and digital operations.

Alibaba made an even more significant transformation. It launched over 20 Hema Fresh stores in Beijing and Shanghai, which provide imported seafood, meat, fruit, and vegetables for high-end customers. The strategy is intended to bring a seamless shopping experience to customers regardless of whether they are on a desktop, mobile device or in a brick-and-mortar store. Cheung (2017) provided a detailed picture of the operation of this new retail model: Hema shoppers are encouraged to download the store's mobile app, which is connected with Alibaba's other products, including the marketplace Taobao.com and the mobile digital payment Alipay. In-store customers can use the app to scan a product barcode to receive information or recommendations for related products. Once done with their shopping, customers can check out using the app.

Since the stores also double as fulfillment centers, shoppers within a roughly 3-km radius of a store can also make purchases remotely using the app, and then have goods delivered within 30 minutes. Alibaba uses data collected on these shoppers and their app usage to build a more personalized shopping experience, as well as to improve its understanding of a consumer's online and offline journey. Thus, Alibaba's business model is transitioning from a pure network orchestrator to a hybrid of network orchestrator and asset builder.

As traditional retailers are facing threats from e-commerce companies, Amazon and Alibaba have made it clear that they want a larger share of consumers by integrating online and offline services. In their domestic markets, we see a large number of investments, partnerships, and acquisitions of grocery chains, and this might be a start of more diverse offline initiatives. Both have made moves in healthcare – Alibaba has an online drugstore, Ali Health, and Amazon has formed a not-for-profit healthcare company recently. Armed with vast amounts of consumer data in their arsenals and advanced tech capabilities, they are in a good position to experiment and adapt to the brick-and-mortar drug stores and insurance companies.

4.2. International Expansion and Competition in Southeast Asia and India

International expansion is always employed to alleviate institutional and market constraints at home and take advantage of opportunities in other countries. Fig. 4 shows the geographic expansion of Amazon and Alibaba over the past two decades. As the largest B2C e-commerce retailer, Amazon already has expanded its e-commerce business to 14 foreign markets.[7] Its international footprint has two characteristics. First, its performance in each foreign market differs. In the developed markets in Western Europe, Amazon has become one of the dominant e-retailers with a top market share or top visitor count. In emerging markets in Asia and Latin America, it is making much slower progress, especially in China, one of the biggest e-commerce markets, where its market share was lower than one percent in 2016.

Second, compared with its 44% share of the e-commerce market in the United States, its performance in foreign markets is less impressive. Several external factors contribute to the financial instability and less robust economic returns from Amazon's global expansion, such as underdeveloped infrastructure, less Internet accessibility, unregulated business environments, less familiarity with local markets, and changing foreign exchange rates. Also, these limited gains partially result from Amazon's business model; Amazon's heavy dependence on logistics makes it difficult to transfer its domestic success. For example, in many of Southeast Asia's markets, Amazon must rely on its vaunted experience in managing and delivering inventory to overcome the lack of reliable infrastructure for last-mile delivery (Chadha, 2017).

Compared with Amazon, the scope and scale of Alibaba's international business are more limited. Far less than Amazon's 14 international sites, Alibaba only had two platforms for international and cross-border commerce by 2016: Alibaba.com, the wholesale marketplace for global trade; and AliExpress, an international marketplace for consumers around the world to buy products and services directly from sellers in China. Also, the net sale of Amazon International was 40 times greater than that of Alibaba International. Although its first website, Alibaba.com, started with the goal to build connections among buyers and sellers across the globe, so far it has only managed to connect Chinese buyers with global sellers. In 2016, the revenue from international e-commerce accounted for 7.5% of the total, almost 75% less than its domestic revenue (Alibaba, 2017).

In the short term, Alibaba's primary focus is likely to be maintaining its competitiveness in the Chinese domestic market. However, it makes no secret of its global aspirations. Alibaba announced a long-term goal for the global market in its annual report (2017): serving two billion consumers around the world and supporting 10 million businesses to operate profitably. To expand its presence in key markets and serve international customers, last year Alibaba proposed building a global commerce platform, World e-Trade Platform (eWTP), which aims to eliminate barriers to commerce to promote free trade and help businesses and consumers everywhere participate in cross-border trade. Rather than being faraway, a head-to-head competition between Amazon and Alibaba is right around the corner in the e-commerce market in Southeast Asia.

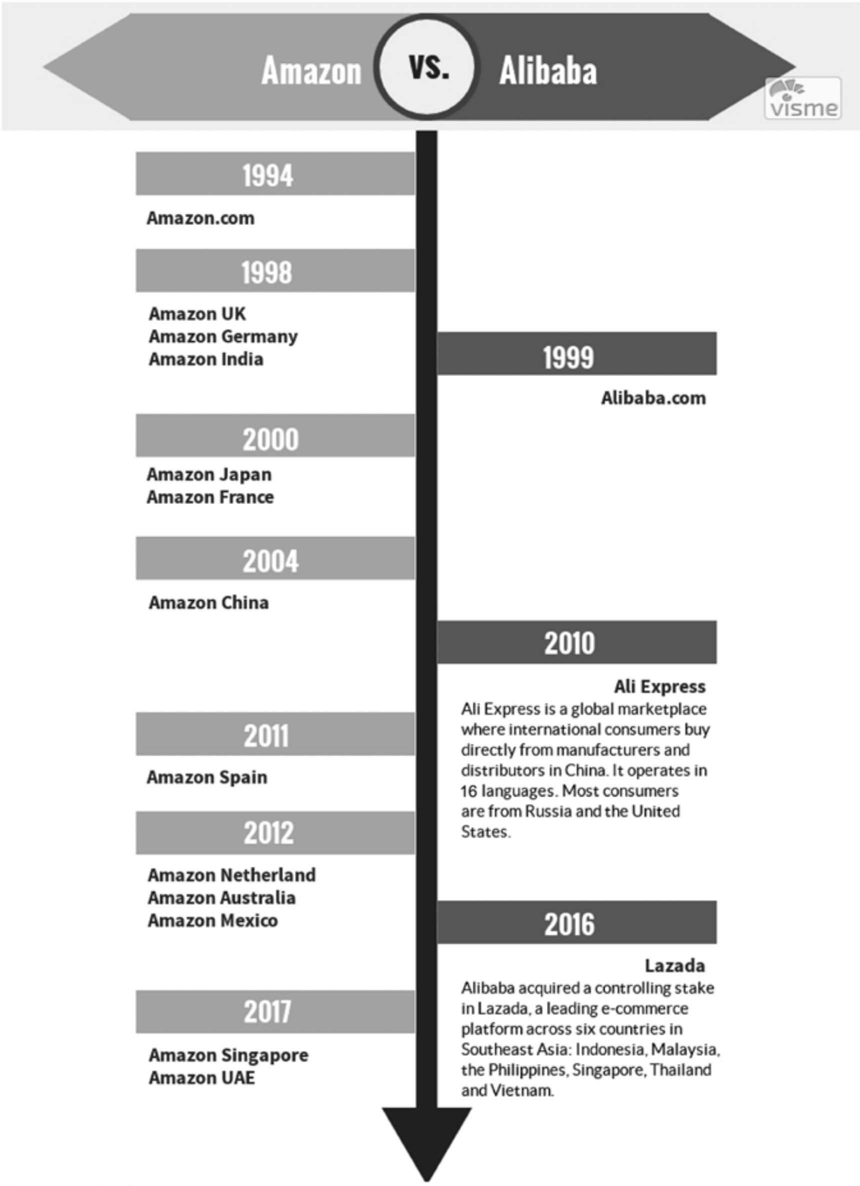

Fig. 4. International E-commerce Websites of Amazon and Alibaba.
Source: Authors.

In April 2016, Alibaba completed an acquisition of a controlling stake in Lazada, an e-commerce company that operates e-commerce platforms in Singapore, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam. Lazada provides local language options and mobile apps to cater to customers in each of the six markets. It has developed its own logistics infrastructure with warehouses and a last-mile delivery fleet to offer quick and reliable service to its customers. Sellers on this platform have access to a combined population of approximately 560 million and an Internet user base of approximately 200 million in these six countries. Alibaba intended that Lazada be the vehicle for expansion into the Southeast Asia consumer market, including potential cross-border opportunities introducing Chinese merchants and international brands to Southeast Asian consumers.

In the meantime, Amazon made the Prime Now app available for download in Singapore on both Apple's App Store and Google's Play Store. Singapore's dense, urban nature will also make it easier for Amazon to manage delivery logistics within Prime Now's two-hour delivery window (Chadha, 2017). The company has already built a fulfillment warehouse of about 100,000 square feet in Singapore to serve consumers there. With the move, Amazon has fulfilled a long-held expectation that it would target Southeast Asia's e-commerce sector. The expansion pits Amazon directly against Alibaba in Southeast Asia, where e-commerce sales are expected to more than double between 2016 and 2020, from US \$1 trillion to \$2.7 trillion (eMarketer, 2017).

4.3. Internet Governance and Home Country Politics

Currently, there are few People's Republic of China laws, regulations or rules for e-commerce because the industry is relatively new. However, it does not mean that e-commerce-related activities are not carefully monitored and controlled by the government. For example, e-commerce is classified as a value-added telecommunication business by the Chinese government, which restricts foreign ownership in this sector. As a result, Amazon has to operate its business in China through companies that are owned, wholly or partially, by Chinese citizens. Alibaba is also keenly aware of the potential adverse effects that Internet regulation in China has on its business. In its annual reports, it has been warning investors that requested disclosure of user information or data by the Chinese government due to either national security concerns or Internet censorship may harm Alibaba's services and reputation in the future.

The contemporary Internet governance structure in China was established in 2000. According to the framework provided by de Bossey (2005) and Yang and Muller (2014), it has five major categories: cybersecurity, content regulation, Internet resources, intellectual property, and developmental issues (see Fig. 5). Over the last two decades, a common theme of these regulatory endeavors has been to strengthen government control over the Internet. Muller (2011) contends that China's approach reflects cyber-nationalism and the exercise of sovereignty in Internet governance, which is contrary to the "private-sector based, more capitalistic, freer" international environment of Internet governance, which is "subject to US hegemony." As a result, Internet governance in China is meant to support the dominance and power of the state.

INTERNET INFRASTRUCTURES

Issues relating to infrastructure and the management of critical internet resources, including administration of the domain name system and IP addresses, administration of the root server system, technical standards, and telecommunications infrastructure.
E.g., *China Internet Domain Name Regulations* (2002); *China Internet Domain Name Regulations (2004)*

CYBERSECURITY

Issues relating to the use of the internet, including spam, network security and cyber crime.
E.g., The Golden Shield Project (2003); Real-name Registration (2015)

INTELLECTUAL PROPERTY

Issues that are relevant to the Internet but have an impact much wider than the internet and for which existing organizations are responsible, such as intellectual property rights (IPRs) or international trade.
E.g., *Regulation on Telecommunications* (2000); *China Internet Copyright Self-discipline Convention* (2005)

DEVELOPMENTAL ISSUES

Issues relating to the developmental aspects of internet governance, in particular capacity-building in developing countries.
E.g., *Interim Regulations on the Management of International Networking of Computer Information* (1996); Special Management Share (2017)

CONTENT REGULATIONS

Issues relating to the censorship and regulation of messages publicized on the internet.
E.g., *Administrative Provisions for Electronic Bulletin Services on the Internet* (2000); *Interim Regulations on the Administration of Internet Culture* (2011)

Fig. 5. Five Aspects of Internet Governance in China.
Source: WGIG (2005) and Yang and Muller (2014).

This section mainly focuses on the interaction between Alibaba and three of China's most controversial Internet policies: The Great Fire Wall (GFW), real-name verification, and the special management share. First, we show the influence of Internet governance on China's digital companies in practice and the implications for the digital economy. We also will briefly review Internet governance from a comparative perspective. With this understanding, we will be able to examine the interaction between Internet governance in their home countries and the international expansion of Amazon and Alibaba.

4.3.1. Great Fire Wall

Among China's Internet regulations, GFW is usually seen as the most controversial. It was launched in 2003 to prevent unfettered access to foreign websites as part of the Golden Shield Project. Multiple foreign Internet corporations were affected by GFW, including Google, Facebook, and Twitter, whose access to the Chinese market was restricted. Google, for example, was required by the Chinese government to accept a non-negotiable legal requirement of self-censorship when it launched in China in 2006. Under such censorship, Google must remove any information related to democratic, religious, or human rights issues in its search results (Hartnett, 2011). In 2010, the search engine decided to stop providing service in mainland China. Based on the government's statement quoted by the official news agency, Xinhua, the reason for this decision is that "Google violated the promise it made when entering the Chinese market by not filtering its searching service and blaming China through insinuation for alleged hacker attacks" (Helft & Barboza, 2010). Since then, users visiting Google and its subsites, like many other websites that are blocked by the GFW, would be directed to a blank webpage.

GFW, viewed through the lens of strengthening national sovereignty, is seen as a boon to China's domestic Internet companies. Because the GFW blocks foreign competitors in a targeted manner, it left enough space for Alibaba, Baidu, and Tencent to grow. However, it would be misleading to give GFW undue credit for the domestic Internet boom. GFW is a reminder of the values underpinning the regime of state sovereignty. Foreign Internet companies were banned because their values did not conform to those of the Chinese government. In contrast, Jack Ma, in his public speech and social media posts, dutifully recycles political buzzwords like "China Dream" and "new normal" (Foley, 2015). Alibaba and other Internet corporations recently agreed to invest \$11.7 billion in the state-owned China Unicom (Yuan, 2017), furthering the government's goal of channeling private money into state companies. Therefore, Alibaba became the biggest e-commerce corporation in China partly by maintaining a good relationship with the government and advocating for its values.

4.3.2. Real-Name Verification

The second type of Internet regulation in China is real-name verification. Since 2010, China's Ministry of Industry and Information Technology (MIIT) has required real-name verification for Internet users. In the beginning, its enforcement relied on China's three telecoms: China Mobile, China Unicom, and China Telecom. Then it was extended to the registration process of social media, such as Weibo and WeChat. In 2016, all users of online payment platforms, which includes Alipay, were required to link their accounts to an identification or bank account issued in mainland China.

Another regulated area related to Alibaba is delivery, which requires real-name verification to mail out or sign for a package. The MIIT claims real-name verification protects Internet users from cybercrime. In contrast, Columbia Law Professor Tim Wu claims the definition of cybercrime is distorted in this context (Osnos, 2010). Although most countries have decided that the Internet be subject to national laws, China's idea of Internet sovereignty is unique in its lack of respect for the idea of an "open Internet." China's Internet regulations are often against "divulging state secrets," "subverting state power," "damaging state honor," "propagating heretical or superstitious ideas," and "spreading rumors and disrupting social order and stability" (Ash, 2017). These rules equate Internet security to actions such as hacking and other forms of cyber-crime.

Since this regulation is very recent, there are few clues about its impact. However, it could be helpful to look at other countries that have implemented real-name verification on Internet users, such as South Korea. In 2007, the South Korean government implemented a Real Name Verification Law by which Internet users must pass a verification process to express their opinions on most websites. Cho (2013) researched the impact of this law on privacy protection and free speech. He found that after the implementation of real-name verification, Internet users' identity is more traceable; also, it has become more difficult to guarantee freedom of speech in South Korea's Internet. By monitoring and restricting the content of the Internet, the state has more power to keep track of both the content users as well as providers.

4.3.3. Special Management Share

Chinese government regulators are pushing some of the biggest Internet corporations to give the state an ownership share and a greater role in decision making. The idea of special management shares emerged in 2016 when Beijing issued a draft proposal suggesting a government stake of one percent in exchange for board representation (Yuan, 2017). The stake comes together with the stipulation that investors appoint a government official to company boards and have a say in their operations. Some companies were worried about this plan in part because of the potential for shareholder lawsuits and the high cost of shares. A one-percent stake in Alibaba, for example, would cost over $4 billion. Others privately worried that bringing the government onboard would jeopardize their relative independence and affect innovation.

This special management share plan shows that, even though the government already has a heavy hand in existing rule making, they are still concerned about the growing power of Internet companies. Until now, the state has begun its "special management shares" project with two media start-ups, taking stakes of less than two percent in Yidian Zixun and Beijing Tiexue Tech, which operate news sites. No real action has been taken on Alibaba or China's other Internet titans thus far.

