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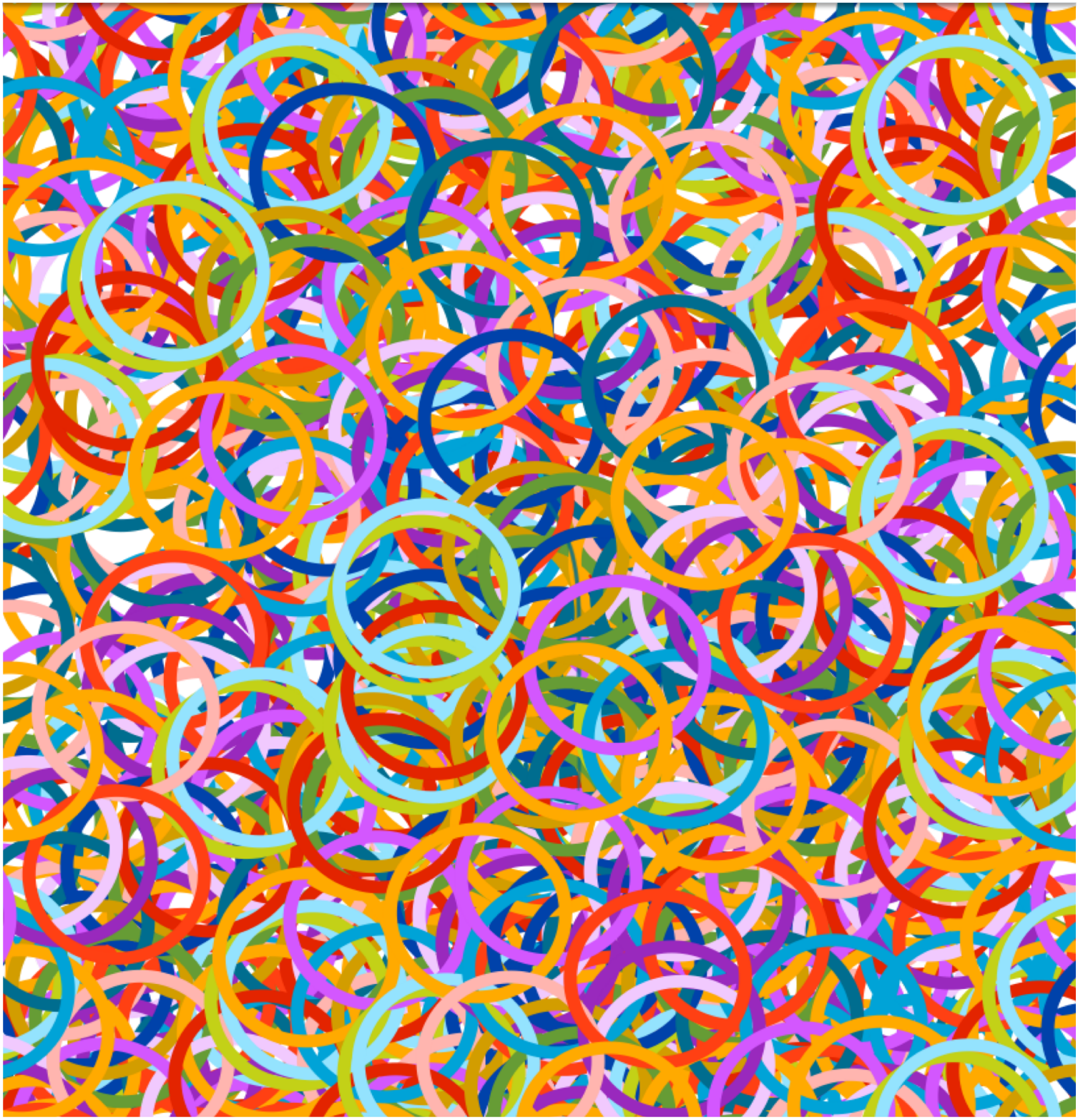

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Whiskey Tango Foxtrot: Technological Convergence?

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Editorial

Wisdom of the crowds, Technological capabilities and Functional alignment, which when recognised and utilised in innovation processes, can unlock the ability to source, develop and commercialise ideas at rapid pace. The phenomenon is known as technological convergence. By definition, technological convergence is described as the process by which Information and Communications Technologies (ICTs) converge towards new and more unified markets. This convergence often leverages the three dimensions of innovation – economic, technical and functional. On the economic side, the focus of a focal firm is on maximising profits with minimal costs under resource constraints brought about in-part by liberalisation of markets. In this regard, open innovation which involves harnessing wisdom of the crowds at the fuzzy front-end of the innovation process has increasingly been promoted as a pragmatic mechanism for accessing widely distributed knowledge (Thanasopon, Papdopoulos & Vidgen, 2016), in large firms (Brunswicker & Chesbrough, 2018) and SMEs (Vanhaverbeke, Frattini, Roijakkers & Usman, 2018). On the technical side, the main driver has been the rise of enabling technologies, at times revolutioning social behaviour but mostly brought about through incremental shifts in technical abilities. Finally, convergence is realised through functional alignment, characterised by integration of computational, behaviour and communication factors in a unique value-proposition delivered through new product or new service (Canals, Torres & Borés, 2001). The growing prominence of technological convergence means firms can no longer afford to work in silos or rely on proprietory waterfall solutions to achieve competitive advantage and influence societal progress. Here, we build on our July 2018 editorial which emphasised the cumulative importance of management research and management practice working together for societal progress. W-T-F is offered here as the fundamental trilogy that both managers and researchers need to address to survive and thrive in an increasingly digitised and globally-connected world.

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Traditionally, firms have relied more on their internal capabilities for R&D, however in recent times, and especially since Chesbrough (2003) reignited the importance of wisdom of the crowds, a paradigmatic shift towards open innovation has been evident (Randhawa, Wilden & Hohberger, 2016). For firms, open innovation aids in coping with three main challenges – technological pace, market and behaviour uncertainty and the need for complementing resources. The possibilities of convergence in an open innovation setting emerges as firms signal their intentions to achieve economies of scale through horizontal co-operation and structure the value chain to reach new markets and increase profitability through vertical co-operation. At a firm level, these cooperations involve adoption of platforms that allow for sourcing, developing, managing and integrating the wisdom of crowds into innovation, both in its process and as the eventual product. With a growing need to foster mediums that cater for dynamic inclusion and expression of ideas, opinions, judgements and evaluations, firms are starting to realise the potential of social media in and for innovation (Marion, Barczak & Hultink, 2014; Pan et al., 2017). Social media in business not only serves as a mechanism to source ideas and and market products, but also helps to socialise, combine, externalise and internationalise knowledge across traditional boundaries (Scuotto, Del Giudice and Omeihe, 2017). But of course adoption of open and collaborative innovation processes require a shift in organisational mindset. Trust emerges as the core element of open innovation which at an inter-organisational level is about the trustworthiness of the crowd in general and close partners with whom the focal firm collaborates for innovation (Salampasis, Mention & Torkkeli, 2014). If embedded in the innovation process, trust can foster openness and knowledge exchange to deliver results faster, with less costs and lower resource requirements for the focal firm.

Technical abilities are equally important as the slack in time-to-market and leveraging stakeholder inputs continues to reduce. The so-called enabling technologies have emerged as a solution to rapid design, develop and deploy strategies. Key Enabling Technologies (KETs) provide foundations for complementary cross-disciplinary, multi-sector innovations. Robotic process automation (RPA), artificial intelligence (AI), virtual reality (VR) and blockhain are some examples of KETs. They are the enablers that provide foundations for complementary cross-disciplinary, multi-sector innovations and are the fundamental building blocks of the Industry 4.0 and digitalisation. KETs help firms address the many concerns of driving manufacturing innovation - increased global competition, mass customisation and resource limitations. The economic impact of KETs is considerable (see Baumers, Dickens, Tuck & Hague,2016; Oesterreich & Teuteberg, 2016). The challenge though is in sensemaking of the environment (i.e. what is out there) and then sensegiving through strategic actions that align required capabilities for the innovation to be realised.