4.3.4. Internet Governance in Comparative Perspective

According to Eichensehr (2014), China is advocating a multilateral model that prioritizes state control to govern the Internet. On both the domestic and international fronts, they tend to legitimize their efforts to regulate Internet participants and content and to monitor and restrict online activities as threats to national security. In 2017, the Ministry of Foreign Affairs and the Cyberspace Administration of China released guidelines on the International Strategy of Cooperation on Cyberspace. On the international side, it is reflected in a draft treaty – the International Code of Conduct for Information Security – that China, Russia, Tajikistan, and Uzbekistan proposed at the United Nations in 2011 (Ministry of Foreign Affairs of the PRC, 2011).

In practice, China's Internet governance model has a complex influence on corporations, as the interaction between Alibaba and Chinese Internet regulations shows. Although Alibaba's competitiveness in the domestic market partially originated from the restriction on foreign investment in China's e-commerce industry, there is concern Alibaba's edge will evaporate when it must compete with Amazon for the global market. While Alibaba's internationalization strategy emphasizes localizing its business model by acquiring and collaborating with local firms, an inevitable question is how to avoid the same fate in the Southeast Asian market that befell Amazon in China.[8]

By contrast, the United States is pursuing a multi-stakeholder Internet governance model, arguing for the equal rights of all Internet participants in making the rules, including the private sector, governments, non-governmental organizations, civil society, academia, and individuals (Eichensehr, 2014). A recent example that could give us a glimpse of Internet governance in the United States is Internet neutrality rules, which require Internet providers to give consumers equal access to all content online. It first became a source of debate when Tim Wu (2003) published "Network Neutrality, Broadband Discrimination" and discussed neutrality between applications and different types of data and traffic at the level of network infrastructure, and proposed legislation to deal with these issues. In February 2015, the Federal Communication Commission (FCC) voted in favor of net neutrality rules to "keep the Internet open and free" under the Obama Administration.[9] Within just two years, they were repealed in December 2017 by FCC under the Trump Administration.

Thus, this debate, which started as a technical dispute about the Internet, has become central to the concern of various actors in the digital economy, including the private sector, the Internet ecosystem (operators, application providers, content delivery networks, etc.), national states, regulatory entities, and finally, civil society and academic groups (Musiani et al., 2012). Although perspectives diverge on how this change might affect innovation and the direction of the digital economy (Kang, 2017), this controversy shows state sovereignty is not the only voice in deciding the design and outcome of Internet governance in the United States.

However, while the difference between the Internet governance model in the United States and China is striking, we want to shed light on a growing common ground: the recent policies and regulations in both countries show an increasingly restrictive attitude toward Internet governance. More importantly, this trend is not country-specific but increasingly global. Not surprisingly, China's Internet sovereignty concern has affected the neighboring Southeast Asian region and India. Singapore's Parliament, for instance, passed Cybersecurity Act 2018 (Act. 9 of 2018) in February 2018 that imposes China-like rules on digital-service providers. Also, India's government has proposed a new requirement that asks foreign tech companies to store sensitive data only within the country and puts a restriction on the ability of foreign e-commerce companies to compete with domestic firms on price (Goel, 2018). In May 2018, the European Union enacted the General Data Protection Regulation (GDPR), which contains tough rules on personal data protection. This new law, which allows people to request their online data and restricts how businesses obtain and handle that information, will not only force tech companies like Google and Facebook to adjust their data collection practices, but it may be a harbinger for a more unified global approach as Brazil, Japan and South Korea are poised to follow Europe's lead.

Given the Internet's borderless nature, the regulation of online data privacy is bound to have an outsized impact far beyond Europe (Satariano, 2018). Digital corporations are intimately intertwined with projects of national economic development. Designing an Internet governance model that protects society while allowing for the Internet's enormous economic potential to be fulfilled is a difficult task. The regulatory risks posed by the interaction between Internet governance and corporate power are more complicated in real life, and some will probably take longer to be noticed. However, the awareness of such risks is crucial.

5. CONCLUSIONS

Our study of Amazon and Alibaba provides a comprehensive look at the ecosystem of the digital economy from the perspective of the two largest e-commerce companies in the world. While recent frameworks of the digital economy are quite useful in identifying the types of digital MNEs that make up the system (UNCTAD, 2017a) and the main roles these firms carry out (Libert et al., 2016), they fail to convey the ways in which these activities and roles are interconnected within individual companies. The digital capabilities created over time by both Amazon and Alibaba go well beyond e-commerce and leverage other aspects of the digital economy ecosystem including digital content, digital solutions and Internet platforms. In addition, extensive investments in physical assets – both distribution networks to get products quickly to their customers and the recent acquisition of offline stores – challenge the notion that digital economy firms are "asset-light."

In terms of whether the Internet era has transformed the basic governance structure of global value chains, the evidence is conclusive that a platform economy now exists, and Amazon and Alibaba are leaders in linking consumers and suppliers in new ways across the multiple B2C, B2B, and C2C platforms that they manage. However, the scenario of platform-company-driven chains does not exclude the option, as early global value chain theory anticipated, that internet-based sales can also be exploited by the lead firms in traditional producer-driven and buyer-driven chains (Gereffi, 2001a, pp. 1633–1634; Gereffi, 2001b, pp. 37–38). These more integrated digital and bricks-and-mortar scenarios also fit the tendency of Amazon and Alibaba to incorporate both online and offline stores in their strategies.

Finally, we highlight the significance of varied forms of Internet governance in evaluating the strategies of digital economy leaders. Although China is making a strong bid to use the digital economy and its advanced technologies as a pillar for its ambitious "Made in China 2025" development program (Perlez, Mozur, &

Ansfield, 2017), growing state control over various aspects of the Internet in China could put a damper not only on China's attractiveness as a host for digital economy investors, both foreign and domestic, but it could also hurt Alibaba in its efforts to become more integrated into global markets.

The limited number of cases studied in this research provides only a modest start in the effort to build new theories about the digital economy. For example, comparative analysis of the leading search-engine companies (Google and Baidu) and the top social-media companies (Facebook and Tencent) in the United States and China, respectively, is needed. One should also look at the full range of companies in the digital economy ecosystem to derive broader generalizations about the changing structure and impact of this sector. We hope our research on Amazon and Alibaba in the e-commerce sector can spark new insights on IB in the digital economy.

NOTES

1. This group was set up by the Secretary-General of the United Nations in accordance with the mandate given him during the first phase of the World Summit on the Information Society held in Geneva, Switzerland on December 10–12, 2003.
2. This information is also found in Form 20-F submitted to the US Securities and Exchange Commission.
3. All monetary amounts are in US dollars.
4. According to Statista, https://www.statista.com/statistics/259782/third-party-seller-share-of-amazon-platform/.
5. In 2017, it was estimated that AWS accounted for two-thirds of Amazon's market capitalization and that AWS has 47% of the cloud computing market, while the figures for Microsoft, Google, and IBM are 10%, 3.95%, and 2.77%, respectively (Coles, 2017).
6. For example, while the delivery still relies on partner companies, Cainiao provides assisted-delivery services, which help sellers on the e-commerce websites to partner with delivery companies, provide real-time order-tracking information to consumers, shorten the estimated time for packages delivery, and build the "last mile" delivery infrastructure, such as the self-service package delivery machine in neighborhoods.
7. These include the UK, Germany, France, Spain, and the Netherlands in Europe; India, Japan, China, and Singapore in Asia; Brazil and Mexico in South America; in addition, Canada, Australia, and United Arab Emirates.
8. To some extent, Alibaba seems to be following the prescription of the Uppsala internationalization model, in line with the trajectories of Chinese electronics giants like Huawei and Haier, which is to begin its overseas expansion in adjacent markets with relatively low geographic, cultural, and institutional distances (like those in Southeast Asia) before finally entering the global market (Luo & Lemanski, 2017).
9. A detailed timeline for the development of net neutrality under the Obama administration is available at https://obamawhitehouse.archives.gov/node/323681.

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CHAPTER 14

INDUSTRY 4.0 TECHNOLOGIES AND INTERNATIONALIZATION: INSIGHTS FROM ITALIAN COMPANIES

Maria Chiarvesio and Rubina Romanello

ABSTRACT

The contemporary dynamics impose companies to both innovate and internationalize at the same time while remaining competitive in the international marketplace. With this context in mind, Industry 4.0 technologies have the potential to increase the competitiveness of companies, leading to a new era of "Manufacturing Renaissance." Recently, conceptual studies have speculated on possible impacts of the adoption of Industry 4.0 technologies in terms of international business. However, empirical studies on this topic are still lacking. Through a multiple case study approach, this study presents exploratory qualitative research investigating the relationship between Industry 4.0 and the internationalization of companies. The analysis of 16 Italian manufacturing exporting companies, which have adopted some of these technologies, has revealed a more intriguing relationship compared to the one presented in current literature, and thus has opened avenues for future research on this issue.

Keywords: Industry 4.0; emerging technologies; internationalization; international strategy; manufacturing companies; case study

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1. INTRODUCTION

Industry 4.0 has recently captured the interest of practitioners, consultants, press, policy makers, and academics. The European Union has developed measures, policies, and frameworks to boost the adoption of emerging technologies aimed at encompassing the digitalization of production processes based on devices autonomously communicating with each other along the value chain (Smit, Kreutzer, Moeller, & Carlberg, 2016). Some Member States have developed specific programs to spread the adoption of Industry 4.0 technologies and the development of coherent ecosystems.

Some works have already investigated potential challenges, functions, and outputs related to emerging technologies that are implemented within and across companies, in relation to different aspects like products, sectors, and strategies. Certainly, investments in technological advances become a logical choice for manufacturing companies that aim at remaining competitive in the international landscape. Still, there are many unanswered questions. Above all, the world of Industry 4.0 is wide and includes a variety of applications with different functionalities and potential impacts.

From a research perspective, according to a literature review (Liao, Deschamps, Loures, & Ramos, 2017), Industry 4.0 technologies have been investigated so far, mainly in relation to Computer Science (59%) and Engineering (28%), while studies in the fields of Business, Management, and Accounting are not well represented at the time. In the Business area, studies mainly concern Operations and Supply Chain Management, Production Management, and Logistics. In fact, though, Industry 4.0 technologies are already quite widespread in some sectors, for example, biomedical, aeronautics, and automotive industries, others will probably never be influenced (Laplume, Petersen, & Pearce, 2016). Still, manufacturing is expected to be dramatically impacted (Wee, Breunig, Kelly, & Mathis, 2016), leading to a "Manufacturing Renaissance" (Mosconi, 2015). For instance, a recent report has shown that 70% of Italian companies from the metals, machinery, and equipment sector have already adopted at least two applications of Industry 4.0 (Federmeccanica, 2016).

International Business (IB) research has just approached this topic, with some conceptual studies suggesting that the adoption of emerging technologies may impact on the structure of global value chains (Laplume et al., 2016; Rehnberg & Ponte, 2016), on the international configuration of the company (Rezk, Srai, & Williamson, 2016), on multinationals' advantages (Strange & Zucchella, 2017), and on the dynamics of competition (Porter & Heppelmann, 2014). However, there is a need for empirical investigations on the relationship between Industry 4.0 technologies and the internationalization of companies.

This exploratory study investigates whether, and eventually how, the adoption of emerging technologies is related to internationalization strategies and to what extent it influences decisions regarding the geography of production and distribution, and the relationships with the value chain. Through a multiple-case study approach, we investigate: (1) which emerging technologies were implemented and in what activities of the value chain; and (2) whether the adoption of Industry 4.0 technologies is related to internationalization strategies of companies.

This exploratory study mainly contributes to IB literature. First, it investigates whether an association exists between the choice of investing in Industry 4.0 technologies and the internationalization of companies. Second, it highlights some possible impacts on international strategies of firms, particularly referring to decisions regarding the localization of production and the choices related to the distribution strategy. Furthermore, it provides preliminary empirical evidence on the impacts of Industry 4.0 from the IB perspective.

After defining Industry 4.0 and reviewing the scarce literature on emerging technologies among IB studies, we explain the methodology, cross-case analysis and articulate the discussion.

2. LITERATURE REVIEW

2.1. Industry 4.0 and Emerging Technologies

Industry 4.0 identifies a group of rapid transformations that affect the design, manufacture, operation, and service of manufacturing systems and products (EPRS, 2015).

In 2011, Germany launched a High-Tech Strategy, a policy framework aimed at enhancing and innovating the productive capacity of German companies by pushing the adoption of emerging technologies, the so-called "Industrie 4.0." Germany coined this term and brought new attention on the emergence of a set of technological changes in manufacturing that are supposed to impact the organization of production processes. In this way, Germany paved the way to automation and integration of services and Information and Communications Technologies (ICT) into industrial production, crowning itself as main actor in the development of new digital technologies applied to manufacturing in Europe (Smit et al., 2016). Soon after, other European countries had adopted measures and policies to support the spreading of emerging technologies among companies (e.g., France, Italy, the UK, Belgium, Portugal, Spain, Italy, Slovenia, etc.).

Today, Industry 4.0 represents a new paradigm, where digital technologies, the Internet, and conventional industry will merge together, leading to a whole transformation of industrial production. In this framework, the organization of production processes is based on technologies and devices autonomously communicating with each other along the value chain, which to its maximum extent would lead to the creation of the "smart" factories of the future, where computer-driven systems will control production processes, create virtual copies of physical products/contexts/processes, or make decisions based on self-organization mechanisms (Smit et al., 2016).

Industry 4.0 has raised great interest and technologies included under this umbrella have been defined and categorized in different ways by consultants, practitioners, and policy makers. According to Rüßmann et al. (2015) from Boston Consulting Group, there are "Nine Pillars of Technological Advancement" driving the transformation toward a Manufacturing Renaissance: (a) big data and analytics; (b) autonomous and collaborative robots; (c) simulation; (d) horizontal and vertical system integration; (e) the Industrial Internet of Things (IoT); (f) cybersecurity; (g) cloud; (h) additive manufacturing; and (i) augmented reality. Table 1 describes technologies belonging to each category.

The first consultancy reports on this theme investigated the attitudes of managers and companies toward Industry 4.0, observing knowledge and the spreading of technologies and highlighting barriers and challenges faced during implementation (Wee et al., 2016). In addition, some works have highlighted how these technologies affect value creation and the mechanisms to capture value (Rüßmann et al., 2015; Sauter, Bode, & Kittelberg, 2016; Wee et al., 2016). According to McKinsey, most companies expect that the implementation of Industry 4.0 will increase their competitiveness (Wee et al., 2016), with some other potential benefits. Firstly, some applications aim at reducing costs and increasing productivity, for example, horizontal and vertical integration, or automated and collaborative robots. Another aspect concerns the possibility to increase flexibility with the utilization of 3D printing to produce small batches of customized products. The third benefit relates to new concepts of intelligent or predictive maintenance used to optimize the stability, assure quality achievements, and improve operational excellence, by using remote maintenance and diagnosis to service machines or products. Last, but not least, some applications have the power to completely open-up new markets with new products/services or experiment with innovative business models (Sauter et al., 2016). In general, however, an empirical study showed that manufacturing companies that achieve good progress invested an average of 18% of their R&D budget in the Industry 4.0 project, suggesting that these technologies require a considerable investment, even to introduce incremental innovations (Wee et al., 2016). Even though Industry 4.0 is often mentioned like a whole system, each single technology can be implemented in different activities of the value chain, with different functions, outputs, and impacts. The value chain activities where each application may be implemented vary depending on the product, sector, and decision of top management. Meanwhile, the adoption of emerging technologies may produce different outputs, in terms of how to manage value creation, as introduced earlier (Sauter et al., 2016).

2.2. Industry 4.0 in IB Literature

The adoption of some Industry 4.0 technologies may have strong impacts for the company itself, and in some cases, even across its boundaries (Porter & Heppelmann, 2014, 2015). Studies adopting an IB perspective are limited. So far, few conceptual studies have suggested relationships that may exist between the adoption of some Industry 4.0 technologies and IB outcomes, such as global value chains reconfiguration (Laplume et al., 2016; Rehnberg & Ponte, 2016, 2017), the international configuration of companies (Rezk et al., 2016), ownership, location, and internalization advantages (Alcácer, Cantwell, & Piscitello, 2016; Strange & Zucchella, 2017) and industry competition (Porter & Heppelmann, 2014).