Understanding where in the convergence process can the firm create the greatest impact is part of unravelling the challenge. Another plausible approach is to focus on the value streams to identify unique value propositions and shape the convergence process in iteself (e.g. something like what Apple did with Ipods and Microsoft did with its Windows CE). Open innovation-as-a-service is an emerging trending. Firms are realising that static partnerships are no longer viable amidst converging markets and there exists a strong need to develop agile and dynamic collaborative platforms and ecosystems, inclusive of start-ups, innovation hubs, accelarators, co-working environments, universities, research centres and others (Chesbrough, Vanherbeke & West, 2014). Often developing a more responsive business model begins with digitalisation of

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workflow. For instance, where data accumulated in files and mainframes is streamlined into real time cloud-based processing. An exemplar case is that of Siemens. Siemens has been using neural networks to monitor its steel plants and improve efficiencies for decades. Nearly two and half years ago, it introduced Mindsphere a smart cloud for industry – in direct competition to GE's Predix. Mindsphere allows machine manufacturers to monitor machine fleets and servicing throughout the world. AI integrated in the turbines continuously learns the optimal combustion conditions through sensors and the result of this technological convergence is that Siemens has been able to reduce emissions in its gas turbines. The logic advanced through this example is that by converging workflow management with real-time decision-making and data capture capabilities can improve efficiencies and cost savings across a wide range of automation tasks. The underlying objective is to free human capital from performing repetitive mundane tasks and allow cognitive capacities to focus on problem solving, judgement and creativity tasks.

Once again, the need emerges to firms to foster organisational culture for innovation. This may mean obvious tasks of developing cross-disciplinary skills and fostering cross-cultural integration but it also calls for strategic signalling strategies to drive efficient open and collaborative processes (Constantiou & Kallinikos, 2015). These signals need to be aimed at blurring the long-established social, cognitive, organisational and functional boundaries, whereby the spatial distance between factors influencing human-side of innovation (Salampasis & Mention, 2017) are radically reframed. Nelson and Winter (1982, 2002) emphasised the need for organisational routines to conceive and crystallise the business-as-usual operating processes. Routines are a way to signal firm's appetite for learning from local and distance experiences or events (Nelson & Winter, 1982) and when treated as building blocks of organisation's core capabilities, they can provide important input into the strategic choices (Dosi, Nelson & Winter, 2001). Routines may be enacted through patenting process, venture sourcing processes, development of experimental test beds, cross-disciplinary collaborations, recognition and award programs, technological road-mapping and business foresight to name a few. Indeed, as Teece (2007) highlights, the strategic intent of a focal firm is often a reflection of the 'best fit' of its capabilities and the opportunities arising from the environmental scanning. Convergence trends tend to curate the sensemaking and road mapping strategies as firms move towards agile innovation methods encompassing generative work relationships to drive futuristic scenarios (Carmeli & Dothan, 2017).

By becoming more agile firms stand to benefit from improved ability to make sense and respond to customer-centric product development opportunities arising from technological convergence (Cardinal, Turner, Fern & Burton, 2011; Porter & Heppelmann, 2015). Over the next ten years a number of key trends and drivers are likely to influence KETs and their potential to revolutionise the way people, industry and society will behave from an economic, social, cultural and environmental perspective. Many broad societal factors will interact with KETs – increasing globalisation, change in customer demands and regulatory attitudes. A key challenge for firms in attracting, developing and retaining the right individuals with cross-disciplinary skills (the so-called T-shaped individuals) to remain relevant and drive profits. In this view, the scholarly work on university-industry collaboration (UIC) triple helix model (Calvert & Patel, 2003)is of particular relevance. Much has been said about the motivations and mechanisms for promoting UIC (Rasmussen & Sørheim, 2012; Temel & Glassman, 2013) as well as patterns and performance of UIC (Al-Ashaab et al., 2011; Ngar-yin Mah & Hills, 2014). Yet, little has been said about how technological convergence is shaping UIC and development of the next cohort of human

capital. While some efforts have been made to understand which technologies fields are central to UIC (see Chang, 2017), many questions remain unanswered in relation to requirements for new curricula.

Naturally, the courses taught at universities should aim to assimilate new technology and talent trends alongside the appetite for breadth of knowledge rather than deepening disciplinary silos. As Kose and Sakata (2018) recently highligted, technological convergence in itself can be leveraged as a promoter of introduction to new skills sets, markets and sectors. Arguably, this calls for managers and academics to know what is out there, building 'work ready' skills and a culture of experimentation and entrepreneurial mindset – pushing the boundaries of ordinary to 'extra'ordinary thought and actions. An important paradigm in this view is to bring about a change in traditional university structures and education programs based on 'academic mastery' towards a more 'education-as-a-service' model. This shift is more than an university setting up innovation labs or a firm hiring university researchers to solve a problem. The shift to the new UIC paradigm of 'education-as-a-service' calls for deeper subject-matter training and fostering an entrepreneurial mindset whilst engaging learners in cross-disciplinary problem solving through targeted strategic partnerships, to deliver value as licensable products or services designed for societal progress. It may be so that the focus now needs to shift towards harnessing the convergence rather than solving a technological puzzle. Alignment and effective partnerships coupled with open and collaborative knowledge exchange environments remain providential for profits and progress.

For researchers, we draw attention to the role of managers and managerial cognition in innovation management. To understand how technological convergence is perceived, promoted and managed requires a closer examination of how external enviroment shapes a firm's strategy. The information collected from the environment in the process of scanning only becomes meaningful through interpretations and mental processes of the managers responsible for shaping a firm's strategy (Gavetti & Rivkin, 2007). In this view even organisational routines for innovation can be considered intrinsically linked to managerial cognition through interpretations of scenarios and strategic choices (Eggers & Kaplan, 2013). For practitioners we call for a developing a stronger voice. This voice needs to be purposefully directed to harness convergence and find ways to collaborate with universities in developing industrially relevant curricula and training programs. Developing platforms of knowledge exchange and strategic partnerships should remain a priority for managers to source and nurture talent. Symbolically, co-working spaces, innovation hackathons, participation in behavioural and cultural intelligence workshops and industrial PhD programs are some examples of cultivating a new mindset to routines and future of work. In summary, the task ahead brought about by technological convergence cannot be achieved through traditional methods. New and agile approaches are needed both from a research and practice perspective. Agility in innovation management can be infectious (Kahan, 2018), but requires a shift in mindset to look at problems in different ways, at times crushing the core assumptions and determining the true goals of work. In this view, W-T-F provide a basic yet valuable framework to advance science and practice of innovation.

Yours innovatively,
Anne-Laure Mention, João José Pinto Ferreira, Marko Torkkeli
Editors

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Promoting the creation of Innovation Ecosystems: the case of the University of Porto

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Letter From Academia

Abstract. Universities are increasingly acting as promoters of innovation, economic growth and regional development, a trend that has attracted the attention of both policy makers and researchers. The objective of this paper is to contribute to a deeper understanding of the role of higher education institutions as dynamic promoters of growth and development. The University of Porto is used as a case study to explore how universities can act as innovation ecosystems leaders and integrators. The main contributions of the paper are threefold. First, the case puts in evidence a key success factor: the talent to transform the knowledge produced by universities into valuable solutions for companies and other organisations. Second, links between universities and industry must assume a long-term and relational nature rather than an intermittent and transactional character. Finally, the success of university-based ecosystems depends on the integration of a diversity of actors, resources and competences. This means that a sustainable strategy of innovation and knowledge valorisation requires an approach that fosters both internal and external networking.

Keywords. Technology transfer; Intellectual property; Entrepreneurship, Start-up, Spin-off, Incubation; Ecosystem; Regional development.

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1 Introduction

Universities are increasingly focusing their attention on knowledge-based value creation. Side by side with the two traditional missions – Education and Research – higher education institutions are allocating more resources, efforts and talent for Innovation. This has attracted the attention of both policy makers and researchers. In Europe there is a growing number of studies and reports, most of them produced by institutions of the European Union, addressing the interface universities-industry and its impact on the competitiveness of economy, progress of territories and development of society (cf. Goddard and Kempton, 2011; DG Research and Innovation, 2014; Edwards et el., 2017; Jonkers et al., 2018). Researchers are also paying a growing attention to this issue. Concepts of knowledge transfer (Barro and Fernandez, 2016; Azagra-Caro et al., 2017), university-industry interface and collaboration (Albats et al., 2018; Rohan and Moore, 2018), and entrepreneurial university (Schmitz et al., 2017; Bouncken, 2018) are object of increasing investigation.

The University of Porto is an example of success in this front. With a strategy aimed at fostering innovation and entrepreneurship that began more than two decades ago, the university has achieved significant results. In this context, the objective of the paper is to contribute to a deeper understanding of the role of innovation ecosystems boosted by higher education institutions as dynamic promoters of growth and development. Based on the case of the University of Porto, the paper is structured into six sections. After this introduction, section 2 offers a comprehensive overview of the university with a special focus on its innovation ecosystem. This is followed by three sections on the core of this case study: transfer of technology, creation of new ventures and incubation. The paper ends with a synthesis of the main contributions of the case, and offers a vision for the future of universities as innovation ecosystems leaders and integrators.