Table 1. The Nine Pillars of Technological Advancements, Based on the Classification of Rüßmann et al. (2015).

Pillar	Description	Example
Big data and analytics	The collection, analysis, and evaluation of data gained through many sources.	Data from production equipment and systems used to support real time decision making.
Autonomous and collaborative robots	Autonomous, flexible, and cooperative robots, which have greater capabilities and can also work safely side by side with humans.	Collaborative robots (Cobots) used in production, which perform complex tasks and work closely to humans.
Simulation	3D simulation of products, materials and production processes, which leverage real-time data to reproduce the physical world in a virtual model.	Operators use simulation to identify weaknesses in their products, test and optimize machine settings and processes in the virtual world.
Horizontal and vertical system integration	IT systems that are fully integrated in both senses: vertically, within the company (from production to corporate), and horizontally, across different companies (from suppliers to distributors).	Collaboration platforms that allow operators at different levels to share real-time data: from production to corporate, within the company; or from suppliers to distributors.
Industrial Internet of Things	Field devices and sensors (e.g., cyber-physical systems) enriched with embedded computing and connected using standard technologies.	Smart products endowed with sensors and devices that allow the traceability, collection, release, and transfer of data.
Cybersecurity	The necessity to protect critical industrial systems and manufacturing lines from threats of cybersecurity.	Cybersecurity companies offer services to protect companies or sometimes develop partnerships with them.
Cloud	Cloud-based software to share data across sites and company boundaries.	Cloud technologies used to connect, for example, production systems and products, to allow process monitoring and controlling, and to connect to distribution systems.
Additive Manufacturing	Additive-manufacturing methods like 3D printing used to prototype or produce components.	Used to produce small batches of products or those products characterized by complex designs.
Augmented reality	Augmented-reality-based systems provide real-time information.	Augmented-reality glasses can be, for example, used for training purposes.

Some technologies are expected to increase the productivity of plants and production systems, enable shorter time-to-market and development cycles, such as customized production at lower costs (Bals, Daum, & Tate, 2015). This means that manufacturing companies, through these investments, could increase their productivity and, consequently, competitiveness. From an IB perspective, we may expect that the adoption of these technologies can influence decisions concerning the localization of production in the future. For decades, companies in developed economies have offshored products and processes, because of high production costs in domestic markets. Some companies may still consider offshoring as the best strategy to realize advantages, or even decide to increase the efficiency of offshored production through the deployment of new technologies. However, in the upcoming years, the emerging technologies that increase productivity could open-up new opportunities to backshore, which means relocating business processes, production, and services that have formerly moved to an offshore or nearshore location, back to the country of origin (Bals et al., 2015; Laplume et al., 2016). From this perspective, Industry 4.0 could bring into light new reasons to consider backshoring as a viable strategy to achieve competitiveness. For instance, some applications with this impact may be smart logistics, vertical and horizontal integration, and additive manufacturing used in production.

Laplume et al. (2016) suggest that 3D printing has the potential to reshape global value chains in terms of scope and density, at least in industries that are affected by this technology, or which may be impacted in the future. In fact, through 3D printing, companies may re-think their production systems and decide to disperse print shops in locations that are closer to end users (localization), with a subsequent revolution of the distribution strategy. In this framework, 3D printing can reduce production costs and make economies of scale redundant. This chance could affect the rules of the game, challenging multinationals as coordinators of global value chains and opening up new opportunities for SMEs and other actors (Alcàcer et al., 2016; Laplume et al., 2016). Hence, this reasoning fits a scenario where this technology is used to substitute traditional manufacturing, to create products that formerly were produced with traditional technology. In this framework, additive manufacturing pushes the smiling curve (Mudambi, 2008) upward, supporting decisions concerning the decentralization of production in favor of localizations that are closer to end-consumers (Laplume et al., 2016; Rehnberg & Ponte, 2016, 2017).

However, in other cases, the scenario may be different, with 3D printing complementing traditional manufacturing technology. This may happen in automation, for example, where factories use additive manufacturing to produce small batches of customized products at lower costs. In this case, Rehnberg and Ponte (2016) underline different dynamics, where 3D printing is used to print components to reduce the development cycles and lead times of products, suggesting a deepening of the smiling curve, with actors closer to the needs of end customers becoming more and more important (Rehnberg & Ponte, 2016, 2017). Even if these works are focused on additive manufacturing, each Industry 4.0 technology should be analyzed in different scenarios, investigating whether it is complementing or substituting traditional technology. The complementary or substituting effect may have different impacts on the international organization of companies in terms of localization and management of production and distribution.

From a different perspective, Rezk et al. (2016) have looked at the influence of emerging technologies on the international configuration of companies, in terms of horizontal and vertical decoupling. This means that product and process characteristics on the one hand, and the nature of knowledge flows on the other hand, impact on horizontal and vertical decoupling. In this framework, the authors have speculated on how some new technologies may impact the potential for fragmentation of tasks and activities. For example, 3D printing may give firms new options to decouple their downstream manufacturing activities from their upstream design, pushing companies to move vertically (Rezk et al., 2016).

Looking at Industry 4.0 another way, Strange and Zucchella (2017) have developed a first analysis of the IB impacts of four groups of technologies: IoT, Big Data and Analytics, Robotics, and Additive Manufacturing. After explaining positive and negative implications related to the adoption of each technology, the authors have discussed potential implications in terms of ownership (O), location (L), and internalization (I) advantages (Dunning, 2000). With regards to ownership, for example, the authors argue that some technologies may change the logic behind the decisions of MNEs about which activities of the value chain they should control. Regarding the location advantages, they have posed questions on how technologies that increase productivity (e.g., advanced robotics) may influence the geography of production. For instance, when applied in advanced countries, they could favor the relocation of productive subsidiaries in developed economies (reshoring, backshoring) (Bals et al., 2015; Fratocchi, Di Mauro, Barbieri, Nassimbeni, & Zanoni, 2014). Also, in light of Industry 4.0 impacts, MNEs should increasingly internalize knowledge, while externalizing operations, in order to benefit from the internalization advantages (Strange & Zucchella, 2017).

Another relevant aspect concerns the impact of "IoT." Through the inclusion of sensors and cyber physical systems (CPS) in products, manufacturing firms can deliver new "smart and connected products" (Porter & Heppelmann, 2014, 2015). In particular, the dimension of connectivity poses the foundational basis for some important changes, for instance, allowing remote managements system and/or big data collection and analysis with different potential consequences. Even in the case of IoT and smart products, there may be different scenarios: a first one, where services remain complementary to a product offering (Cusumano, Kahl, & Suarez, 2015), and another one, where digital services substitute the traditional product (Vendrell-Herrero, Bustinza, Parry, & Georgantzis, 2017). In this second scenario, smart products reach their maximum impact when they lead companies to develop a new business model, where services are offered instead of traditional products. This trend may entail new challenges related to distribution, for example, which needs to consider post-sales services and services offerings as gaining always more importance. In other words, smart and connected products may change the logistics related to sales (Porter & Heppelmann, 2014), such as other technologies like 3D printing, which may be used in marketing activities. From a value chain perspective, the IoT drives the servitization that enables organizations to extend their value chains to serve customers (Rymaszewska, Helo, & Gunasekaran, 2017). Thus, digital technologies may disrupt the way manufacturing companies compete and offer services (Nguyen & Simkin, 2017; Porter & Heppelmann, 2014, 2015; Woodside & Sood, 2016), paving the way for a shift from a traditional product-centric logic toward a model where the greater value is created through service offerings (Vendrell-Herrero et al., 2017).

In this articulated framework, scholars and experts hypothesize that emerging technologies of Industry 4.0 will favor the regionalization of production and distribution, in the end (Scalabre, 2016), suggesting that the new manufacturing will become more productive and flexible, with several implications. On the one hand, this could favor the relocation of factories in home countries, or anyhow imply that the decisions regarding localization may be influenced by a "consumer proximity" logic. On the other hand, this revolution will affect the size of factories, which will become smaller, agile, flexible, multiproduct, and adopting a make-to-order logic.

This exploratory study investigates whether, and eventually how, the adoption of Industry 4.0 emerging technologies is related to internationalization strategies and to what extent it influences decisions regarding the geography of production and distribution, and the relationships with the value chain.

3. METHODOLOGY

3.1. The Case Study Approach

Responding to previous calls for qualitative methods in IB research (Birkinshaw, Brannen, & Tung, 2011; Doz, 2011; Welch, Piekkari, Plakoyiannaki, & Paavilainen-Mäntymäki, 2011), we adopted the case study approach (Eisenhardt, 1989; Eisenhardt & Graebner, 2007) to investigate the propensity of companies toward emerging technologies and their potential impact on firms' international configuration. The case study method is particularly suitable to the exploratory nature of the research question (Coviello, 2014; Eisenhardt, 1989). The purpose of this research is inductive theory-building (Eisenhardt, 1989; Welch et al., 2011). We chose as unit of analysis the firm. The study involved multiple investigators to enhance the creative potential of the research (Eisenhardt, 1989). Notably, when observations of multiple investigators converge, the confidence in findings increases.

The research focus is on the emerging technologies attributable to "Industry 4.0" as defined by the European Parliament (EPRS, 2015) and their effect on the international configuration of companies. We developed a categorization of Industry 4.0 technologies based on the one proposed by Boston Consulting Group (Rüßmann et al., 2015).

Since the phenomenon observed is new, we developed an inductive exploratory qualitative research and selected a small number of case studies (Eisenhardt, 1989).

We followed a purposive sampling approach (Miles & Huberman, 1994). We used two key criteria to select the sample firms: (1) being an exporter and (2) having adopted at least one Industry 4.0 technology, according to Boston Consulting Group (BCG) categorization mentioned above. In addition, we selected companies from the two main sectors, according to policy makers, which characterize the manufacturing base of the region Friuli Venezia Giulia (FVG) in the North-East of Italy: (i) wood and furniture and (ii) metals, machinery, and equipment. During the selection process, we involved four institutions related to these sectors and innovation: two clusters and two technology transfers. We collaborated with experts, managers, and consultants from these institutions to identify companies that had already approached Industry 4.0. We adopted a "technocentric" perspective following previous studies (Laplume et al., 2016; Rehnberg & Ponte, 2016).

From April to July 2017, we conducted face-to-face interviews with the entrepreneurs, CEOs, and production directors of 16 exporting manufacturing companies. The interviews were based on semi-structured questionnaires including two parts. The first part concerned Industry 4.0 and its applications in the value chain; in particular, questions which specifically addressed the knowledge and adoption of Industry 4.0 applications, in order to assess which value chain activities had potentially or effectively been affected by each technology. The second part investigated aspects related to the internationalization processes: with topics ranging from the location choices of production to Foreign Direct Investments (FDIs) and the roles of subsidiaries, from the marketing to the distribution strategy.

Each interview lasted from 90 to 210 minutes and, in most cases, was followed by a visit to the production factories. All interviews were recorded and *verbatim* reported. This activity produced a total of 150 pages of transcripts. Also, follow-up contacts with respondents were conducted to refine information and data collected through the interviews. Press, archival data, and internal confidential documents were used for data triangulation purposes. Data were finally organized in excel paper sheets and tables, which have been used to support cross-case analysis.

The real name of companies interviewed has not been disclosed for confidentiality reasons. Sampled companies are all mature manufacturing exporters, with different features in terms of age (Ave Age: 43.8 years, min: 8, max: 90), size (Ave Turnover (€): 32.4 M, min: 2.5 M, max: 200 M) and internationalization paths. Most of these companies are established incremental exporters, with the exception of four companies that entered foreign markets within three years from their establishment and achieved early and rapid internationalization (e.g., companies 7, 8, 14, and 15). Nine companies have productive and/or commercial FDIs, as illustrated in Table 2. All of them have adopted or developed at least one technology of Industry 4.0. Table 2 describes some features, internationalization paths, and investments in Industry 4.0 technologies of sample companies.

3.2. The Context: Strategic Industries in the Regional Economy

According to Deloitte, Italy is in 28th position in the Global Manufacturing Competitiveness Index 2016, with the presence of 400,000 manufacturing companies (The European House – Ambrosetti, 2017). The World Bank estimates show that Italy occupies 4th place for added value produced by manufacturing and 7th for manufacturing exports (The European House – Ambrosetti, 2017). For the whole of 2016, the Friuli Venezia Giulia region contributed to national exports with 13.2 Billion Euro ISTITUTO NAZIONALE DI STATISTICA (ISTAT), 2016. In the regional economy, policy makers and the regional administration have identified two strategic sectors in 2016: wood and furniture, with a contribution of 10.6% to the regional economy, and metal products, machinery and equipment (with 30.3%). The wood and furniture sector registered an export value of 1.4 Billion €, while metals and machinery accounted for 5.6 Billion € (ISTAT, 2016; Regione Autonoma Friuli Venezia Giulia, 2017a; 2017b). In the wake of German

Table 2. Description of the Main Features and Technologies Adopted by Each Company.

Company	Product	Age	Turnover 2016 - M €	FSTS%	FDIs	Industry 4.0 Technologies: Adoption and Purposes
1	Furniture components	60	120	99	Productive subsidiaries in East Europe; JV in the United States	4.0 Logistics and inventories and robots in production; some investments in vertical integration driven by the purposes of increasing plants' efficiency and reduce costs, in order to remain competitive with international competitors.
2	Wood panels	60	200	40	Productive subsidiaries in East Europe	Robots used in production; vertical integration; horizontal integration with suppliers and distributors, through the cloud with the purpose of reducing production costs in factories located in the home country. Augmented reality offered as a service to distributors as a way to improve international sales. Documents shared through the cloud within the company and outside its boundaries, with suppliers and distributors in order to facilitate communication. IoT in progress in order to create smart and connected products.
3	Packing machines	72	20	90	Commercial subsidiaries (UK, United States). In the past, commercial subsidiary in East Europe	IoT in progress in order to respond to the demand of MNEs clients.
4	Coffee machines	90	22	50	None	3D printing used for special components for cost reduction purposes. IoT used to create smart and connected products to test the market response on this topic.
5	Construction machinery	60	70	95	Commercial subsidiaries in Hong Kong and Europe. Productive and R&D subsidiaries in East Europe	Simulation used in the prototyping phase to improve both the product and the production process. IoT is used to create smart and connected products sold to customers worldwide. Each product is connected to the manufacturer (for remote diagnostics) and to the customer (for performance monitoring).

6	Beverage machines and plants	32	10	40	None	Robots in production to reduce the costs of production. IoT fully implemented to create smart and connected plants, which are vertically and horizontally integrated. The first one entails that the whole production process is made of interconnected machines, which are connected to the different value chain activities of the company (from orders to post-sales). Also, plants are horizontally integrated since the manufacturer remotely controls, monitors and manages the plants for its customer.
7	Programmable ovens	8	6	75	None. In the past, commercial subsidiary in China	IoT related to the creation of smart and connected products that are sold globally. Products include sensors and are connected to the manufacturer, to the app (international customers) and to the cloud.
8	Ecological cars	9	2.5	85	Five commercial subsidiaries in West Europe and in Japan	IoT leading to create smart products, which are connected to the manufacturer, the customer (global customers), the cloud, and a digital sharing platform.
9	Precision mechanics	38	6.5	65	None. In the past, productive subsidiary in East Europe	Investments in production including advanced robotics, 4.0 logistics and inventories, simulation, interconnected machines, vertical integration, which have been implemented to increase efficiency of plants, reduce costs, improve lead times and increase the flexibility of production. Horizontal integration in progress with main MNE clients.
10	Mechanical machinery	22	7		None	Simulation used at the design stage to improve the subsequent production process. IoT applied to the product: smart and connected products, where connectivity is offered mainly as a service of remote diagnostics with international customers.
11	Precision mechanics	40	7.8	90	Commercial subsidiary in Nord Europe	Investments in production, including advanced robotics and interconnected machines (in progress), for cost reduction and efficiency increase purposes. The company has been moving toward a model of vertical integration.
12	Precision mechanics	50	6	70	None	Investments in production including simulation, advanced robotics, and interconnected machines, which have been implemented to increase efficiency of plants, reduce costs, improve lead times, and increase the flexibility of production. Full vertical integration. Horizontal integration achieved with most of its MNE clients.

Table 2. (*Continued*)

Company	Product	Age	Turnover 2016 - M €	FSTS%	FDIs	Industry 4.0 Technologies: Adoption and Purposes
13	Saws	40	18	80	Commercial subsidiaries in West Europe, China and United States	Advanced robotics, cobots, and interconnected machines, aimed at achieving vertical integration to increase efficiency of plants, reduce costs, improve lead times and increase the flexibility of production. Simulation used in prototyping to improve the production process and offered as a service in pre/post-sales. Big data analytics in progress – related to the utilization of the tool – with the purpose of further improving the product.
14	Mechanical machinery	14	10	95	Commercial subsidiaries in Asia and South America	IoT as smart and connected machines in progress, which are sold to worldwide customers.
15	Wheeled machinery	16	2.5	80	Commercial subsidiary in India	Smart products using an intelligent localization system that are sold globally to customers.
16	Trailers	90	10	20	None	Simulation used in prototyping to forecast performance measures of the product during utilization. Some interconnected machines in production, implemented in order to partially achieve vertical integration. IoT used to create smart products, which include sensors and allow the extraction of simple data on the utilization of the product.

"Industrie 4.0" and the orientation of the European Parliament (Smit et al., 2016), the Italian Government has developed policies to spread the implementation of Industry 4.0 technologies in order to boost productivity of manufacturing production. Along this line, the regional administration of FVG has developed policies and measures to support investments in ICT and Industry 4.0, specifically targeting companies that belong to these two strategic sectors.

4. CROSS-CASE ANALYSIS

The cross-case analysis was conducted in two phases: firstly, we analyzed which Industry 4.0 technology was adopted by companies and in which activity of the value chain; next, we examined purposes and effects of the adoption of Industry 4.0 technologies. Hence, we drew some reflections on whether, and eventually how, these emerging technologies may influence or have already impacted on the international dimension of companies. Industry 4.0 technologies have found a variety of applications in different activities of the value chain, ranging from design to post-sales, from production to logistics. Investment followed different purposes, which can be grouped in two main trajectories of innovation, as summarized in Table 3.

Table 3. Goals of the Investments in Industry 4.0, Sample Companies and Examples.

Goals of Investments in Industry 4.0	Sample Companies	Examples from Case Studies
Process innovation and improvements Increase the efficiency, the quality or the flexibility of processes, with positive returns on the quality of products and services offered to the customers.	1, 2, 6, 9, 11, 12, 13, 16	• Simulation software systems used in the design and prototyping phase to increase the efficiency of the process and to improve the quality of products. • Interconnected machines and vertical integration to increase the efficiency and the responsiveness during the whole process, from orders to post-sales services. • 3D printing used to reduce costs by internally producing or outsourcing small batches of customized components. • Horizontal integration with customers in order to improve the relationship with customers.
Product innovation and improvements Improve the quality of products and services offered to customers; Create smart and connected products, which could be connected to the manufacturer, customers, the cloud, or to digital platforms.	2 ,3, 4, 5, 6, 7, 8, 10, 14, 15, 16	• Simulation software offered in addition to the physical product, through which customers may test the characteristics and applications of products during the working process. • IoT and the inclusion of cyber-physical sensors in physical products in order to allow the collection of big data related to its working process or to achieve the connectivity to, for example, the cloud or the app offered to the customers.

A first group of companies has implemented some Industry 4.0 technologies to achieve process innovation and improvements. Consequently, this resulted in increased productivity, improved lead times and quality standards. Some investments were directed to interconnect actors within the company on the one hand (vertical integration), and to reach connectivity with suppliers and distributors on the other hand (horizontal integration). For instance, company 16 has made selected investments, introducing two interconnected machines in production, which are connected to each other, with the technical office and the R&D department. In this way, the company has thrown a first stone to achieve vertical integration. Other companies (e.g., companies 9 and 12) have taken it one step further, since they have invested substantial resources in technological innovation and have been evolving toward the model of "Smart factory," which is vertically and horizontally integrated.

Another trajectory upon which companies have invested is product innovation and improvements achieved through Industry 4.0 technologies. However, for the large majority of metals and machinery companies, smart products were the result of continuous investment in product innovation over the years, which naturally led to the IoT and the inclusion of CPS in physical products (e.g., companies 3, 4, 10, 15, and 16). Besides, companies have created smart and connected/connectible products, where the latter may be connected to the manufacturer (e.g., companies 5 and 6), the customer's app (e.g., company 6), the cloud (e.g., companies 7 and 8), and/or digital platforms (e.g., company 8). Say, in the furniture sector, company 2 has worked on the creation of smart tables that should be included in smart buildings and connected to a centralized monitoring system.

Most of the companies have chosen to focus on one trajectory so far. However, some companies in this sample have invested in both aspects; this propensity mainly pertains large companies, even though, for example, company 16 is small.

In conclusion, Industry 4.0 technologies may have different applications in value chain activities and different impacts accordingly. In general, over the years, companies have invested in Industry 4.0 following the innovation strategy of the company that was usually put in place years before. In fact, the adoption of Industry 4.0 technologies seems to be the result of a long-term investment in technology, R&D and innovation, which started in the previous years. After introducing one or two technologies, companies tend to approach new applications, with a ripple effect. However, not every technology may be interesting for all the companies. The choice largely depends on the product and production characteristics.

In some cases, Industry 4.0 investments in design, production, and logistics have produced positive results in terms of increased productivity, efficiency gains, and shorter lead times in the factories located in home countries. Overall, these investments were generally made by companies in order to remain competitive in the international marketplace and find a space within the dynamics related to price-competition. From another perspective, Industry 4.0 addressed the creation of smart and connected products, which led companies to diversify the product portfolio, enter new markets and segments, or find a specific price positioning.

In fact, we cannot identify a clear and direct relationship among investments in Industry 4.0 technologies and international activities, neither declared by the companies, nor indirectly identified during data collection. However, we can discuss the possible connection among technological investments, reorganization of companies' international configuration, and new market opportunities.

5. DISCUSSION

5.1. Industry 4.0 Technologies and the International Configuration of Production

Industry 4.0 technologies implemented in production or logistics allowed companies to increase productivity in home countries. This could be the first step toward backshoring or reshoring (Bals et al., 2015); however, this effect is more articulated. In fact, on the one hand, companies' FDIs have not been affected so far, even though companies could benefit from local efficiency gains by changing the geography of outsourcing. On the other hand, growth processes may consider that future investments could be more concentrated in the home country or in few locations, rather than spread abroad.

Companies with production concentrated in-house have continuously invested in technological innovation over the years, and have finally introduced Industry 4.0 technologies to improve production processes, in terms of, for example, efficiency, productivity, flexibility, quality, and lead times. During the past decade, some of them (e.g., companies 1, 2, 5, and 9) had formerly invested in productive subsidiaries in low-cost manufacturing countries in East Europe. Despite the Industry 4.0 investments made in main factories in home countries, none of them have backshored or reshored yet. Either way, this does not seem part of their future plans.

> Our productive subsidiaries in East Europe are located close to the forests, which provide the raw material for the production of furniture and panels. Actually, we have made huge technological investments to improve production in home factories. Yet, our Eastern European subsidiaries are home to different operations, which are still more convenient there, if compared to Italy. I personally do not see any space to backshore these activities. (Company 1)

At the same time, the role of industrial clusters (Porter, 1998) appears as a relevant factor. Overall, the findings have highlighted the importance of the local production system, which provides a strong base to outsource locally. The point is that Industry 4.0 has the potential to further improve the local production system, which constitutes an alternative choice to outsourcing or creating subsidiaries in distant countries where the manufacturing costs are cheaper. In fact, another group of sampled companies mainly focus on assembling components and deliver final products to consumers. These companies are located in industrial clusters, where they can quite easily find high-skilled suppliers. Benefiting from this ecosystem, firms tend to locally outsource most of their production. Also, some respondents declared that production costs in East Europe have increased in recent years, whereas local suppliers have increased efficiency thanks to the implementation of emerging technologies in production. This aspect can make sourcing in low-cost countries less convenient. Consequently, some firms are considering sourcing within the cluster products or components that formerly used to be outsourced in East Europe or Asian countries – in a logic of "outsourced backshoring" – or, they are again flanking local suppliers to foreign ones.

> We decided to backshore some outsourcing in our home country from East Europe. Actually, local suppliers are investing in technological innovation. In fact, today, there are some cost advantages, flexibility, better quality and improved lead times when sourcing locally. Of course, since we are located in a metal district, it is quite easy to find high-skilled suppliers that are close to our factory. However, we are flexible and always monitor the international market to evaluate the best opportunities. (Company 5)

Despite different sizes, all the companies have adopted Industry 4.0 technologies in home factories. Even though companies have not actually backshored, in some circumstances they shut down factories abroad, favoring the concentration of production facilities in one or few places (generally, the home country). An example is company 9.

> We opened a productive subsidiary in Romania in 2004 with the goal of delocalizing part of our production there and decreasing the costs for our clients. Luckily, we kept on investing in technological innovation in the home factory over the years. We started with advanced robotics more than 10 years ago to increase the productivity of plants in Italy. Now, we have implemented the vertical integration within the company, while horizontal integration with our main clients is in progress. In the meantime, the costs of production in Romania have increased, whereas in Italy they have decreased thanks to the emerging technologies implemented. For this and other reasons, in 2010, we decided to close our factory in Romania and concentrate our production at home. (Company 9)

At any rate, when applied to offshored factories, Industry 4.0 technologies will increase the attractiveness of production subsidiaries in foreign countries too. In our sample, however, none have implemented Industry 4.0 in foreign productive subsidiaries yet.

In conclusion, we may suppose that the decision of where to adopt Industry 4.0 should reflect the broader firm strategy. At the same time, production choices may be influenced by the nature of the ecosystems, where factories are located and by the end markets served by the company.

In summary, Industry 4.0 technologies have the potential to improve the manufacturing base. However, this does not necessarily mean that companies will reshore or backshore their production. Despite this, the particular features of Industry 4.0 entail that managers and entrepreneurs carefully ponder where to address these investments, which are resource-requiring. In some cases, Industry 4.0 could favor the concentration of production in some locations, which may (or should), instead, reflect the broader firm strategy.

5.2. Industry 4.0 Technologies, Smart and Connected Products, Post-Sales Services, and Customer Relationship Management

IoT, smart and connected products may influence the relationship with foreign clients and distributors. This may impact on the logics of post-sales services as well. For instance, the function of remote monitoring and management entails the opportunity to re-organize some post-sales services in-house, in headquarters, or in main factories located in the home country. This may diminish the reliance of companies on foreign distributors or impact on the role of foreign commercial subsidiaries, which were formerly used to cover the service worldwide.

> We have developed a simulation software that allows us to support our clients during pre- and post-sales activity, wherever they are. Nowadays, we acknowledge that the distribution chain has become shorter and we directly manage our clients, reducing to at large extent our reliance on distributors. (Company 13)

Another point concerns connection. Some products connect the customer to the manufacturer, pushing the last one to get in touch with the customer's habits in the use of its product. In some cases, the manufacturer starts handling the customer directly and reduces its reliance on distributors. Consequently, the manufacturer increases its customer knowledge, while it is pushed from a business-to-business (B2B) logic toward the adoption of a business-to-consumer (B2C) perspective. This aspect may require the creation of specific foreign market knowledge (e.g., to find legal privacy agreements) or the development of internal skills that were formerly provided by foreign distributors.

Another consequence of smart and connected products concerns the enlargement of service offering. Our analysis has shown a bunch of new additional services offered thanks to these technologies, say remote monitoring and management of plants. For example, the connectivity allows companies to offer remote technical assistance (performance monitoring and diagnostics). However, companies may encounter difficulties in meeting the willingness of customers to pay.

> My product has a premium positioning. I will be honest, though, my competitors from Asia and East Europe manufacture good-quality products. Even if production costs have increased in those countries, there is still some convenience in sourcing there. My customers are German or Swedish, they consider additional services as part of the product. I can't increase the price. However, we have a relationship. They buy my products and enjoy my services. The positive return is that they do not source components from my low-cost competitors. (Company 9)

At the same time, smart products with systems of intelligent monitoring may change the way companies offer post-sales assistance, which could be centralized in one place, also in their home countries. Consequently, commercial subsidiaries may be relieved of some post-sales services, influencing the way companies choose distributors or their relationships with them. This aspect could also simplify the international expansion of companies, especially if the need for investments in local distributors decreases. Additionally, companies that have always used distributors may be pushed to adopt a B2C logic. Indeed, this change in post-sales may require that companies develop new marketing skills and different types of efforts to train distributors and offer proper post-sales services.

At their maximum extent, smart connected products can push manufacturing companies toward new servitization business models (e.g., companies 6 and 8), where products are given for free and customers or clients pay just the services – in a new "digital servitization" logic (Vendrell-Herrero et al., 2017). As a result, the service offering overcomes the product selling. This is the case of Company 6, which sells smart and connected turnkey plants in the food and beverage industry.

Through Industry 4.0, the manufacturer obtained the capacity to offer additional services like real-time and remote monitoring and management of plants, and gradually moved toward a service-orientation logic. Despite its production of machines and plants, company 6 has been transforming its business model, which is now based on giving machines on gratuitous loan, while asking a fee to use a services package on an annual basis. This choice, though, entails that the number of international and domestic clients that benefit from this kind of services is limited, because this relationship is resource-demanding.

However, these products do not always gauge the market response to it. In some cases, after receiving negative feedback from the market, companies give up or try to win against the resistances of the market, which may relate to, for example, the comprehension of utilization modes, the price, or to privacy concerns. In our study, company 8 obtained the connectivity of products with the inclusion of sensors and cameras and encountered privacy problems. Also, the complexity of smart and connected products is not necessarily appreciated in the market, especially when they do not provide any greater benefit than traditional products. Consequently, some companies have been looking for other market segments interested in this aspect (e.g., company 2).

In most of these cases, the creation of smart products has been a natural consequence of companies' former investments in R&D and technological innovation. Besides, most companies had to structure their service offering accordingly, including new services related to, for example, post-sales assistance. This kind of technology may support the propensity of companies for selling products globally. This is the case of companies 7 and 8, created to serve customers worldwide from the real beginning. However, this is not the general rule. In fact, entering and increasing presence in foreign markets seems not be facilitated when dealing with smart connected products. As we have seen, they may require more resources in terms of customer relationship management and foreign market knowledge.

6. CONCLUSIONS

Companies have invested in Industry 4. 0 following the firm innovation strategy, which had already been in place and not necessarily overlaps with the international strategy. On the one hand, companies had two main objectives: product innovation or process efficiency. On the other hand, we did not find a direct relationship between Industry 4.0 and internationalization, nor did we find any underlying impact in terms of internationalization.

However, a more in-depth analysis of this topic provided some food for thought in terms of IB implications, underlining effects on the international configuration of production, and opening reflections on the re-organization of post-sales activities and the roles of foreign subsidiaries. Table 4 suggests topics for future research questions from an IB perspective.

More specifically, by studying how specific Industry 4.0 technologies impact on a firm's strategy, it is also possible to identify the impacts on the international competitiveness of companies. It would be interesting if future research could

Table 4. Suggestions for Future Research Questions about Industry 4.0 and IB.

Suggestions for Future Research Questions about Industry 4.0 and IB
• Does the adoption of Industry 4.0 technologies that improve the manufacturing base in home countries drive backshoring or reshoring from low-cost countries? • Does the adoption of Industry 4.0 technologies favor the concentration of production in a few places, is it an alternative to the internationalization of production, what is the relationship with destination markets? • Where and why companies have invested in I4.0? Are companies investing both in home and foreign countries? • What is the relationship between investments in I4.0 and the firm strategy to remain competitive in the international context? • What is the relationship between the creation of smart and connected products and the marketing strategy of companies, with particular attention to distribution? • Do connectivity and the remote management of products impact on the number of foreign customers and on global reach? • Does IoT push B2B companies to adopt a B2C logic? • Do smart connected products influence the number, location, and role of commercial foreign subsidiaries? • Do smart and connected products increase or decrease the necessity to create foreign market knowledge?

investigate the relationships existing among Industry 4.0 technologies investments in product/process and their related effects on the international configuration and performance of companies.