2 The innovation ecosystem

The University of Porto has 14 faculties, 1 business school and 49 research units that cover the most important areas of knowledge. The Faculty of Engineering is the largest school with 8 thousand students. The other faculties focus on health and life science, natural and social sciences, humanities and arts. Overall, the university has 32 thousand students coming from more than 150 countries, which puts in evidence the international reputation of this higher education institution. The quality of teaching is closed linked with research. The R&D units along with a significant number of interface institutes make the University of Porto responsible for 25% of scientific production in Portugal. This very significant role is seen by the university as an opportunity but also as an obligation: to actively contribute to the creation of value based on the knowledge produced.

In this context, the University of Porto has a strategy of innovation that involves internal players (faculties, R&D units, interface institutes, tech transfer office and the science and technology park) along with key external actors (companies, business associations, local councils and external R&D centres) in order to create a dynamic innovation ecosystem aimed at promoting both economic, social and environmental development.

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The innovation and entrepreneurship ecosystem of the University of Porto encompasses all stages of social and economic valorisation of knowledge, from its transfer to incubation, including the support to the creation of new ventures whose competitiveness relies on products, processes or business models based on scientific knowledge.

In order to transform the knowledge generated in its R&D structures into effective solutions useful to companies and other organisations, the university adopts three major approaches (Figure 1): protection and commercialisation of intellectual property, development of joint projects with industry, and creation of spin-offs emerged within its innovation ecosystem.

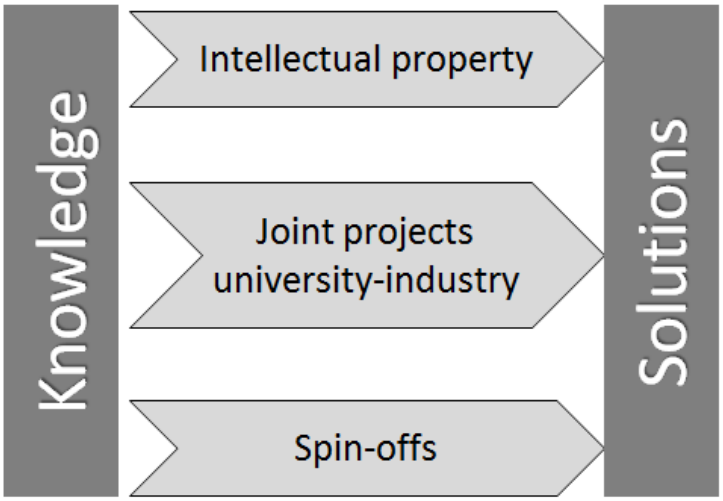

Fig. 1 – The Process of Knowledge Valorisation

In this way, the University of Porto has not only a strategy, but also sound structures with real impact on the ecosystem. The following sections put in evidence the role of the university as promoter of change and integrator of actors, resources and competences.

3 Knowledge transfer

Knowledge transfer relies primarily on U.Porto Innovation, the tech transfer office (TTO). Its mission is to support the value chain of innovation promoting the best use of knowledge based on the interface between the university and industry.

With an extensive experience initiated in 2004, U.Porto Innovation ensures the interconnection between the university's research centres and both large and small companies. To do so, this TTO provides technical support in three major areas: protection of intellectual property, creation of spin-offs, and link to companies. The results achieved are significant as shown in Table 1.

U.Porto Innovation provides the registration of patents and identifies opportunities for their economic valorisation, examining the best alternatives for placing the technologies generated at the university on the market through licensing or the sale of the patents. Because of this

strategy, the University of Porto is the leader of Portuguese higher education institutions in terms of patents, most of them in co-ownership with other universities or companies.

Table 1. U.Porto Innovation: Key Performance Indicators.

KPIs (31 December 2017)	
Intellectual property	
Patents registered since 2004	+ 460
Active national and international patents	243
Active licensed patents	23
Promotion of entrepreneurship	
U.Porto Spin-offs	58
Patents held by U.Porto Spin-offs	115
Investment raised by U.Porto Spin-offs	+ 64 M €
Link to companies	
A2B – Academia-to-Business programmes	39
Participants involved in A2B programmes	1 168

(Source: U.Porto Innovation statistics)

On the other hand, to stimulate the creation of new ventures, U.Porto Innovation awards the "Spin-off U.Porto" brand to the start-ups that develop products and services produced as a result of research done at the university. The start-ups granted with this brand become members of The Circle, a club of spin-offs whose objective is to promote both internal and external networking, opening technological, marketing and financial opportunities in the most dynamic global value chains.

The third mission of U.Porto Innovation is to foster the link between the university and large and medium-sized companies. In this regard, the programme A2B – Academia-to-Business deserves a special attention. This innovative approach facilitates the matching between the university's research centres and the industry aimed at establishing partnerships for the joint development of applied research projects. Samsung, Bosch, GlaxoSmithKline, together with the largest Portuguese economic groups (e.g., Sonae, Amorim and Galp) are some of the University of Porto's clients involved in projects based on the A2B programme.

In short, these critical initiatives are, in most cases, the first steps of an investment process towards the development of close and long term relationships with the industry.

4 Generation of new ventures

In addition to what has been referred in the previous section, the university carries out several initiatives to promote the emergence of start-ups whose competitiveness is global and based on the

integration of knowledge (whether technology-based or not) in their products, processes or business models. The most relevant initiatives in this field are BIP – Business Ignition Programme and the School of Start-Ups, two complementary programs since the former is technology-driven while the latter is mainly market-driven in nature. Anyway, both aim at transforming knowledge into viable and profitable business solutions.

BIP is managed by U.Porto Innovation. Its purpose is to develop competitive business models for technologies developed by R&D centres of the university. The programme involves heterogeneous and multidisciplinary teams of researchers, MBA students and corporate executives as mentors. In this 12 weeks course, business models are developed and validated by the market, and then presented to investors such as VCs and BAs.

The School of Start-Ups is run by UPTEC, the science and technology park of the University of Porto. It is directed to entrepreneurs who have business projects and are interested in starting their own start-ups. The purpose of the programme is to support the entrepreneurs in view of the challenges they face when developing a new venture. Those taking part in this programme have the opportunity to work at the science and technology park, integrating a network of start-ups and global companies, and being mentored by senior executives of strategic partners who support them in the validation of their business ideas.

5 Incubation

UPTEC – Science and Technology Park of the University of Porto was created in 2007. It acts not only as incubator of start-ups but also hosts innovation centres of large companies. Microsoft, Vodafone, Alcatel-Lucent, Vestas and the German institute Fraunhofer are some of the stakeholders with innovation centres at UPTEC.

With facilities that cover an area of more than 30 thousand square meters, mostly financed by European funds, the park is structured according to thematic campuses – Technology (UPTEC TECH), Creative (UPTEC PINC), the Sea (UPTEC MAR) and Biotechnology (UPTEC BIO). This gives room for a cluster strategy and the sharing of resources between start-ups, innovation centres and anchor projects, ensuring the specific support they need and, at the same time, keeping them organised in an extensive and crosscutting network of large and small companies, local councils, business associations and policy-makers. Furthermore, this web of relationships created within the park is a critical success factor inasmuch as it fosters not only internal interaction but also external networking with research centres, potential customers and investors.

UPTEC is the largest university-based science and technology park in Portugal with a significant impact on the innovation ecosystem (Table 2). More than 500 start-ups were created over the past 10 years. By the end of 2017, there were 194 ongoing projects at the park, involving more than 2,400 highly qualified people in a range of areas such as nanotechnology, energy, health, biotechnology, information technologies, digital media, architecture, relationship marketing and content production. The annual impact on GDP is quite significant, reaching almost 190 million euros, and the generation of taxes is about 40 million euros per year.

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Table 2. UPTEC: Key Performance Indicators

KPIs (31 December 2017)	
Entrepreneurial projects *	
Total	194
Start-ups	119
Innovation centres	41
Anchor projects	21
Graduated companies	64
Human resources *	
Jobs	+ 2,400
Economic impact **	
On GDP	188 M €
Generated tax revenue	40 M €

Source: * UPTEC statistics and ** study of impact conducted by the School of Economics

7 Conclusion

The University of Porto is strongly committed to the creation of value (economic, social and environmental) based on the knowledge produced in its R&D centres. To do so, it acts as leader and integrator of resources and competences owned/controlled by internal players and external actors. The results achieved are significant in terms of contribution for the creation of a dynamic ecosystem with high impact on the development of the region where it is located.