Each technological application may be implemented in various activities of the value chain, with different effects. Our analysis has confirmed that some technologies may be more adapt to certain businesses (e.g., Laplume et al., 2016), whereas other applications may be used for some products, instead of others. For instance, in the wood sector, IoT is not applicable to the simple wood panels produced by company 1, while it becomes relevant for company 2 that started manufacturing smart desks. In contrast, machinery equipment producers may be interested both into smart and connected products, and Industry 4.0 applications that increase productivity and automation in production. However, the latter aspect is related to the production processes implemented, as, for example, assembly-to-order processes are less repetitive and, consequently, more difficult to automate.

Therefore, we claim studies in the management field that carry on an in-depth analysis of products, production organization, business, and sector in relation to the Industry 4.0 emerging technologies. This approach could clarify in which activities each application could be implemented in order to increase the competitiveness of the company in its sector. Moreover, future studies could investigate, for instance, groups of companies adopting the same technologies in the same activities, or different technologies adopted with similar purposes. In this sense, we claim future research on the relationship between IoT and the international strategy of companies.

Alternatively, we hope that scholars will devote efforts to study whether the increases of productivity thanks to Industry 4.0 influence the choices regarding the international configuration of production or open new spaces for the phenomenon of reshoring and backshoring. As an implication, in fact, we underline that Industry 4.0 can be considered an alternative to the internationalization of production. Also, the extent of resources required for improvements in production requires that companies clearly decide where and why to put their efforts in these terms. Accordingly, investments in Industry 4.0 should reflect the long-term firm strategy. For this reason, we recommend that future studies should investigate the associations between the strategic dimension and the investments in Industry 4.0; particularly, from an international competitiveness perspective.

These cases have particularly showed the potential role of smart products in redefining the relationships of the company within the value chain, from production relationships (e.g., new suppliers for smart components, closer suppliers to interact on complex products) to market relationships (with final customers or distributors), asking for new skills or even business models; this is a line of research that is worth deepening. On the other hand, to date, investments in the production process aimed at increasing efficiency seem to be less disruptive in terms of reorganization of manufacturing activities at the international level.

Limitations stem from the small number of cases, which do not allow the generalizability of findings. However, the purpose of this qualitative study is inductive theory building regarding the relationships that may potentially exist between the Industry 4.0 technologies and the internationalization of companies. For this reason, we call for future research testing these relationships in larger samples.

Another limitation relates to the fact that this is a single country study. Indeed, comparative research on this topic may reveal a different approach to these technologies, or different effects. It would be particularly interesting to compare companies located in countries where Governments have developed measures to support the spreading of Industry 4.0 technologies and see if the different institutions have somehow influenced the relationship Industry 4.0 technologies-international strategy among the companies. In the meantime, another interesting approach could be comparing companies from countries where institutions have supported Industry 4.0 and firms located in countries where this kind of support was not provided.

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CHAPTER 15

ON THE ROLE OF CLUSTERS IN FOSTERING THE INDUSTRY 4.0

Marta Götz and Barbara Jankowska

ABSTRACT

This chapter focuses on the junction of space and technology, place and context, on the one hand; and modern industrial systems, on the other hand; as well as the relevance of clusters and Industry 4.0. The authors will first briefly present the basics of cluster, as well as the fourth industrial revolution concepts. Then, the authors will speculate about the possible contribution of clusters to the development of Industry 4.0. This chapter demonstrates that the mechanisms and functionalities provided by clusters seem to be well aligned with the features of modern manufacturing, the industrial Internet and the integrated industry. Hence, it is reasonable to claim that clusters and Industry 4.0 are compatible, not contradictory, terms.

Keywords: Cluster; Industry 4.0; digitalisation; co-operation; knowledge; ecosystem

1. INTRODUCTION

In this chapter, we aim to review and discuss the previously diagnosed avenues through which clusters may facilitate the progress of business digital transformation (Götz & Jankowska, 2017). We will, initially, present the basics of cluster and the fourth industrial revolution concepts. Then, we will speculate about the possible contribution of clusters to the development of Industry 4.0. We will build on the results of our previous study, published in the European Planning Studies and presented at the 43rd Annual EIBA Conference in Milan, during a discussion

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panel focused on Industry 4.0. We will conclude by summarising the main channels, and outlining the limitations of our approach, identifying the future avenues for exploration.

Our investigation was inspired by the observation of an apparent paradox between clusters and Industry 4.0, and the growing popularity of cluster-based policies of re-industrialisation, accompanied by establishing Industry 4.0 representing clusters.

Not all authors wish to call the observed transformation, a 'fourth revolution', instead sticking to the label of 'third industrial revolution', though they acknowledge the changing nature of the competitive advantages of: places, strategies of firms and the governance structure of international business networks (Alcácer, Cantwell, & Piscitello, 2016).

As clusters are location-bound geographic phenomena, and Industry 4.0 is all about IT–assisted, interconnected and dispersed activities, these two focal points may seem, at first sight, irreconcilable (Hermann, Pentek, & Otto, 2015; Maskell & Lorenzen, 2003; Porter, 1998). Industry 4.0, contrary to clusters, builds on diversity, not specialisation, and promotes urbanisation, rather than pure agglomeration. Industry 4.0 and its features make irrelevant the obsolete spatial aspect of clusters while requiring the conducive, cluster-typical context to fully unfold.

Cloud computing and other Industry 4.0-related technologies, enabling distant connectivity and co-ordination as well as the integration of geographically dispersed and distributed activities, may seem to diminish the role of clusters. This could make a cluster – a place-bound variation of the co-operation along the global value chain (GVC) – an outdated, if not rival, concept to Industry 4.0. There is, though, evidence pointing in the opposite direction. Thus, we will seek to explore the somewhat marginalised aspect of the fourth industrial revolution, namely to establish the rationale for such a role, and identify the channels through which clusters might be considered as facilitators for the fourth industrial revolution (Götz & Jankowska, 2017).

2. THE INTRICACIES OF A CLUSTER AND INDUSTRY 4.0

2.1. The Concept of Industry 4.0

Whereas the concept of a cluster has been noted by scholars for some time, the fourth industrial revolution has only gained attention since the turn of the millennium. Therefore, we will highlight the latter more in this chapter. The comprehensive definition of Industry 4.0 identifies four underlying concepts: cyber physical systems (CPS), the Internet of things, the Internet of services and smart factory (Hermann et al., 2015). There are nine key, technological advances, which constitute the backbone of Industry 4.0 – big data and analytics, autonomous robots, simulation, horizontal and vertical system integration, the industrial Internet of things, cybersecurity, cloud, additive manufacturing 3D and augmented reality (Rüßmann et al. , 2015). Thanks to the technological advances, machines, processes, systems and products can be linked with smart networks, which oversee each other, and are associated with the concept of the industrial Internet or integrated industry. Thus, the future of manufacturing is presented as intelligent, interconnected and technological systems. Industry 4.0 is based on six design principles: interoperability, virtualisation, decentralisation, real-time capability, service orientation and modularity.

Since the concept of Industry 4.0 has emerged relatively 'late in the day', there is still a lack of a clear, specific definition, and it functions rather as a concept comprising a wide array of interdisciplinary technologies – with the different levels of maturity and market availability – which facilitate digitisation, automation and process integration along the value chain (Götz & Jankowska, 2017).

Nevertheless, it is possible to indicate the key features of the fourth industrial revolution. According to Kagermann, Wahlster, and Helbig (2013), there are three key characteristics. First is horizontal integration through value networks (integration of IT systems, processes and data flows between customers, suppliers and other external partners; as well as co-operation across company borders). Second is the end-to-end digital integration of engineering (usage of CPSs). Third, despite the horizontal integration, the vertical integration – the integration of IT systems, processes and data flows within the company, from designing the product to its sales – is very much in evidence (Kagermann et al., 2013).

The key implication of the digital transformation sweeping through the advanced economies labelled as Industry 4.0 (the fourth industrial revolution) is the profound modification of the current business models (Hermann et al., 2015; Hüther, 2016; Kagermann et al., 2013; Rüßmann et al., 2015). Given the surrounding uncertainty, and yet high expectations towards Industry 4.0, policy makers and industry insiders tend to attribute an important role in its development to clusters (Sofuł & Ziarno, 2017).

The manufacturing sector has one of the highest multiplier effects on the economy, as it is a major driver of knowledge building and job creation (Farshchi, Janne, & McCann, 2009). New studies point towards the system's nature of the industry defined as a combination of manufacturing and services, that is, the organisation along supply chains, highly complex interactions, blurred boundaries among entities and growing interdependencies (Götz & Jankowska, 2017).

Industry 4.0 combines the strengths of traditional industries with cutting-edge Internet technologies. It is worth mentioning that business-to-business (B2B) face should be distinguished from other 'economic' aspects of digital transformation, which have so far been inadequately differentiated, and not systematically captured, such as Business to Consumer (B2C), Consumer to Consumer (C2C) and Consumer to Business (C2B). Industry 4.0 is changing the manufacturing landscape by virtualisation, decentralisation and network building (Brettel, Friederichsen, Keller, & Rosenberg, 2014). It stipulates the emergence of a fully integrated and intelligent environment. As globalisation has increasingly taken the form of the sharing of tasks, trading services and the operation of complex international value chains, which require just-in-time delivery, information technology and communication (ICT) duly became the driver (Dadush, 2017). The principles of Industry 4.0 have gone global, even if the term does not ring a bell everywhere (Industry 4.0: the fourth industrial revolution – guide to Industrie 4.0; https://www.i-scoop.eu/industry-4-0/).

Although the digital transformation may suggest the death of distance, and hence, the importance of place-bound clusters, certain facts contradict such a statement. A 30-year window of arbitrage, allowing multinationals called 'agents behind global integration' to thrive, is slowly closing, forcing them to retreat (The retreat of the global company, 2017). General Electric and Siemens are 'localising' supply chains, production, jobs and taxes into regional or national units. Simultaneously, local firms have become more sophisticated. In fact, the companies at the cutting edge are now local, not global. It can be expected that, even if they only act as 'low-profile agents' over time, these millions of small firms trading across borders, might replace the bigger firms as the transmitters of ideas and capital. In a response to a tough business environment, such enterprises, despite the differences within their industries – specific lifecycles and supply chain structures – are starting to use services, rather than products, to increase their competitiveness. More manufacturing firms are trying to adopt service business models, which are labelled as 'servinomics'. Horizontal integration around smart factories will create new business models based on manufacturing as a service (International: Industry 4.0, 2016). Introducing services, which are more resilient to business cycle fluctuations, might be the way to diversify or establish a precautionary move. This re-orientation is promising, though it also causes many challenges and involves uncertainty for the European Union's (EU) companies, as available evidence suggests, that the US entrepreneurial, digital ecosystem is more apt to service business models than European ones (Aquilante, Bustinza, & Vendrell-Herrero, 2016).

Given the ongoing processes, industry needs to be defined as a combination of manufacturing and services. Taking such an approach better explains recent interest in promoting industry in the EU, along with the calls to re-industrialise European economies, and assure the development of key enabling technologies, which constitute the prerequisite for successful modernisation of the industrial policy.

Industry 4.0 combines the strengths of traditional industries with cutting-edge Internet technologies. 'Industrie 4.0' or the 'industrial Internet', epitomises, in fact, the 'B2B' interface of digital transformation (Hüther, 2016). This describes the interaction between companies in a highly digitalised network, or along a value chain within the industry-service joint production. It should be distinguished from other 'economic' aspects, so far inadequately differentiated, and not systematically captured, such as B2C, C2C and C2B.

The term 'Industrial Internet' implies, not only robotics and the automation of production, but also digitisation of business processes (Roblek, Meško, & Krapež, 2016). It refers to complexity across community interactions, digital media, hardware, sensors, clouds and microprocessors (Delgado, Porter, & Stern, 2014; Peterlin, Dimovski, Uhan, & Penger, 2015).

Industry 4.0 can also be perceived as the comprehensive fusion of all industries with IT. It is about the new approach to technology assisted manufacturing, which will kick off, only when the individual order has been placed. It is a mass individual production. Industry 4.0., therefore, constitutes, the smart combination of IT applications adopted in firms, the complex configuration of engineering, computer science and management. In order to build on the digitalisation of traditional industry branches, Industry 4.0 ensures the blurring of the borders among single companies or geographical areas. Experts argue that despite some progress, many firms still have implemented only a fraction of the whole ecosystem, and thus, Industry 4.0 is fragmented and patchy (Experts, 2016). Given the fact that many of the constituent components of the fourth industrial revolution are already present (Cloud computing, Big data, Internet of things [IoT], etc.), some argue that an observed and announced revolution is rather an evolution of existing solutions (Maślanek, 2014).

Manufacturers face increased cost pressures and market volatility. Product life cycles are getting shorter. Production must be faster and increasingly local. This acceleration of 'time-to-market' may occur due to the solutions of Industry 4.0, with supply chains morphing into highly adaptive networks with integrated entities. The hype for Industry 4.0 can be traced back to two premises. First, contrary to previous revolutions, this one has been somehow anticipated and *ex ante* awaited. Second, the predicted impact on the economy has been impressive, as in Germany, for instance, Gross Domestic Product (GDP) may rise by almost 80 billion euros higher up till 2025 (Hermann et al., 2015). A study, conducted by Roland Berger, and commissioned by the German Industry Association, The Federation of German Industries (BDI), shows that Germany may benefit to the tune of 425 billion euros by 2025, thanks to the increase of the value added, which is nearly 5,300 euros per citizen. Europe can, at the same time, generate 1.25 trillion euros (Bundesverband der Deutschen Industrie, 2016). However, if it fails the digital transformation, Germany would have to bear losses of some 220 billion euros, and Europe even 600 billion euros, within the next 10 years.

What makes the current revolution different from the previous ones is that it has been initiated within society and influences industry, rather than the other way round – 'its main drivers are the invention of social networks and smart devices (…) this development of interconnectivity pushes into the industrial sector today' (Schuh, Potente, Wesch-Potente, Ruth Weber, & Prote, 2014).

Industry 4.0 links the strengths of classic industries with cutting-edge Internet technologies, and provides various gains, such as the shortening of production time or efficiency improvements, but it is not without additional complexity, coming along in the form of collateral damage (Schmidt et al., 2015). Various concepts are classified under the notion Industry 4.0, including – a smart factory equipped with sensors and autonomous systems, with the ability of self-optimisation and autonomous decision-making; more individualised product and service development, with both product intelligence and memory; self-organisation, with changes in the entire supply and manufacturing chains; and the life cycle management of a product with manufacturing processes, closely connected across corporate boundaries, towards decentralised self-organisation (Roblek et al., 2016).

Challenges stemming from these developments, pertaining to unknown consequences for the legislative system, issues of safety and security, labour market functioning, training and education and other aspects of the economy, should not overshadow multiple gains, which can be achieved thanks to these processes.

Though it is a technological and economic phenomenon, Industry 4.0 is also a clear policy issue. This is particularly visible in Germany. Initiatives developed there under the heading of *Industrie 4.0* are a clear evidence of an active industrial policy. Proponents of the idea that Industry 4.0 is indeed a breakthrough revolution, and not just a gradual evolution, even claim that, as societies we are facing Life 4.0 (Bundesverband der Deutschen Industrie, 2016).[1] The formidable changes affect, namely, not only industry, manufacturing production or business models, but also public administration, health care, working conditions including commuting, training, workplace organisation and even free-time organisation. Simultaneously, the role of governments in this revolution is being stressed more frequently. More is expected with respect to the provision of key infrastructure, the development of broadband networks, incentivising small businesses for a proactive approach and embracing the fourth revolution, or at least, assuring safety and security standards (Götz & Jankowska, 2017).

Whereas scholarly documents usually highlight the IT system, management or operational issues, dossiers drafted by the leading international institutions, think-tanks and consultancies focus on the global challenges and advantages accruing to Industry 4.0.