The contributions of this case study are summarized in the following vision for the future of universities as innovation ecosystems leaders and integrators.

Universities produce knowledge but companies need solutions. The outcome of research conducted in universities is scientific knowledge but what companies need are effective solutions to improve products, processes and business models. In this regard, a key success factor of any university is the ability to transform (which is more than mere transference) knowledge into valuable solutions. An important skill for those who work in the promotion of innovation is the talent to stimulate the "dialogue" between research centres and companies, two types of organisations with very distinct cultures, objectives and governance structures.

Developing long-term relationships. Universities must work with large and small companies, policy-makers, and local authorities at diverse levels. However, these links cannot assume a transactional and short-term character. Rather, they must be long term in nature since this is the only way for building trust and routines between universities and their main stakeholders. This requires vision and a strategic approach acknowledging that close and lasting relationships is the result of an investment process whose results are achieved in the long run.

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Networking, networking, networking. The success of any university ecosystem depends on the integration of different but complimentary actors, resources and competences. In this context, universities face an important challenge since they produce the "raw material" for the global and sustainable competitiveness of most businesses: knowledge. However, its valorisation is only achieved on the basis of a joint work of a variety of actors that operate at regional, national and European level.

To sum up, universities are increasingly recognised as promoters of innovation, economic growth and regional development. The case presented in this paper is not a recipe that can be straight replicated in other ecosystems. Each one has its own idiosyncrasies that deserve a unique and differentiated approach. Nonetheless, the case of the University of Porto offers good insights that can inspire both policy makers and higher education leaders to effectively fulfil the Third Mission of universities.

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Unlearning at the Individual Level: An Exploratory Case Study in a High Power Distance Country

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Abstract. This paper presents a case study that addresses factors that influence unlearning at the individual level. These factors were studied in a public sector organization located in a country characterized by high power distance. The case organization went through a change process of a daily routine caused by the introduction of a new technology. Data were collected through semi structured face-to-face interviews with shop floor agents in the state of Santa Catarina/Brazil. The results highlight the strong influence of the support of formal leaders on the unlearning process of individuals, suggesting that managers operating in a high power distance environment have to make bigger efforts compared to their counterparts in small power distance settings to promote unlearning processes of employees. The study advances the limited body of knowledge regarding unlearning in general and unlearning at the individual level in particular. It also stresses the influence of the national cultural dimension on the unlearning process of individuals.

Keywords. Unlearning; Routine Change; Knowledge Management; National Power Distance.

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1 Introduction

Changes in organizations have become more and more frequent in the 21st century. In fact, many changes in organizations have their origin in the advancement of technology (Mehrizi and Lashkarbolouki, 2016). The increasing internationalization has also been a driving force behind a number of changes in organizations (Casillas et al., 2010). Thus, a shorter half-life of organizational knowledge is found in many areas (Leal-Rodríguez et al., 2015), and employees are in continuous learning processes for new procedures and routines. However, learning sometimes requires unlearning. This occurs frequently when existing processes change. Moreover, the capacity to discard obsolete knowledge is associated with innovative behavior in organizations (Rebernik and Sirec, 2007; Becker, 2008; Leal-Rodriguez et al., 2015). Consequently, the ability of individuals to unlearn, meaning to eliminate obsolete knowledge, can be deemed crucial for adapting to new and more complex environments (Griffith and Hoppner, 2013). This, in turn, means that an inability to unlearn may be considered a significant weakness of organizations (Leal-Rodríguez et al., 2015).

So far, very few studies have had the topic of unlearning at their core (Akgün et al., 2006; Tsang, 2008; Tsang and Zahra, 2008; Brook et al., 2016), even though unlearning has been studied as a sub-process of organizational learning for the last three decades (Akgün et al., 2006; Brook et al., 2016). As unlearning prepares the ground for innovation (Cepeda-Carrión et al., 2012; Leal-Rodríguez et al., 2015) it should be studied in more depth (Tsang and Zahra, 2008; Becker, 2010;).

Among practitioners, unlearning appears to be underestimated or even non-existent. One reason might be that unlearning is perceived as opposite to learning. If learning is understood as a positive attribute for an organization – "organizational learning" sounds like being associated with a better organizational performance – unlearning may be interpreted as a negative issue. Thus, this negative connotation may prevent people from tackling the topic. In Brazil, for instance, the concepts of "organizational learning" and "learning organization" are known at the leadership level; the term "unlearning" is rarely mentioned, if not completely unknown (Rodrigues et al., 2015).

Previous studies have suggested that unlearning in organizations for managerial purposes can be better understood by considering the phenomenon at the individual level. Several researchers (e.g. Becker, 2008, 2010; Navarro and Lario, 2011; Gutiérrez et al., 2015; Brook et al., 2016;) also state that the context in which unlearning takes place plays a significant role.

Discarding current knowledge may vary according to mental models, concepts, and ideas influenced by national culture and reality (Zahra et al., 2011). However, few studies have investigated environmental factors, such as organizational culture (e.g. Leal-Rodriguez et al., 2015) that might influence unlearning at the individual level. Moreover, a possible influence of national culture on individual unlearning is an underdeveloped field of research.

Even though some papers (e.g. Heizmann et al., 2018; Wang and Guan, 2018) have shown the effect of national culture on learning processes in organizations at the individual level, we did not identify similar studies that connected unlearning with national culture.

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Against this background, in the present paper, the following research question was addressed: What factors influence unlearning at the individual level in a company located in a high power distance country that changes a routine? To answer the question a case study in Brazil was carried out. The present study was inspired by a similar research conducted in Australia, a small power distance country, by Becker (2010). We use Hofstede's (1991) approach of national cultures to understand the phenomenon. A series of semi structured interviews was conducted in a Brazilian public organization to identify barriers and enablers in the unlearning process of a routine operated by shop floor agents due to a change that was triggered by the introduction of a new technology.

Our research aims to better understand unlearning at the individual level and thereby extends the underdeveloped body of knowledge regarding unlearning with an empirical study of the unlearning process in an organization located in a high power distance country.

This paper is structured as follows. In the next section, the relevant literature is outlined. Then, section 3 describes the methodology of the study. Thereafter, section 4 presents the results followed by a discussion. The final section outlines the conclusion of the research and highlights some suggestions for future research.

2 Literature Review

This section presents studies on unlearning in organizations. It starts with presenting an overview of unlearning at the organizational level in order to underline that individual unlearning in this paper refers to the organizational context.

2.1 Organizational Unlearning

In this paper, we understand organizational unlearning as the intentional abandonment of knowledge by the organization after questioning current beliefs and actions (Mehrizi and Lashkarbolouki, 2016). Unlearning aims to eliminate obsolete knowledge, assumptions, or routines (Hislop et al., 2014) from the organizational memory (Akgün et al., 2006) by discarding old logics and making room for new ones (Sinkula, 2002; Cegarra-Navarro et al., 2010; Leal-Rodriguez et al., 2015).

Unlearning as a process is commonly studied in the same context as the learning process (Akgün et al., 2007; Yeo, 2007; Yildiz and Fey, 2010; Leal-Rodríguez et al., 2015). Even though "little consideration has been given to unlearning" (Becker, 2008, p. 89), some researchers highlight the importance of the process of unlearning as an antecedent to new learning related to innovation and organizational change (McGill and Slocum Jr., 1993; Lei, Slocum and Pitts, 1999).

There are also authors who understand the unlearning process as a phenomenon that is separated from the learning process (e.g., Tsang and Zahra, 2008), suggesting that these processes require different skills (Zahra et al., 2011).

Thus, the concept of unlearning may vary slightly according to the approaches of the abovementioned authors. However, the literature suggests that there is a general agreement among

authors that unlearning relates to a conscious or intentional "abandoning', 'eliminating', 'rejecting', 'discarding' or 'giving' up something" by organizations or individuals" (Hislop et al., 2014, p. 12).

At the organizational level, once a specific knowledge is discarded, it can disappear through deleting contents from knowledge repositories. In contrast, at the individual level, it may be retrievable (Hislop et al., 2014). Thus, the challenge of unlearning processes is to remove old undesirable content from the human storage system (Tsang and Zahra, 2008). This implies that one needs to look more closely at individuals.

2.2 Individual Unlearning

Sinkula (2002) underlines that unlearning at the organizational level occurs only if it first occurs at the individual level. Therefore, understanding the unlearning process at this level makes sense if we want to understand the phenomenon at the organizational level (Becker, 2008; Tsang and Zahra, 2008; Hislop et al., 2014).

At the individual level, we understand unlearning as a conscious release of particular values, assumptions, knowledge, behavior (Hislop et al., 2014), and actions (Becker, 2008) by individuals in an organization.

Thereby, it is important to distinguish unlearning from forgetting (Azmi, 2008; Tsang and Zahra, 2008; Cegarra-Navarro et al., 2013). Unlearning means an intentional loss of knowledge stored in an individual's long-term memory, i.e. to make room for accepting new knowledge when new learning is required. While forgetting can be accidental (bad memory), unlearning has to be an intentional withdrawal by an individual from what he/she knows (Cegarra-Navarro et al., 2013). Forgetting is not examined in the present paper.

Unlearning at the individual level is associated with psychological phenomena such as changing belief structures, mental models, frames of reference, or mental maps (Akgün et al., 2007). Anxiety (Akgün et al., 2006) or feelings of nostalgia and attachment to current procedures may be obstacles for an individual to unlearn old knowledge and to learn new knowledge (Azmi, 2008). Thus, unlearning should be managed with great care in organizations (Rushmer and Davies, 2004).

Individual unlearning can be categorized into three types: fading, wiping, and deep unlearning (Rushmer and Davies, 2004; Hislop et al., 2014). Fading occurs due to a lack of knowledge application. Wiping occurs when unlearning is generated by factors external to an individual, for example, changes imposed by the company where the individual works. Wiping relates to strategic changes at the organizational level, affecting routines at the operational level (Hislop et al., 2014). Deep unlearning is generated by experiences that change ones' frames of reference or belief structures and can be a reason for anxiety, fear, and confusion (Hislop et al., 2014).

Considering the importance of unlearning at the individual level for successful change management, we focused on enablers and barriers of individual unlearning in organizations.

2.3 Factors that Influence Individual Unlearning

In the literature review, we identified some barriers and enablers that influence the unlearning processes at the individual level. They were classified into two categories: personal characteristics (Table 1) and (predominantly) external factors that influence individual unlearning (Table 2). These categories were assigned based on the influence on the individual unlearning process either coming from the individual personal characteristics or from elements external to the individual. We assume that an organization can act on some factors of the second category to facilitate individual unlearning processes.

Table 1. Personal Characteristics for Individual Unlearning

Enablers
[A] Willingness to face novelties (Sinkula, 2002).
[B] Open-mindedness, receptivity, and willingness to listen (Rushmer and Davies, 2004).
[C] Tolerance for uncomfortable feelings like vulnerability, uncertainty, embarrassment, humiliation, loss of status or of credibility (Rushmer and Davies, 2004).
[D] Willingness to be brave and to shoulder personal risks (Rushmer and Davies, 2004).
Barriers
[E] Fixed beliefs like established mindsets, frames of reference, or convictions about the current methods (Starbuck, 1996; Rushmer and Davies, 2004; Akgün et al., 2006; Azmi, 2008; Becker, 2008; Tsang, 2008; Hislop et al., 2014).
[F] Anxiety (Akgün et al., 2006).
[G] Expertise (turned into tacit knowledge) as perceptual filters (Starbuck, 1996; Becker, 2008, 2010).
[H] Emotional traits like reactions against imposed changes, routine seeking, fear of the unknown, or short-term focus (Rushmer and Davies, 2004; Becker, 2008, 2010).
[I] Age as a resisting factor to changing routines due to long-time usage (Zahra et al., 2011).
[J] Fear of hierarchy (Azmi, 2008).
[K] "Local patriotism" - employees at lower levels that misunderstand the intentions of the upper-level management (Becker, 2008).
[L] Prior training and experience (Brook et al., 2016).
[M] Lack of awareness about the need for unlearning: "If it ain't broke don't fix it" (Rushmer and Davies, 2004, p. ii13).

From Table 1 some issues emerge we will reflect on in the following. Not only psychological aspects specific to an individual seem to play a role in unlearning processes, but also factors related to the age of the individual (Starbuck, 1996; Zahra et al., 2011). Older people may be more resistant to unlearn processes, as they normally have been following the same routine for many years (Tsang and Zahra, 2008). Williams van Rooij (2012), however, states that

human beings do not lose their learning-unlearning skills with increased age. Elements that can influence cognitive and behavioral changes in older people may be found in the ways in which new knowledge is presented. This also includes the omission of contexts (Williams van Rooij, 2012).

Sometimes resistance for relinquishing "the old" is related to critical reasoning: does unlearning always induce positive results for an organization? Brook et al. (2016) mention the negative side of unlearning processes when political interests in organizations are concerned. And Tsang (2008) reminds: "even when unlearning is intentional, the new routines are not always better than the old ones they replace" (p. 7). Older people and persons with large experience in old routines might be more aware of what the cited author refers to.

External influences on unlearning at the individual level are discussed in the literature as highlighted in Table 2. According to Becker (2008), external influences can either encourage or discourage unlearning by people.

Table 2. External Factors for Individual Unlearning

Enablers
[N] Leadership behavior for an appropriate unlearning context, openness to new ideas, awareness of environmental changes (Cegarra-Navarro et al., 2010; Hislop et al., 2014; Gutiérrez et al., 2015; Brook et al., 2016), and motivation for the teams for changes (Cegarra-Navarro et al., 2010; Gutiérrez et al., 2015) acting as "change leader" (Sinkula, 2002).
[O] Team reflexivity and constant self-reflection of its members for information sharing inside the group and a revision of current routines and beliefs (Lee and Sukoco, 2011).
[P] Supportive environment for openness, creativity, and vulnerability (Rushmer and Davies, 2004).
[Q] Crisis or turbulent environments (Sinkula, 2002; Akgün et al. 2006).
Barriers
[R] Attachment of managers to old routines in which they gained authority (Tsang and Zahra, 2008; Becker, 2010).
[S] Senior managers with vested interests in the current situation (Starbuck, 1996).
[T] Existing organizational policies, structures, procedures, practices, and processes, which no longer contribute to organizational progress (Becker, 2008).
[U] Organizational memory (Becker, 2008; Zahra et al., 2011).

The content of Table 2 also provides room for some reflections. A crisis and dynamic environments (Sinkula, 2002; Akgün et al., 2006) often generate in individuals the awareness of a need for changes and consequently a readiness to abandon old ways of working. In our time, the implementation of new technologies frequently triggers routines to be modified. Sometimes individuals have no alternatives but to unlearn the old ways of working/doing things and to adopt a new one if they wish to keep their jobs. They face wiping unlearning (Rushmer and

Davies, 2004) which can require an additional effort from the individual to abandon a known routine.

As stated in Table 1, cognitive and emotional aspects can influence individual unlearning processes. As shown in Table 2, there are also external aspects that can be managed by the organization to eliminate barriers and to promote a positive attitude to unlearning by the individuals. Thus, unlearning requires an appropriate context and environment which can be provided by the management (Brook et al., 2016; Hislop et al., 2014). One example of how managers can create a favorable environment to unlearning is to promote intense communication, which stresses the benefits of the newness to be implemented. While resistance to unlearning can happen when people do not understand its advantages (Hislop et al., 2014). Another example of how managers can promote a supportive environment is by starting discussions about the abolition of a current situation with the whole group to support team reflexivity (Lee and Sukoco, 2011).

Akgün et al. (2006) stressed the groupthink phenomenon as a possible barrier to unlearning at the individual level. "Groupthink refers to a deterioration of mental efficiency, reality testing, and moral judgment that results from in-group pressures" (p. 9) (Janis, 1982 cited by Whyte, 1998). This negative attitude towards novelties can be avoided when managers act as "change leaders", which are individuals whose mindset is oriented to a "why not?" mentality showing an open attitude toward changes.

Established organizations, in particular, have difficulties with promoting unlearning because withdrawing things that made the entity successful is not easy (Mehrizi and Lashkarboluki, 2016); thus, being attached to past successes can be one more factor that hinders unlearning. Another situation that can make unlearning more difficult for individuals is when they learn new knowledge at the same time they discard the old one. However, when the old and the new practices are similar, unlearning the old and adopting the new practice is less difficult (Tsang, 2016).

Having investigated the unlearning process during the implementation of new technology in an Australian government-owned corporation of the energy industry, Becker (2010) proposed seven factors that influence unlearning at the individual level.