2.2. The Concept of a Cluster

The term 'Cluster', as compared to Industry 4.0, is a much older concept, and is mainly understood as a geographic concentration of interconnected companies, specialised suppliers, service providers and associated institutions in a particular field, which are present in a nation or region (Porter, 2000).

Often, also viewed as hybrid forms of long-term contracting and reciprocal trading, residing somewhere between hierarchies and markets (Maskell & Lorenzen, 2003), clusters are characterised by competition, as firms in a cluster both co-operate and compete, simultaneously. They are associated with multiple advantages, which rest on the assumption that regional specialisation, based on the interlinked activities of complementary firms and their co-operation with public and private research institutions, creates synergies, increases productivity and leads to economic advantages.

Higher competitiveness and innovative capabilities commonly associated with clusters render these places attractive locations (Ketels & Memedovic, 2008; Malmberg & Maskell, 1999). A knowledge environment can be regarded as one of the sources of the attractiveness of clusters, along with pecuniary agglomeration economies enhancing effectiveness and thus improving profitability, while the institutional setting possibly reduces uncertainty and transaction costs (Götz, 2009; Jankowska, 2010).

3. RECONCILING CLUSTER ATTRIBUTES WITH INDUSTRY 4.0 FEATURES

Based on a review of the literature, we can identify the channels through which clusters impact upon the advancement of Industry 4.0. Seen as 'repositories of competences', they not only possess certain knowledge attributes, such as university, scientific, research institutes or pools of a highly qualified labour force, but also provide mechanisms facilitating knowledge development, dissemination and accumulation, via co-operation platforms, business-education forums, social networks, spill-overs, etc. As the expectations towards CPSs – the basic component of industry 4.0 – are versatile and enormous (robustness, autonomy, self-organisation, self-repair, predictability and interoperability), challenges to the R&D community are formidable (Götz & Jankowska, 2017).

Given the complexity of requirements, the knowledge available in well-established, highly specialised clusters, where practitioners and scholars work together, seems to be especially sought after. The interactive character of learning introduces geographical space as a necessary dimension, which must not be neglected, even in the era of Industry 4.0. The more tacit the knowledge is, the more important becomes spatial proximity, and direct, face-to-face contacts (Götz & Jankowska, 2017). A successful transformation towards the fourth industrial revolution requires conditions intrinsic to clusters: mutual trust, plus shared norms and values. Typical for Industry 4.0, a merger of R&D, manufacturing, logistic and marketing-facilitated IT solutions mirrors physical closeness present in clusters, thanks to the spatial concentration.

Besides, Industry 4.0 embodies the concept of 'connected enterprise' with blurred boundaries, implying the co-operation of almost everyone with everybody, which, as it seems, clusters can emulate. Indeed, clusters epitomise the broad and comprehensive understanding of Industry 4.0, which is not simply limited to the digitalisation of production, as it covers the ecosystem of humans, machines and organisations. The whole digital transformation revolves around comprehensive systemic modification of the markets and structures of value creation; it involves the emergence of the architecture of platforms, whereby clusters can act as nodes in networks or a core of the platforms. Additionally, clusters should be regarded as a very promising policy tool and instrument of modern industrial policy, aiming at digital transformation and pursuing the fourth industrial revolution.

Firms operating in clusters can, therefore, be better equipped to face the fast-changing turbulent environment of Industry 4.0. Additionally, it should be stressed that clusters can actually exist in traditional and advanced sophisticated sectors, such as Industry 4.0 (German Cluster Platform, 2017).

Clusters can be a laboratory for Industry 4.0 experiments, since they provide a unique climate of trust, which stimulates knowledge creation and dissemination. They are vehicles for implementation of advanced projects, and can ultimately serve as nodes in the architecture of platforms. Despite this compatibility, Industry 4.0 might be expected to redefine the cluster towards the platforms of collaboration or alliances, stripping this term of its geographic attributes and reinforcing the broader definition, not location-specific or geographically concentrated (http://www.cluster-industrie-40.de).

The Internet age and the long-distance communication and collaboration it duly enables might have suspended the importance of regional agglomerations (Alcácer et al., 2016). In other words, there seems to be a certain paradox between clusters promoting localised learning and production, and new technologies facilitating the worldwide dispersion of activities (Götz & Jankowska, 2017). As our preliminary study shows, these two, in fact, do not exclude each other. Whereas new technologies allow us to conduct business in fresh ways, clusters are perfectly complementary to these new functionalities, as they provide for centres of excellence, where knowledge might be developed and greatly enhanced. ICT solutions have certainly facilitated the dispersion of activities, the exchange of knowledge, and prompted the connectedness of them, worldwide. This global connectedness, however, does not reduce the importance of knowledge; particularly, as a source of competitive advantage for firms. As this tends to be generated and developed in hubs and local clusters, the role of such places does not seem likely to recede any time soon.

New industries, which are at the beginning of their life cycle, and in which there is a high level of uncertainty about future technological and market developments, show a clear tendency for co-operation (Hornych & Brachert, 2012). This factor empowers companies to reduce their transaction costs, enhance the knowledge base, increase their innovative power by using external resources and reduce other risks of research efforts. The process of networking enterprises can, therefore, have a spatial dimension. This is because the spatial proximity additionally reinforces the positive effects of co-operation (Götz & Jankowska, 2017).

On the European level, a special role may be played by the European Cluster Collaboration Platform (https://www.clustercollaboration.eu), which provides networking support for clusters (organisations and members) aiming to improve their performance and increase their competitiveness through the stimulation of transnational and international co-operation. The platform also makes efficient use of networking instruments (to search/find potential partners and opportunities); develops collaboration trans-nationally (within Europe) and internationally (beyond Europe); supports the emergence of new value chains through cross-sectorial co-operation; accesses the latest quality information on cluster development; improves the performance of the clusters, as well as its own; and enhances the competitiveness of its members. The presented research may complement the debated aspects of regional and development policies in a digital era, whether conceived as spatially blind, space neutral or a place-based policy (Götz & Jankowska, 2017).

4. CONCLUSIONS AND THE WAY FORWARD

Our research demonstrates that a cluster's attributes constitute the answer many challenges and requirements brought about by the fourth industrial revolution. In other words, the mechanisms and functionalities provided by clusters seem to be well aligned with features of modern manufacturing, the industrial Internet and the integrated industry. Hence, it is reasonable to claim that clusters and Industry 4.0 are compatible, not contradictory terms. Nevertheless, Industry 4.0 might be expected to redefine the cluster towards the platform of collaboration/alliance; stripping this term of its geographic attributes and reinforcing the broader definition, not location specific, geographically concentrated.

The identified channels certainly do not exploit the whole range of possible influence. Clusters may be particularly conducive for small and medium enterprises (SMEs), and assist them in implementing the industrial Internet.

The importance of such locations can derive from an apparently lower uncertainty, and a better, institutional framework provided to the cluster members. Last, but not least, clusters not only seem to be an attractive place for fostering the advancement of Industry 4.0, but also the simple result of an Industry 4.0 induced process leading to growing spatial concentration. The identified and illuminated avenues supporting the role of clusters in the digital transformation should be seen as an invitation for further research.

Our study indicates that there is evidence pointing in the opposite direction away from a contradiction between clusters and Industry 4.0; particularly, if the latter is seen as highly adaptive networks of integrated entities, which relates it to a cluster. The concept of a cluster remains, therefore, an appropriate formula, and a vehicle useful for implementing Industry 4.0., adequately adapted to the requirements of a data-driven world. It seems that clusters in the digital age can secure a central place, as locations still equipped with and providing certain positive externalities, but they would be more cross-sectoral, horizontal and less geographically concentrated than classic clusters used to be. It remains to be seen if the classic approach and understanding of a cluster as a geographic concentration of entities specialising in a given field, is under pressure from the fourth industrial revolution, giving way to a more location-unrestricted, geographically unlimited concept of cluster, as an alliance of diversified co-operation and a tool for pursuing a technology development policy.

This chapter argues that a cluster's attributes are, in fact, the answer to many ongoing developments induced by the fourth industrial revolution. It specifically stresses the impact digitisation would have on these concepts. By doing this, the authors are trying to explore how this transformation can play out against a background of clusters.

Another approach focuses on the modification of the governance of GVC into highly adaptive networks of integrated entities, and increasingly emphasises the pressure put on firms' ability to be adaptable, applying swift and flexible reactions. That all the aforementioned is triggered by the fourth industrial revolution may be associated with the processes known and typical for clusters. Industry 4.0-induced challenges would drive firms to assure network embeddedness – to collaborate, share risks and jointly learn – making them more interested in clusters. This consequence, however, given the attributes of the industrial Internet – mainly the global relatedness and IT-assisted connectivity – does not necessarily mean the need for a geographic co-location. So, it can be expected that Industry 4.0 might modify the understanding and attractiveness of clusters, re-designing them more towards place-unbound concepts (Fig. 1).

A critical mass of co-operating and competing entities – firms, universities, R&D units, regional authorities and other supporting service–providing institutions, – are enabling knowledge generation and sharing, providing pools of specialised workers and facilitating internalisation of various externalities (spill overs). All these factors constitute the core of a cluster, which would still be of critical importance, apart from, perhaps, the geographic co-location.

Industry 4.0 involves the entire value chain and ecosystem within which manufacturing operations reside, thus ensuring the alignment is of crucial importance.

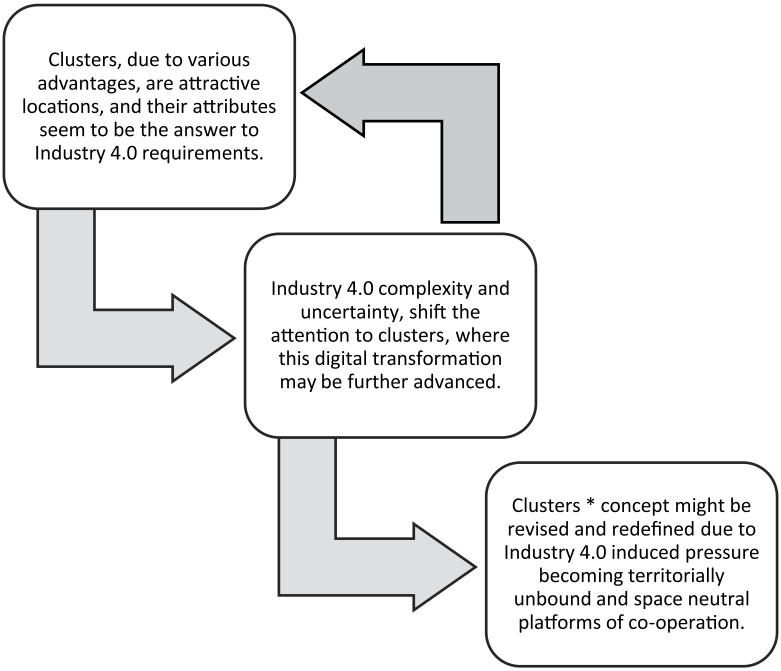

Fig. 1. Cluster-Industry 4.0–Cluster* Relations. Authors' proposal.
Source: cluster* = modified cluster, cluster 2.0 as altered due to I4.0 processes

This chapter has sought to reveal that the digital revolution, which is influencing GVCs, networks and expectations towards manufacturing firms, might turn to clusters as appropriate environments. The presented investigation relates to the question of how important, in the light of IT assisted and globally spread operations of Industry 4.0, does the concept of co-location remain? Spatial proximity, one of the classic features of clusters, might be suspended in the light of Industry 4.0, and specialisation might also be relaxed. Nevertheless, as this chapter has tried to indicate, the consequences of the fourth industrial revolution, in terms of the organisation of value creation or firms' requirements, can be found in clusters. As a result, it would appear that solutions derived from clusters can be utilised, and functioning experiences harnessed, when seeking the methods for advancing the fourth industrial revolution.

As this study (like many others in this new field – see Laplume, Petersen, & Pearce, 2016) has a very explorative nature, it has not been possible to get close to a definite answer, but we have been able to both provide some indicative suggestions and speculate, based on the presented considerations. The information age is certainly reshaping current structures and processes within international economics. The full impact still remains unknown. Scholars can only forward hypotheses as to the most likely directions of changes, and to the scale of transformation the fourth industrial revolution creates. Collecting empirical evidence, in all possible configurations, therefore, seems inevitable for a proper diagnosis of the related components and their interdependencies.

NOTE

1. Bundesverband der Deutschen Industrie e.V. uses the term 'Leben 4.0'; predictive analytics enables, for example, informing the number of vehicles on a road, the distances between them, events in front of them, weather conditions, etc.

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CHAPTER 16

INTERNATIONALISATION OF SCIENCE PARKS: EXPERIENCES OF BRAZILIAN INNOVATION ENVIRONMENTS

Jurema Tomelin, Mohamed Amal, Aurora Caneiro Zen and Pierfrancesco Arrabito

ABSTRACT

Internationalisation became an important component of science parks (SPs) practices. In recent years, they have started to include, among the portfolio of their services, the support and fostering of their tenant firms' internationalisation, such as soft-landing programmes and international immersion experiences for start-ups. Thus, the main aim of this chapter is to analyse these internationalisation practices in the light of the network and internationalisation theories. Based on an exploratory multiple case study the authors conducted in three Brazilian SPs located in the South of Brazil (Rio Grande do Sul State) – Tecnopuc in Porto Alegre, Tecnosinos in São Leopoldo and Feevale Techpark in Campo Bom. The authors provide evidences on how cohesive internal and external ties, networks as well as the level of specialisation are the key drivers of the internationalisation process of SPs and their tenant firms.

Keywords: Internationalisation; network; science parks; network theory, uppsala model revisited

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1. INTRODUCTION

Science parks (SPs) were originally developed to increase the possibilities of commercialising university research and meet the needs of entrepreneurial academic spin-offs. The Stanford Research Park in California, established in 1951, is often regarded as the genesis of the SP movement (Dahlstrand & Smith, 2009). It has changed the Silicon Valley area from one of the poorest regions in the United States into a global centre of technology, finance, education and research. This experience sparked a global phenomenon.

Similar projects fostering relationships between universities, R&D centres and the private business sector have been initiated all over of the world. Their numbers continue to grow as more countries have started adopting the SPs as an important economic development strategy, and part of national or regional innovation systems (Chung, 2002; Cooke, Uranga, & Etxebarria, 1997; Freeman, 1995).

As the global economic scenario undergoes major transformations, there is a growing demand for novelty, increasing the organisational challenges and the need to become more innovative (Engelman, Zen & Gracasso, 2015). In this context, different experiences of SPs in developed and emerging economies started to base their innovation and growth on a strategy of internationalisation. On the other hand, over the last decade, we have observed that SPs have started to offer many internationalisation support services to tenant companies, such as Soft-Landing programmes and international immersion experiences for start-ups (ANPROTEC [Brazilian Association of Science Parks and Business Incubation], 2016).

However, even though we witness a large tendency of such phenomenon, the literature is relatively scarce in providing robust frameworks to the understanding of the SPs' internationalisation (Bengtsson & Löwegren, 2000; Berbel, Rocha, Sá, & Carneiro, 2011; Guadix, Carrillo-Castrillo, Onieva, & Navascués, 2016; Ruiz, Costa, Knies, & Ribeiro, 2016).

To capture such dynamic, we discuss in this chapter the internationalisation practices of the SPs by using a network-based approach. Since we are motivated to provide a general framework of such dynamic, we conducted a multiple exploratory case study among selected SPs located in the south of Brazil, which are the Scientific and Technological Park of PUCRS (Tecnopuc) in Porto Alegre, Technological Park of São Leopoldo (Tecnosinos) in São Leopoldo and the Technology Park of Vale do Sinos (Feevale Techpark) in Campo Bom. We argue that both internal and external strong ties, as well the level of network embeddedness represent the main drivers of the internationalisation path of SP. Such a process is more likely to occur in a more interactive way between the SP and its tenant firms.

In this chapter, we will contribute to this debate in several ways: first, by providing insight on the internationalisation process of scientific and technological parks; second, by establishing the links between the SPs and the internationalisation of firms; and third, by discussing the role of the regional innovation system and how it drives the internationalisation of SPs in an emerging economy.