Table 3. Becker's Factors that Influence Unlearning at the Individual Level (Source: Becker (2010, p. 260))

Factor	**Description**
1. Positive prior outlook	Relating to the outlook of the individual prior to the change; positive overall view and understanding of why the change was needed, and an expectation that they would be well prepared for the new way by the time it was introduced.
2. Feelings and expectations	Relating specifically to feelings of apprehension toward the change, levels of comfort with the prior system, and expectations that changes would be difficult.

Factor	Description
3. Positive experience and informal support	Relating to experiences during the change; in particular the level of support from manager and colleagues, and the impact of their own level of experience on their ability to unlearn and accommodate the change.
4. Understanding the need for change	Relating to the understanding of the need for the new way, why the organization chose the new way and the level of comfort with the decision to change.
5. Assessment of the new way	Relating to the views about the difficulty of the new way and the level of comparison still being done between the old way and the new way.
6. History of organizational change	Relating to how well change had been handled in the past and the perception of previous change efforts.
7. Organizational support and training	Relating to the quality, timeliness, and applicability of the written documentation and the training provided to support the change.

The connections between Becker's (2010) factors with the barriers or enablers presented in the Tables 1 and 2 are presented below.

1. Positive prior outlook - [A]; [B]; [E]; [I]
2. Feelings and expectations - [A]; [B]; [C]; [D]; [E]; [F]; [H]; [J]
3. Positive experience and informal support - [E]; [G]; [I]; [L]; [N]; [O]
4. Understanding the need for change - [B]; [C]; [D]; [E]; [G]; [H]; [I]; [K]; [M]; [Q]
5. Assessment of the new way - [A]; [B]; [C]; [D]; [E]; [G]; [H]; [I]; [L]; [T]
6. History of organizational change - [P]; [U]
7. Organizational support and training - [N]; [O]; [P]; [R]

The letters in parenthesis represent the topics highlighted in the Tables 1 and 2. Thus, Becker's (2010) factors for the Australian context appropriately summarize the content of the tables. Therefore, we chose to apply Becker's (2010) model in the Brazilian context for the purpose of the present paper.

2.4 National cultures and unlearning

Hofstede (1991) states that individuals belong to groups, to organizations, and to a society and they carry within themselves mental programming from different levels of culture: a national level according to the country, a regional and/or ethnic and/or linguistic affiliation level, a gender level, a generation level, a social level, and an organizational level when applicable.

Motivated by the research conducted by Becker (2010) in Australia, we studied a case in Brazil. We chose the national culture layer as a suitable approach to understanding unlearning at the

individual level in conjunction with the implementation of a new technology. The question in the background was whether in the Brazilian case study different factors would emerge when compared to the Australian case study.

Hofstede (1991) explains that aspects of a national culture can be measured relative to other cultures in four dimensions: the degree of inequality (Power Distance Index- PDI), individualism (Individualism Index - IDV), masculinity-femininity (Masculinity Index - MAS), and tolerance ambiguity (Uncertainty Avoidance Index - UAI). All these national culture dimensions have an influence on organizations as well as on individuals. Table 4 summarizes the index and their scores for the two countries:

Table 4. Indexes of Dimensions of National Cultures

Index	**Description**	**Australia**	**Brazil**
PDI	Dependence of relationships in a country.	36	69
IDV	Looseness of ties between individuals in a society.	90	38
MAS	Clearly defined gender roles.	61	49
UAI	The extent to which individuals feel threatened by uncertainty or unknown situations.	51	76

Regarding the indexes presented in Table 4, we argue that PDI and IDV are related to the external factors on unlearning at the individual level (see Table 2) whereas UAI is associated with the individual factors (see Table 1). Consequently, in companies, the higher the PDI the more dependent are the employees on their bosses. According to the PDI presented in Table 4, it is expected that managers in Brazil make bigger efforts as their Australian counterparts to lead the required processes of relinquishing old knowledge. In addition, based on the scores for IDV, the groupthink phenomenon might be stronger in Brazil than in Australia. The UAI in Brazil is higher than in Australia, thus, we may expect in our case study to see an externalization of feelings of fear about upcoming changes.

In line with Tsang and Zahra (2008), we adopted a routine-oriented approach to investigate unlearning at the individual level. For this reason, in the following, some issues about unlearning old routines are presented.

2.5 Routines

Organizational routines can be understood as "repetitive patterns of interdependent actions carried out by multiple organizational members involved in performing organizational tasks" (Tsang and Zahra, 2008, p. 7).

Feldman (2000) argues that "unlearning in organizations" leads to the management of routines, which becomes a source of continuous change as knowledge progresses. Old knowledge embedded

in routines needs to be unlearned and new knowledge needs to be developed with the aim of improving performance (Tsang and Zahra, 2008) and of keeping an organization flexible and agile (Hislop et al., 2014).

The concepts of ostensive and performative aspects of routines should also be taken into account to verify whether unlearning has occurred (Tsang and Zahra, 2008). Ostensive aspects of routines are related to the structured procedures adopted by an organization that can be stored by human beings and by artifacts. Performative aspects are related to the routines executed by a specific individual in a specific place at a specific time (Tsang and Zahra, 2008).

It may occur that ostensive aspects of a routine are removed, but individuals keep the old aspects of the performative routine. In such a case, one cannot assert that the process of unlearning is complete. The unlearning process is considered successful only when both ostensive and performative routines have been relinquished (Tsang and Zahra, 2008).

3. Research Methodology

We chose a case study approach as the research method. A case study enables researchers to have a holistic view of real life events aiming at exploring processes of contemporary issues (Yin, 2010).

The routine change in the process P at Alphabeta Logistics (a fictitious name thereafter abbreviated as AL) was selected as a case for the present study. AL is located in Santa Catarina, a state in the southern part of Brazil, and employs ca. 2000 persons. AL is a public sector organization characterized by a high power distance. The unit of investigation was the parcel delivery agents at the shop floor level.

The suitable process in AL selected for the empirical research was determined after discussions with several managers of the company in April 2016.

Hereafter, the process P at the shop floor level is briefly explained. AL has standardized procedures for agents to deliver parcels. After a sorting process at a local storage center, of which there are hundreds all over Brazil, each parcel is delivered to the recipient. The present investigation covered two storage centers (SC1 and SC2) located in the state of Santa Catarina.

In the old process P, each delivery agent organized manually his/her delivery route completing a paper sheet called List of Objects to Deliver (LOD).

Due to the adoption of a new technology, the process for preparing the LOD changed. Now an IT program defines automatically the delivery routes and prints the LOD for the agent. Then, each agent organizes the parcels he/she has to deliver according to the LOD issued from the computer program. Additionally, the program prints the document which will be signed by the recipient. This document also includes a bar code that identifies the parcel, a significant change from the old procedure. We observed that the agents experienced an incremental change and they had to relinquish the old way of working. Thus, the delivery agents experienced an unlearning process.

To understand which factors did influence the unlearning involved in the process P at the indi-

vidual level, the questionnaire of Becker (2010) was the selected instrument to be sent to over a hundred delivery agents who worked in process P. We chose Becker's (2010) model because she studied the unlearning process for the implementation of a new technology in companies and conducted the research at the operational level. Additionally, Becker's (2010) factors are connected to factors identified by other authors (please refer to Tables 1 and 2) which made her instrument suitable for the present study.

We took the questionnaire in its totality (please refer to Becker, 2010, pp. 258-259) and added one final open question to the instrument ("This space is yours, please write down additional comments about the process experienced"). With this open question, we intended to capture possible additional elements that were considered relevant in the process undertaken.

The questionnaire was translated into Portuguese. We conducted a semantic validation with eight experts in the routine of process P, who recommended to apply the questionnaire through personal face-to-face interviews because shop-floor employees are not used to answering questionnaires sent by mail. Thus, we changed the original data collection strategy and decided to run a series of semi structured interviews in a few delivery centers using the questionnaire as a guide. Each question was posed in the same sequence to all the interviewees. However, they were free to comment on their answers.

The researcher who conducted the interviews also works for AL in the administrative sector but without direct contact neither with the research object nor with the interviewees. It should also be mentioned that the interviewer is an ISO Audit trained professional used to obtain and analyze data impartially.

After adjusting schedules with managers, appointments for the interviews were set. To increase the likelihood of obtaining free and sincere answers, the researcher stressed in each interview the anonymity. In addition, the interviewer clarified the academic purpose of the research and highlighted that no report would be made to any level of the company.