Following this introduction, the chapter is organised into four sections. In Section 2, we set up the general theoretical approach of the SPs' internationalisation.

In Section 3, we briefly introduce the methodology. In Section 4, we present and discuss the main results. We conclude our study in Section 5.

2. LITERATURE REVIEW

The proposal of this literature review is to contribute to the discussion about the internationalisation of SPs and provide a brief analysis of the context and evolution of these innovation environments. We also show how the social network and international business theory contribute to a better understanding of the phenomenon. This review incorporates some recent studies justifying the importance of the internationalisation of new technology-based firms (NTBFs), and how the SPs can support this movement by its tenant firms.

2.1. Science Park Models

Technology and SPs are considered a distinct geographical environment in which social and institutional processes emerge. The environment in which they operate is expected to become more integrated over time through a texture of social and institutional networks. They act to manage the flow of information, facilitating communication between the various actors and even providing a culture of innovation and creativity, facilitating the emergence of new firms (IASP [International Association of Science Parks], 2017; Johannissson, 1998).

SPs have followed a geographical and historical development and evolution. An interesting approach to categorise the various SP models and map their evolution is the 'Generations framework', which shows the different innovation systems of the SPs and the contextual development towards increasingly higher levels of integration in the knowledge economy (ANPROTEC-ABDI, 2008; Cooper, 1971).

Pioneering parks that were created to support technology-based companies, such as the Stanford Research Park, were extensions of a university and included incubating facilities for start-up firms, related business services and pathways into new, research-based technology. The innovation philosophy of the First Generation SP can be characterised as 'science push' approach (Bianchi, 2008; Langrish, Gibbons, Evans, & Jevons, 1972).

The Second Generation of SP remains an extension of the university, and continues to make available a mix of high-quality facilities, by streamlining and combining value-adding business services and managing the flow of technology and related knowledge. This generation can be characterised as 'demand pull' (Bianchi, 2008).

The Third Generation SP is linked with the local community, increasing its participation in local, regional and global innovation. Management recognises that 'post-industrial' economic activities need a much closer interaction with the knowledge suppliers and the wide range of services that support the innovation of firms (Bianchi, 2008; Eriksson, 2012). In a Third Generation SP, innovations, even those performed by a single company, may stand out as comprehensive outcomes of these interactive, functional relationship (Eriksson, 2012).

At the end of the twentieth century, a Fourth Generation model was proposed by Cunha (1998), in which firms and universities elaborate action strategies to ensure the future of the institutions. In this sense, the strategic partnership model seeks a balance between the innovations generated within the university/research institutions and the needs that may arise on the market in the near future. Unlike the previous models, pushing technology or capturing market needs, in this model, both partners meet to establish a strategy for joint action that may bring mutual results.

The partnership model is characterised as symbiotic, one in which both parties depend on each other to get a particular advantage. While the university has the knowledge base, firms may have access to the market in which to sell the resulting product of this knowledge. However, the university and the company both need to maintain a constant exchange of information to enable network learning, so that the product-development process brings positive results to both institutions. In light of such interactive strategy of innovation, the financing may be originated by governmental institutions, since the outcome of this partnership may contribute to regional and local development (Zen & Hauser, 2004).

Considering the evolution of SPs movement, the relation and synergy among the actors are the key factors to the development of a SP at the local and global levels. We propose a general framework to understand the internationalisation process in this context based on the integration of two theoretical lenses – the social network theory and the Uppsala model revisited (2013).

2.2. Social Network Theory and Internationalisation

The social network theory is a loosely organised configuration of claims about the nature of the knowledge process, providing general guidelines for the development of particular theories such as knowledge creation and diffusion (Dunn, 1983).

According to this theory, individuals or even companies with weak ties are deprived of information from distant parts of the social system and might have difficulty organising or integrating into political movements of any kind. An important reason for weak ties is specialisation, which results in a wide variety of specialised role relationships (Granovetter, 1983).

Social capital, as a part of the relational and structural resources attained by individuals and firms, is created by a network of social relationships. Entrepreneurs not only depend on internal knowledge sources for business success, but also need to be able to obtain knowledge and business information externally, through the firm's networks and human relations (Cooper & Yin, 2005; Dai & Liu, 2009). Social capital theory places a great emphasis on human relations and the elicitation of tacit knowledge in the context of the global economy.

Nahapiet and Ghoshal (1998) proposed two key mechanisms for creating social knowledge: (i) incremental change and development from existing knowledge (Schumpeter, 1934), although this involves combining previously unconnected elements; and (ii) exchange and creation of intellectual capital by combining knowledge and experience from different sources.

Johanson and Mattsson (1988) consider the industrial system a network of relationships between firms; this network can be stable or change, according to the activities connected with the transactions made. The authors assume that a firm's activities are cumulative processes in which relationships are continuously established, maintained or broken, and thus the firm's position in the network will secure the long-term survival and development of the firm.

The main obstacle to internationalisation is the lack of knowledge and operations about foreign markets. Thus, knowledge can be obtained from experiences developed in those markets; experience will give the firm an ability to see and evaluate business opportunities (Johanson & Mattsson, 1988).

Nevertheless, internationalisation is an aspect of developing opportunities that emerge in the ongoing interactions in one or more relationships. The multinational business enterprise (MBE) is a network in itself, where different group units have specific network relationships with external firms (Forsgren, Holm, & Johanson, 2007; Ghoshal & Bartlett, 1990; Johanson & Vahlne, 2009).

The revisited Uppsala model (Vahlne & Johanson, 2013) considers internationalisation as a process consisting of two sorts of change variables: decisions committing the organisation to a certain party, project or strategy; and ongoing inter-organisational processes of learning, creating and trust building. Conversely, the static variables can describe the current status of the MBE knowledge and capabilities, as well as the network position, at any moment in time.

Thus, the model is dynamic, and considers the MBE to be a firm that has a capability to build, develop and coordinate value-creating multinational business network structures, involving both internal and external actors.

Although the international business literature has evolved significantly to capture the different internationalisation paths of firms and organisation, there is still a lack of discussion and understanding of the phenomenon of internationalisation of SPs. In Section 2.3, we will briefly discuss the process of SP internationalisation.

2.3. Internationalisation of Science Parks

The literature on international business has highlighted that international expansion represents an opportunity for growth and the creation of value for the company. Enterprises that enter international markets generally increase their technological and market expertise, improve their performance, and often become more innovative and, therefore, stronger competitors in their national markets (Engelman, Zen, & Fracasso, 2015; Hansson & Hedin, 2007).

The internationalisation of a SP is not only mainly based on international partnerships with other SPs, business incubators, and international institutions and organisations, but also depends on the internationalisation characteristics of its tenant companies (Bigliardi, Dormio, Nosella, & Petroni, 2006)

SPs have a wide range of companies, from start-up to multinationals. A common characteristic of the companies in SPs is that they are mainly knowledge-based enterprises, which normally implies higher degrees of innovation and utilisation of technology than traditional business, and are continuously exposed to the phenomenon of globalisation and its effects (Zacharewicz, Sanz, & Jonkers, 2017).

Although new knowledge is patentable, NTBFs can expect international competition because of technology's dynamic evolvement. This is one reason why NTBFs should engage in early-stage internationalisation in order to grow and be competitive (Cahen, Oliveira Junior & Borini, 2017).

Internationalisation also depends on the market demand. A small domestic market could make early internationalisation essential, while some NTBFs have larger home markets, but the products and processes on which these firms base their operations might be highly specialised, corresponding to a very narrow market niche. In order to grow, these firms have to become international, serving their customers on a global scale (Bengtsson & Löwegren, 2001; Cahen et al., 2017).

Internationalisation is not only an issue of growth, but can also be an issue of survival for companies operating in certain industries. Developments in the IT sector in recent years have shown the importance of timing and agile responses in so-called emerging technology markets.

Being a first mover leads to a competitive scenario described as 'winner-takes-all' (Radaev, 2004). Thus, for some NTBFs, early internationalisation is a necessity for long-term survival and competitiveness (Sapienza, Autio, George, & Zahra, 2006).

NTBF internationalisation also concerns the firms' presence in places where technological knowledge is especially advanced and developing fast, the so-called 'hot-spots'. One such 'hot-spot' should of course be their own SP, but there might also be technological 'hot-spots' in other parts of the world for the same or related technological knowledge (Bengtsson & Löwegren, 2001; Bürgel, 2012).

Some NTBFs also need to be present on the international venture capital markets in order to secure capital investment to finance product development activities, and costs associated with the growth and expansion of the business (Bengtsson & Löwegren, 2001). Additionally, NTBFs performing better in terms of growth and profitability present a more elaborate local network with other local firms and universities, as well as a more elaborate international network with foreign customers, suppliers, universities and partners (Keeble, Lawson, Smith, Moore, & Wilkinson, 1998).

A SP can support the internationalisation of its tenant firms by developing and adapting the following services: (i) *international commercialisation*: SPs can support their resident companies by organising trade encounters between companies, missions to accompany their managers abroad, or by bringing foreign managers to visit their resident companies; (ii) *partnerships in international projects*: this can be one of the first solid steps of any young global enterprise towards greater levels of internationalisation; (iii) *international joint ventures*: SPs can help in screening and finding adequate partners for such endeavours; and (iv) *international workforce*: by creating a programme to attract talented international students and organising the selection and training of professionals (Zacharewicz, Sanz, & Jonkers, 2017).

The early-stage internationalisation of NTBFs is mostly explained by the 'Born Global' literature, related to the entrepreneur's networking ability and competencies (Cavusgil & Knight, 2015; Coviello, 2015; Hashai, 2011; Knight, 1996; Madsen & Servais, 1997).

Bengtsson and Löwegren (2001) found that the SP networks may help technology-based firms to bridge supply and demand across international borders. While most SP managers reported that internationalisation is high on their agenda, few parks have any plan or strategy for their internationalisation activities. The SP could also specialise in a particular sector, giving priority to the population, internationalisation and employment parameters as a path to improve its outcomes (Guadix et al., 2016).

Nevertheless, the conditions of the context where a SP is located and operates, the real stakeholders' interests and the life cycle may affect the strategy adopted (Bigliardi et al., 2006). In Section 3, we describe the methodological procedures for this study.

3. METHOD

Most studies have focused on the 'Born Global' and 'International Entrepreneurship' themes, related to the entrepreneur's networking ability and competencies (Cavusgil & Knight, 2015; Coviello, 2015; Hashai, 2011; Madsen & Servais, 1997). However, the present chapter aims to analyse the internationalisation practices of Brazilian SPs in light of the social network theory and the revisited Uppsala Model (2013). Thus, an exploratory approach was adopted using a multiple-case study research strategy, which focuses on understanding the dynamics presented within single settings, when the purpose of the research is to develop theory, not to test it (Eisenhadt, 1989; Eisenhadt & Graebner, 2007; Yin, 1984).

We selected the three Brazilian SPs located in Rio Grande do Sul: Scientific and Technological Park of PUCRS (Tecnopuc) in Porto Alegre, Technological Park of São Leopoldo (Tecnosinos) and the Technology Park of Vale do Sinos (Feevale Techpark) in Campo Bom city. Each of them is connected to universities and located in the metropolitan area of Porto Alegre. They were created from 1998 to 2003 by the local universities, which also are the main financing agents, together with other public institutions and the municipal government. Each has different occupied area, but approximately 90% of the SPs space is reserved for the tenant companies.

We choose a qualitative approach, because 'qualitative research is uniquely suited to "opening the black box" of organisational processes, as it unfolds over time in context' (Doz, 2011, p. 585). In this study, we used three sources of data: interviews, observation and archival data. The primary data source involved semi-structured interviews with the directors of three SPs in the area of Porto Alegre (southern Brazil), during the month of June 2016. Interview times ranged from 50 minutes to 1 hour. The interviewees were interviewed in their mother language, Portuguese. Each interview was recorded and transcribed into the questionnaire form, resulting in 22 pages of notes. The interviews had been conducted in locus. During the first semester of 2016, we participated in events and technical visits in the selected SPs.

The interview data were supplemented with archival data from various sources, including reports, websites and news articles about SPs. These secondary data sources were collected before the interviews, because we considered it very important to understand the context and validate emerging insight from the interviews.

The analysis of data began with the translation of complete interviews. We asked permission to record and present the name of SPs. After the first reading of transcripts, notes and documents, we select the key elements about operation, strategy and internationalisation of each SP.

4. DATA ANALYSIS AND RESULTS

The theme of 'Science Parks' was introduced in Brazil in 1984, through the National Council for Scientific and Technological Development (CNPq). This institutional body is linked to the Ministry of Science, Technology and Innovation, and is responsible for fostering research in Brazil. The lack of an innovation culture and the low number of innovative enterprises existing at that time stimulated the first SPs projects to create the first business incubators in Brazil. This trend has grown rapidly, involving more incubators and innovative companies generated from incubators, universities and research centres throughout the country. In 1987, the ANPROTEC was founded, representing mainly business incubators and Science & Technology Parks. It is experienced at providing leadership to organisations by promoting innovation and entrepreneurship, articulation on public policies, and the generation and dissemination of knowledge. Today, its 261 members represent 400 incubators and 40 Science & Technology Parks, resulting in 6,300 innovative firms, which have generated 33,000 jobs in the country (ANPROTEC, 2014).

4.1. Rio Grande do Sul and Porto Alegre Regional Innovation System

A national innovation system is defined as a complex of innovation actors and institutions that are directly related to the generation, diffusion and appropriation of technological innovation, which are found together within the limits or boundaries of the state (Chung, 2002; Cooke et al., 1997).

In this sense, the state policies for the creation of an industrial and innovative setting may include tax incentives, direct subsidies, public educational and training facilities, infrastructure, and financial support. These play an important role in the transition from nation-based systems of production and innovation towards international and transnational systems (Cooke et al., 1997).

A region's capacity to mobilise its innovative resources is linked to the regional government's budgetary capacity, and is also composed of three main innovation actor groups: universities, industrial enterprises and public research institutions (Chung, 2002; Cooke et al., 1997).

In this sense, Rio Grande do Sul is considered an important Regional Innovation System and knowledge hub.

There are several universities and global players companies that together with the Municipal Council of Science and Technology (COMCET) foster the expansion of the regional innovative environments.

Currently, the local State Universities are increasing the transfer of knowledge and technology to society. Several investments have made the expansion of projects in this area possible, which is led by the state government and the Science and Technology Parks Programme.

As a pioneer in this area, the state of Rio Grande do Sul is home to 26 poles, projects that aim to develop technologies appropriate to different regions of the state; and 15 technological parks, physical areas where companies and R&D centres are established. This geographical and territorial expansion of SPs has been accompanied by a great commitment of financial resources to support this trend. Approximately USD $30 million has been already invested, which will increase due to the speed and capillarity of the results (ANPROTEC, 2014; Mammarella, Ferreira, & Tartaruga, 2015).

Rio Grande do Sul has the fourth largest Gross Development Product (GDP) in Brazil, is home to approximately 10,000 companies, and boasts 25 universities and federal institutes with about 53,000 researchers, instructors and PhD programmes. The state government has a programme that encourages the implementation of Scientific and Technological Parks in all its regions, with the support of local community colleges, and founded the 16 SP initiatives currently underway, with four in operation, seven undergoing deployment and five in project stage (ANPROTEC, 2014).

Porto Alegre, the capital of the Rio Grande do Sul, is among the most attractive Brazilian cities for receiving investments in innovation for two reasons: the inputs for the innovation taking place and the outputs resulting from innovation (Endeavor Brasil, 2016).

The city has a privileged geographic location in relation to the MERCOSUL Free Trade Area agreement between Brazil, Argentina, Paraguay and Uruguay, because it is located between two major centres of Buenos Aires and São Paulo. The city has 1.3 million inhabitants, and the metropolitan area has more than three million inhabitants Porto Alegre's technological infrastructure, financing resources, and qualified human resources and their innovative ability contribute to this status.