Ten agents of the storage center SC1 were interviewed within three days. The questionnaire supported the interviews. The interviewer read each statement of the questionnaire noting by hand the answers and additional comments of the interviewee to each question. Each interview lasted up to 30 minutes.

About one week after the data collection at the storage center SC1, we received the agreement from the manager of the storage center SC2 for running interviews. There, six agents were interviewed within two days, following the same procedures as in the storage center SC1.

After contacting some more storage centers to gather further data, the interviewer was informed that it was not possible to continue the data collection, as the agents were going on strike. Because of the arising difficulties in pursuing the data collection, we decided to work with the data they had obtained up to this point.

In the following, we would like to make some remarks about three aspects related to the data collection. First, the questionnaire proposed by Becker (2010) with subdivisions related to time (before the change, during the change, and after the change) provided difficulties to the interviewees, as they could not easily determine the exact moment of their perception. Second, the interviews were conducted in an extraordinary situation: AL is a public-sector organization and

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political instabilities have affected managerial practices in the organization. The organizational climate is influenced by the general political situation in the country, according to a few informal complaints obtained from some interviewees. This specific context made us think about giving up the research and waiting for a more stable situation within AL. However, according to Yin (2010), a case study is suitable to depict phenomena the way they occur at a specific snapshot of time. Since the research was conducted in a natural environment, we decided to investigate the events the way they occurred. The third aspect that has to be discussed is the fact that the researcher who executed the interviews is an employee of AL. On the one hand, this facilitated access to the organization. On the other hand, the risk of biases either in positive or in negative answers has to be taken into account when analyzing the results. Some interviewees may have reinforced negative aspects because the interviewer was a colleague, and the interviewees could have taken the interview as a moment of expressing feelings. But they could also have stressed positive aspects under the fear that otherwise, the interviewer would report to managers the identity of the agent, even though the researcher guaranteed anonymity.

Some of the interviewees mentioned that some colleagues who did not accept the implemented change had to be removed from the activity. The interviewer tried to talk to them, but they refused to talk about the matter.

The data collected from the sixteen interviewees were transcribed to an Excel Sheet. The factors of Becker's (2010) model were adopted as categories for the subsequent data analysis.

4 Results and Discussion

As mentioned, we interviewed sixteen delivery agents: twelve males and four females (Table 5).

Table 5. Profile of Interviewees

Interviewee	**Age range (years)**	**Time worked in the organization (range/ years)**
A	46-60	< 5
B	31-45	6-10
C	46-60	11-15
D	31-45	16-20
E	< 30	< 5
F	31-45	6-10
G	< 30	< 5
H	< 30	< 5
I	31-45	16-20
J	31-45	11-15
K	46-60	>20

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L	31-45	11-15
M	31-45	11-15
N	46-60	>20
O	31-45	11-15
P	46-60	>20

The sample represents mainly individuals that were introduced to computers during adulthood or in their middle age. More than 60% of the interviewees have been working for AL for over 10 years, which suggests that they know the company culture and have had experience with prior changes.

Noteworthy, and in contrast to the findings of Tsang and Zahra (2008) and Becker (2008), we noticed that the interviewed senior agents were as receptive to abandon the old way of working as their younger colleagues. They were aware that technology adoption is a critical issue for a better performance of the company. In line with Williams van Rooij (2012), they also expressed to be open to changes, which makes processes more efficient and helps in increasing the likelihood of success.

However, it must be stated that it was also reported to the interviewer that there were senior agents who did not accept the changes and therefore were removed from the process P. It also needs to be mentioned that the removed employees were close to retirement, according to the interviewees.

In the following, the findings, which were categorized based on the seven factors proposed by Becker (2010), are presented.

a) Positive prior outlook: In this study, more than 60% of the interviewees expressed positive expectations for the upcoming changes in the routine of process P. Statements were expressed in this sense:

It was high time to progress... There is technology like biometry... we have to progress. (Interviewee A).

The company must invest in technology! (Interviewee B).

I think that progress was little. More technology should be implemented at AL. (Interviewee D).

Some agents said that they did not have any expectations (either positive or negative). Some interviewees expected to have more work in their routines after the implementation of changes. Some others expressed fear for the company losing market share because the competitors were already using more advanced technology for similar processes.

The interviewees expressed awareness of external factors like technological development and behavior of competitors. The agents mentioned that these factors push individuals to accept

changes. This suggests that the agents had a positive prior outlook related to the upcoming change. Middle-aged agents had a very positive opinion towards technological gadgets ("*my grandson explained this to me...*"), and they perceived the adoption of technology as positive.

Through the statements of the interviewees, we understood that when a novelty already exists outside the company and it has a positive general reputation, individuals can be more comfortable in unlearning old ways and in learning new ones.

b) Feelings and expectations: About half of the interviewees expressed their apprehensions with the new procedures, e.g. fearing that the new routine would make their work more difficult than before.

In each new process, there is anguish and fear of the unknown. It makes the learning process more difficult. At AL, where many employees have been working for the company for over 30 years, this situation is more critical. The manager must be able to guide the team. (Interviewee D).

However, some interviewees commented that they did not fear the complexity of the new technology because they heard that the colleagues from other delivery centers (who were already working with the novelty) were happy with the changes. The level of agreement among the employees on the need for implementing the new routine was rather high. In spite of the expressed apprehensions prior to the changes, more than 75% of the interviewees said that they were curious and wished to try the new routine.

We cannot stay attached to the past. We have to innovate. (Interviewee F).

Many of the interviewees expressed that technology adoption was necessary and that the company should have already done it a long time ago

The new procedure would facilitate my work, as the [delivery] route is readily prepared for me. (Interviewee E).

[The change] is positive. The company has to adopt new technologies (Interviewee F).

Yet, also unease was expressed

I had some fear about the new procedures... (Interviewee C).

A high level of communication and a positive prior outlook in a group can help to control the anxiety level of individuals. Managers who have answers to questions related to an upcoming change give confidence and assurance to the group.

The words of some agents suggest that the strategy of implementing change in progressive steps proved to be appropriate, as it gives time to individuals to reflect and to prepare for the upcoming change.

There was not much of a problem with most of the colleagues because the new procedures were implemented in steps, one workplace at a time. (Interviewee E).

The awareness of changes in the environment expressed by the interviewees has to be underlined. In spite of the fear of the unknown, the majority perceived technology as a necessary evil.

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c) Positive experience and informal support: All the interviewees stated that their superiors (especially at the level n+1) guided them during the change process, which facilitated the acceptance of the technology introduction in their routine. The statements confirm that leadership can powerfully influence the replacement of the old by the new in a group.

The training activities were conducted by the manager and by the supervisors. We were lucky because one of the supervisors knew the new system very well.... (Interviewee F).

The managers and the supervisors of both storage centers personally conducted training sessions for the new process, and they were very committed to introducing the new routine as quickly as possible. For the management of the company, the change should mean a productivity increase in the process P.

During the interviews, the interviewer observed an open management style in both delivery centers, without hierarchical distance between managers and employees. The informality allows people to talk openly both with their peers and their managers to exchange opinions and perceptions.

In the present study, the progressive implementation of the routine change apparently enabled the communication among agents of different centers. Regarding group support, the favorable informal information from the agents, who had experienced the change, influenced positively the attitude of the agents for whom the change was still to come. However, some of the interviewees mentioned that there still were a few colleagues who were skeptical about the change process.

d) Understanding the need for change: After experiencing the adoption of the technology, the interviewees had a clearer understanding of why the company was implementing the changes. They could realize the performance improvement by adopting technological issues in the process. The level of confidence in the company's decision increased after the implementation of the new routine with the employees.

Currently writing by hand does not make any sense! (Interviewee G).

In spite of the high positive prior outlook, the complete acceptance of the changes in the routine by the agents occurred only after a gain of productivity became evident.

e) Assessment of the new way: After implementing the new routine, some of the interviewees found that the new way was not as difficult as they had thought before the implementation, and they soon got used to the new procedures.

The new way brought much time savings. We save about 20 minutes per day. (Interviewee B).

Manual [procedure] is a lot more work. (Interviewee H).

We saved time with the new procedures... (Interviewee C).

Nevertheless, some of the agents revealed that in the beginning there were many errors which required continuous corrections. It took some time until everyone incorporated the new procedures. The acceptance of failures during the implementation process of the new routine allowed

agents not to be ashamed of admitting them. This motivated them to keep trying until they unlearned the old procedure and learned the new one.