The city has built a technological development programme where the municipal government performs an articulating role between the local actors. Over the last two decades, two programmes have reflected this effort by the local government: the Porto Alegre Tecnopole and the COMCET. The former is an initiative involving nine institutions (research centres, public administration and the business community) that, in 1995, formalised their partnership to jointly develop and coordinate actions to promote the economy of the metropolitan area of Porto Alegre, based on innovation and technology. The latter aims to formulate, propose, evaluate, and monitor public actions and policies of technical and scientific development, through government initiatives or in partnership with private agents (Zen & Hauser, 2005).

4.2. Case Studies

The three main SPs operating in Rio Grande do Sul state are the Scientific and Technological Park of PUCRS (Tecnopuc) in Porto Alegre, Technological Park of São Leopoldo (Tecnosinos) in São Leopoldo and the Feevale Techpark in Campo Bom. Each one is connected to a university and located in the metropolitan area of Porto Alegre (Mammarella et al., 2015).

These SPs were created from 1998 to 2003 by their respective universities, which are also the major investors, together with other public institutions and the municipal government.

Despite these similarities, the governance is managed in different ways: in the case of Feevale Tech Park and Tecnopuc, the governance is exclusively run by the universities, whil Tecnosinos presents the Triple Helix model: local government, entrepreneur associations and Unisinos University.

Feevale Techpark and Tecnosinos administrative staff comprise six and seven employees, respectively: SP director and administrators; incubator administrator, analysts and assistants. The Tecnopuc staff comprises, in addition to the general director, a negotiation manager, a relationship manager, secretaries, a communication team and a counselling team, for a total of 18 employees. The networks developed by the three SPs consist of various stakeholders and include local, regional and national partnerships.

The main institutional partnership is the Business Incubators and Technology Parks Network of the State of Rio Grande do Sul (REGINP). Beyond this common partnership, we found alliances with Endeavor Brasil (innovative entrepreneurs) and the Techno Policy Network for Tecnosinos and Tecnopuc.

Tecnopuc has a more complex institutional network, which also involves other research, innovation and technology funding centres, such as the Science and Technology Foundation (CIENTEC), Rio Grande do Sul Research Agency (FAPERGS) and National Research Funding (FINEP); and entrepreneur groups such as the Young Entrepreneurs' Association and the Consortium of Communitarian Universities.

The services portfolios offered by the SPs to the tenant companies include innovative business solutions, juridical support and consultancy. An interesting partnership of Tecnopuc and Tecnosinos takes place within the incubator accelerator programme named '*Ventur*', which provides a wide range of services and alliances for a limited period of time to make start-ups ready for the market, including connecting with investors.

Another relevant aspect within the Tecnopuc SP is the Innovation and Entrepreneurial Network of Tecnopuc (INOVAPUC), which brings together several specialised laboratories, a technological management agency, an entrepreneurial management agency, a technology transfer office and an innovation management support centre.

Tecnopuc and Feevale Techpark have internal bureaus of intellectual property protection, while Tecnosinos has an external partnership, even though the university has its own intellectual property agency. The three SPs present a multidisciplinary business area, as can be observed in Table 1.

Table 1. Business Areas Comparison.

Feevale Tech Park	Tecnosinos	Tecnopuc
• Information and communication technology • Creative industry • Materials and nanotechnology • Health sciences and biotechnology	• Information technology • Communication and digital convergence • Health technology • Engineering and automation • Environmental sciences and renewable energy	• Information and communication technology and electronics • Energy and the environment • Biological and health sciences and biotechnology • Creative industry

Source: Research data.

The main goal for the three SPs is the economic, technological and social development of the region and the country. To reach these common objectives, they aim to attract R&D centres and NTBFs, by fostering the relationship between academia, government and businesses through the flow of knowledge and technology.

Beyond this extensive institutional role, Feevale Techpark and Tecnosinos directors highlighted some more specific goals. One remarked on the importance of the SP in creating employment, thereby increasing the quality of life in the region. Another declared the SP to be focused on developing some specific business areas, such as environmental technology and renewable energy, which are related to a plurality of sectors. Tecnosinos also fosters the creation of start-ups in the area of health, an outcome of a non-institutionalised partnership with a medical cluster in Germany.

4.3. Internationalisation

This part of the interviews approached the internationalisation practices of the SPs; the partnership with other SPs, incubators or international organisations; and the results for the SP itself or its tenant companies.

Feevale admitted to not having a declared internationalisation strategy, but instead created eventual partnerships with other SPs via the 'Land2Land' project of the ANPROTEC. Land2Land is a platform for the internationalisation of innovative enterprises that intend to settle in innovation environments, such as technology parks and business incubators in Brazil or any other country. The platform also provides easy access to a trusted network of technology parks and incubators.

By accessing the platform, companies can meet and contact incubators and SP with a record of supporting innovative enterprises during their internationalisation process. These environments are able to monitor and provide support throughout the internationalisation process – from assessing the responsiveness of a given product or service to the intended target market, to the installation and operation of the business in another country.

The strategy of Tecnosinos is based on institutional partnerships such as ANPROTEC and the IASP, as well as informal agreements with the commercial areas of the embassies of Switzerland, Canada, the UK and France; and the Brazil–Germany Chamber of Commerce and Industry in Porto Alegre (RS AHK).

Tecnopuc has international agreements with various Science and Technology Parks around the world, in addition to international networks and platforms which give access to dozens of innovation environments.

The agreements are part of Tecnopuc's internationalisation programme and enable companies in the park to access the global market in a more flexible way, while also allowing foreign companies to receive support to access the Brazilian market. This approach benefits not only the companies interested in settling in another country, but those also who are seeking the other types of connections and international partnerships. Table 2 presents the international partnerships of Tecnosinos and Tecnopuc.

The three SPs are associated with ANPROTEC and IASP. They interact with the two associations via the 'Land2Land' platform and at conferences. It is also important to note that Tecnopuc participates in the INCOBRA Programme (Increasing STI Cooperation between Brazil and the European Union). This is a project of IASP, which provides the expertise and the vast resources of its global network. The overall objective of INCOBRA is to focus, increase and enhance Research & Innovation (R&I) Cooperation Activities between Brazil and European Union R&I actors, so that both regions benefit from the best value of the mutual cooperation.

Feevale Techpark, together with the international programme of ANPROTEC, facilitated a resident company to expand its market through an agreement with a multinational company. The main goal of the international programmes promoted by Anprotec and IASP is to match characteristics and needs of tenants companies with other SP resident companies, or established multinationals, which can offer their distribution channel or market knowledge for a mutual advantage arising from the exploitation of the technology solution offered.

The results obtained by Tecnosinos focus on participation in international programmes in order to expand or reinforce the international network and to generate knowledge exchange, even informally.

Tecnopuc has formal partnerships with universities and international organisations of research areas and SPs (Table 3). It also fosters knowledge, techniques and an environment of international culture by promoting entrepreneur exchanges through specific programmes such as Take-Off and Soft-Landing. These programmes offer resident companies effective business bridges to new markets and innovation ecosystems. They aim to accelerate that process by facilitating exploratory business trips lasting from a few days to a few months.

The firms benefit from a full package of infrastructure and services to support their business development. These include ready-for-use and free-of-charge premises and facilities for intermittent visits or limited periods (1–3 months); support, guidance and organisation of accommodation and transportation within the targeted country or region; and customised business introduction, cultural integration and coaching services. It is worth noting that the internationalisation results take into consideration the goals obtained during the current management of each SP.

Table 2. International Partnership of Tecnosinos and Tecnopuc.

Tecnosinos	Tecnopuc
• Russia – Skolkovo Innovation Center • Canada – David Johnston Research and Technology Park, University of Waterloo • Canada –- Spark Center of Durham • South Korea – Expo Science Park, Daejeon	• Germany – HMWVL – Hessiches Ministerium für Wirtshaft, Verher und Landesent and House of Information Technology • Ireland – PRE-Park • Canada – GTMA - Greater Toronto Marketing Alliance • China – TUSPARK – Tsinghua University Science Park • United States – University of South Florida Research Park • Italy – Fondazione Bruno Kessler • UK – UKTI – United Kingdom Trade and Investment
Not all partnerships have been contractually formalised	• Russia – Skolkovo Innovation Center • Global ICT Parks Network

Source: Research data.

4.4. Discussion and Propositions

Although SPs are host to a wide range of companies, from start-ups to multinationals, a common characteristic is that they are mainly knowledge-based enterprises, which are continuously exposed to the dynamic context of globalisation and its implications for innovation and competitiveness (Zacharewicz, Sanz, & Jonkers, 2017).

The literature on international business has highlighted that international expansion represents an opportunity for growth and the creation of value for companies (Engelman, Zen, & Fracasso, 2015; Hansson & Hedin, 2007). This is in some extent why NTBFs should engage in early-stage internationalisation, particularly by seeking to achieve the specific goals of o grow and competitiveness (Cahen et al., 2017).

SP internationalisation is a complex phenomenon, dealing with different aspects such as the own characteristics of tenant and established companies, regional innovation systems and local governance. Thus, the attempt to set up a general framework of SPs' internationalisation faces several challenges. First, the literature in strategic management and innovation is relatively scarce when discussing the internationalisation of SPs (Bengtsson & Löwegren, 2001; Berbel, Rocha, & Carneiro, 2011).

Second, while most of the literature has focused on the 'Born Global' and 'International Entrepreneurship' theories about entrepreneurs' networking ability and competencies (Cavusgil & Knight, 2015; Coviello, 2015; Hashai, 2011; Knight, 1996; Madsen & Servais, 1997), the process of SPs' internationalisation per se is still under-studied. We believe that the understanding of this process requires a more advanced interpretation of how networks shapes its dynamic.

Individuals and firms rely on their networks of social relationships to acquire relational and structural resources. In this case, entrepreneurs need to be able to

Table 3. Internationalisation Results.

Feevale Tech Park	Tecnosinos	Tecnopuc
- Marina, a tenant company in Feevale Techpark, was selected by the 'Support System Innovative Enterprises Internationalisation Programme' of Anprotec and Apex-Brasil. The result was a partnership with Goodyear to find alternative solutions for traditional raw materials.	- The 'Sharing of Korea's STP Experience' Programme, the Technology Park of South Korea. Knowledge Exchange in INNOPOLIS innovation cluster in the city of Daejeon. - Student exchange through the Innovation Research Lab, Germany 2015. - The Brazil–Germany Chamber of Commerce and Industry in Porto Alegre (AHK RS) offers the services provided by the chamber and international facilities to local companies.	- Signing the memorandum of understanding aimed at increasing participation in international networks conversation with UKTI. - Take-Off programme for the start-up Pandorga. - Exchange of entrepreneurs from England, Belgium and Poland. - Bilateral cooperation agreement signed with USF (University of South Florida).

Source: Research data.

obtain knowledge within the firm's networks and through human relationships (Cooper & Yin, 2005; Dai & Liu, 2009). Considering the literature and the results of the empirical data from the aforementioned three case studies, the following propositions arise:

P1. Cohesive internal and external ties shape the internationalisation process of SPs and their firms.

We understand that this process occurs because such strong ties, in the extent they support the process of learning and trust building of firms, they also may contribute to position the firms and organisation in the network. In the perspective of the Uppsala model, such a process of network positioning is determinant of firms access to knowledge, building of dynamic capabilities, and therefore, to their internationalisation. Thus, we suggest that:

P1a. In the extent cohesive internal and external ties generate network positioning, they will lead to the internationalisation of SPs and their firms.

According to the social capital theory, individuals or even companies with weak ties are deprived of information from distant parts of the social system, and might have difficulty organising or integrating into political movements of any kind. Thus, the exchange and creation of intellectual capital might be facilitated by combining knowledge and experience from different sources (Granovetter, 1983; Nahapiet & Ghoshal, 1998).

The Tecnopuc presents a cohesive internal network through the INOVAPUC internal system, comprising connected actors working in a collaborative way to reinforce the network capabilities of NTBFs and established firms. In addition, a strong regional cooperation, such as through the REGINP, and national and international actors such as ANPROTEC and IASP, all contribute to the network position (Johanson & Mattsson, 1998; Vahlne & Johanson, 2013). However, the lack of such network commitment may also motivate a governance in the SPs to seek for a strategy of internationalisation. Thus:

P2. Weak external ties may lead to the early stage internationalisation process of SPs and their firms.

Johanson & Mattsson (1998) assume that a firm's activities are cumulative processes in which relationships are continuously established, maintained and broken, and therefore the firm's position in the network will secure its long-term survival and development. We may conclude that either weak and strong ties are constantly changing; a weak or non-institutionalised tie may help the SP foster contacts for internationalisation, thus developing opportunities that emerge through ongoing interaction in one or more relationships (Johanson & Valhne, 2009, 2013).

Finally, we believe that ties building by SPs and their tenant firms depends on the own specialisation path of the SPs. We, therefore, propose that:

P3. Higher specialisation of SP may drive higher levels of its internationalisation and, thus, international networking position.

This main proposition is based on the assumption that an important source of weak ties is the level of specialisation, which results in a wide variety of specialised role relationships in which one firm knows only a small segment of the other's personality (Granovetter, 1983, p. 203). In the SP scenario, specialisation contributes with innovation in a more effective way, such as the Tecnosinos experience of fostering the creation of start-ups in the area of health as a result of a non-institutionalised partnership with a medical cluster in Germany.

While experience will provide the firm with the ability to see and evaluate business opportunities (Johanson & Mattsson, 1998), the MBE is a network in itself, where different group units have specific network relationships with external firms (Forsgren et al., 2007; Ghoshal & Bartlett, 1990; Johanson & Vahlne, 2009, 2013).

5. CONCLUSIONS

SPs and incubators have evolved over time, and this evolution is embedded in their regional and local environment. However, their internationalisation entails significant changes in the pattern and dynamic of firms' competitiveness. The three cases present different paths, but also point to similar features.

The internationaliation practices of Tecnosinos are based on institutional partnerships, such as those with Anprotec and IASP, and through informal agreements with the commercial areas of the embassies of Switzerland, Canada, UK, and France, and the Brazil–Germany Chamber of Commerce and Industry in Porto Alegre.

Tecnopuc has international agreements with various Science and Technology Parks around the world, in addition to international networks and platforms providing access to several innovation environments. The agreements are part of

Tecnopuc's Internationalisation Programme, and enable companies in the SP to access the global market in a more sustainable manner.

This approach not only benefits the companies interested in expanding to another country, but also those seeking other types of connections and international partnerships, from both a marketing and technological point of view. Feevale Techpark didn't present robust internationalisation practices, instead developing partnerships with other SPs through ANPROTEC's 'Land2Land' programme, which allows Brazilian companies to access different markets around the world in a more effective way, and enables the SP to internationalise its operations with the support of innovation environments. The three SPs are associated with ANPROTEC and IASP, while Tecnopuc is the only case that participates in the INCOBRA programme offered by IASP.

In sum, the internationalisation of a SP is mainly based on international partnership with other SPs, business incubators, and international institutions and organisations, but it also depends on the internationalisation characteristics of its tenant companies. The SP can support the internationalisation of its tenant firms by developing and adapting the following services: (i) international commercialisation; (ii) partnerships in international projects; (iii) international joint ventures; (iv) international capital (equity/shareholders) and (v) international workforce.

By combining the literature on Network Theory (Forsgren et al., 2005; Ghoshal and Bartlett, 1990; Granovetter, 1989; Johanson & Mattsson, 1998; Johanson & Valhne, 2009, 2013) with the results of this exploratory study, we reveal that cohesive internal and external ties and networks, as well as specialisation, contribute to the internationalisation process of SPs and their tenant firms. Conversely, weak external ties and networks contribute to the early stage of the internationalisation process of SPs and their tenant firms.

This study has several limitations. First, our main findings are based on an explanatory research of three case studies. We understand that the internationalisation path of SPs is context bound, and, therefore, our main conclusions are very likely to reflect the set-up of the specific institutional and regional conditions of the selected cases. On the other hand, we highlighted the role of the university as a main driver of the interactions among all the involved regional innovation actors. We, therefore, consider that our findings are specific to SPs where universities are the originating of such local governance. Finally, we believe that the internationalisation of firms located in SPs may, in the long run, shape their own internationalisation trajectory. We suggest for future researches more in depth and country comparative studies. Particularly, by comparing the set-up of local innovation system and internationalisation governance between developed and emerging economies. We also recommend a more quantitative methodological approaches to test the international performance operating in SPs.

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