There were also some agents who mentioned their negative perception of the new way of running the process P. To them when they were writing the delivery route list LOD they could pay attention to each parcel individually. Receiving a completed LOD from the system makes the process rather impersonal in their view.

. . . but there have been negative impacts on ergonomics for the agents (Interviewee C).

We save time, but the final quality of the service was better before. (Interviewee I).

*With the manual process, there were fewer errors. (*Interviewee H).

It should be mentioned that interviewees H and I can be viewed as younger agents. Unexpectedly for someone of this age group, they have manifested advantages in manual procedures. Their remarks were interesting because they focused on the quality of service instead of the perception by the majority of the interviewees, who highlighted the relief that the new procedures brought to the agents' work, irrespective of the effect on the quality of service.

f) History of organizational change: The case of process P can be understood as unlearning through wiping (Hislop et al., 2014) and the unlearning process was generated by changes imposed by the organization. Such changes have not been unusual at AL.

About half of the interviewees expressed that changes in the company have often been without prior announcements. Some of the interviewees did not give an answer to this question, but they did express themselves with sighs and head-shakings. We interpreted the signs as melancholic and uncomplaining answers. We noticed that when the interviewees wanted to give negative answers, they expressed their dissatisfaction with body language.

Even though most of the interviewed agents mentioned that previous change processes in the company had not always been implemented smoothly, they did not consider this fact as a barrier to try new changes. One may suggest that such a reaction could be a cultural trait of AL agents. According to them, last minute changes in the company are not unusual and the employees know that this is the way it is. "At the end, everything goes fine; when something does not go well, it means that this is not the end, yet" - this is a Brazilian popular saying that was expressed by some interviewees.

At this point, one may go back to the factor "positive prior outlook" of the process and conclude that the positive perception towards the nature of change - the introduction of a new technology - was stronger than the skeptics of the agents related to the management of such a change. Here, we may conclude that the nature of the change influences the acceptance of the novelty. According to the interviewees, they had already heard about the new technology and this facilitated the adoption of new procedures in the process P.

g) Organizational support and training: Formal training procedures were conducted mainly by the supervisor or by the manager of both storage centers. The training method consisted of speeches and explanations on site. The opinion of most of the interviewees about the training was very positive.

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The manager conducted frequent training sessions [about the upcoming change] because a novelty always scares. (Interviewee C).

Some of the managers prepared written material or presentations on their own initiatives, which was considered useful and helpful. The agents found that the time gap between planning and implementing the change was satisfactory for this specific change of routine. The guidelines by the managers and their positive advertising about the new routine prior to the implementation facilitated the upcoming change process. However, more than 50% of the interviewees argued that opinions of their immediate superiors did not influence their personal decision to adapt to the new routine, which showed a contradiction with the emphasis on the positive behavior of the managers expressed by the interviewees. It might have been that the agents wanted to stress to the interviewer that they were able to think and decide for themselves about their engagement with the novelty and not simply follow hierarchical orders.

During the interviews, it was perceptible that the agents practiced the new routine without regrets. Recalling Tsang and Zahra (2008), in the present study it was realized that the agents unlearned both performative and ostensive aspects of the old routine. Even though the old routine still remains in the memories of some agents, it is discarded in practice.

Furthermore, it became clear that the actions of the supervisors and managers emerged to be crucial for each factor in Becker's model. Although more than half of the interviewees argued that they were not influenced by the opinions of their superiors, some of them stressed the role of managers and supervisors before, during, and after the change.

The factors that influence the unlearning process at the individual level presented in the literature were also found in process P. Yet, we found that not all of them are of equal influence. The leaders' formal training sessions - which were mentioned recurrently and many times by the agents – appeared to be the most relevant step for understanding and accepting the introduction of the new technology in process P. The study's findings also suggest that in addition the formal support provided by managers and supervisors in the form of training, their daily and spontaneous behaviors and attitudes toward the upcoming changes stood out as supporting aspects for the workers' ability to readily discard the old routines.

It is generally acknowledged that leadership is crucial in every organizational management process. The case study in AL organization confirmed that too. Particularly in unlearning processes relating to routines, managers and supervisors have to take the role of "change leaders". The strong need for leadership as stressed by the interviewees reinforces the role of cultural aspects that might be influencing unlearning processes at the individual level too.

We learned from Becker's research that in an Australian context the role of leadership was present as informal support provided by the managers to the employees. In AL, however, the interviewees highlighted that the formal training sections were conducted by the managers and not by instructors or Training & Development professionals. By recalling Hofstede (1991), we assume that the greater importance of leadership at AL may be explained by the different countries involved: Australia (in Becker's context) and Brazil (the context of the present study). Societies with a high Power Distance Index (PDI) stress the role of managers, whilst societies with a low PDI seem to focus on the role of employees. In the latter case, there is less dependence of the employees on their superiors. Hofstede (1991) mentions that in countries where Romance lan-

guages are spoken one finds a medium to high PDI, while in countries where Germanic languages are spoken one finds a low PDI. Indeed, the PDIs presented by Hofstede (see Table 4) depict Australia as a country with a small power distance and Brazil as a society with a high power distance. Hence, the power distance seems to be a factor that explains the heavier weight put on managers by the individuals in the unlearning process.

In Brazil with a PDI higher and an IDV lower than in Australia, we expected pronounced collective thinking. However, based on the interviews conducted we could not find a confirmation for it. Individual opinions about the changes were expressed based on individual points of view.

Concerning the Uncertainty Avoidance Index, most of the interviewees expressed simultaneously fear and confidence about the upcoming change. On the one hand, they expressed fear of novelties. On the other hand, the nature of the change was an implementation of an already known technology. Besides, as mentioned before, colleagues who have already experienced the change have spread positive opinions about the matter. Thus, for the present case study, UAI did not show a relevant impact on the unlearning process of the individual.

5 Conclusions

In this study, we addressed an under-researched field of study, namely unlearning. Unlearning is rarely employed in organizations and relatively little is published about this phenomenon in the scientific literature in general. Based on the body of knowledge available, we identified barriers and enablers on unlearning. Among the external factors that may influence individual unlearning, we stressed the national culture as a promising lens for exploring unlearning at the individual level. We used Becker's instrument (2010) developed from an Australian study in a similar unlearning process as an inspiration to look into an unlearning process executed in a public sector organization situated in a high power distance country. Recalling Hofstede's (1991) national cultural dimensions, we can conclude that in the study conducted, the high power distance in Brazil might explain the important role of managers in unlearning processes. Interviewees involved emphasized the key role of managers at the n+1 level. Thus, the study indicates that the managers must highly engage themselves in continuous communication and training actions for mitigating the difficulties in the unlearning processes at the individual level. It seems the role of the manager is decisive for the success of unlearning in the context of a high power distance culture in particular.

Our findings further highlight that developments coming from outside the organization affect the successful implementation of changes in routines. For example, individuals tend to accept more easily an alteration of a routine, when the change relates to a new technology, which they have already experienced in their daily lives. Managers in charge of running unlearning processes that are similar to the one presented in this study are invited to continuously promote an innovation-oriented mindset, e.g., by encouraging team reflexivity with regard to novelties and newness.

Some managerial implications can be drawn from the study's findings. Even in situations of

incremental change employees working in a high power distance organization are rather likely to expect formal support from their superiors, like training sessions. The idea of training is directly connected with the acquisition of new knowledge. However, successful learning is often preceded by pouring out old knowledge that acts as a barrier for the new one. A Chinese saying states: "it is necessary to empty the cup before filling it up with new beverage". Consequently, in training sessions managers will need to start with techniques that can support employees with abandoning the old way. By convincingly demonstrating the advantages of doing things differently, managers might help the detachment from the past and promote the required unlearning process as a preparation for new learning, when required. Additionally, the findings indicate that an intense preparation of the managers at the n+1 level for change management in organizations operating in a high power distance context is required. Hence, we suggest the selection of managers who are "change leaders" with good communication abilities to neutralize feelings of anxiety in the group. A manager operating in a high power distance context should demonstrate the acceptance of errors during the acquisition of the new routine. He/she should also teach and support the employees.

Regarding future research, we suggest that further studies should be conducted about the influence of national cultural factors on unlearning in general and unlearning of routines in different countries. More rigour investigations based on Hofstede's approach to cultural differences could bring promising contributions to the field of unlearning. Some authors (e.g. Becker, 2008) argue that unlearning is a driver for innovation. Thus, research on the possible influence of national cultural dimensions on the unlearning at the individual level could also help in developing our understanding of the innovation capability of different countries. Future research could also examine factors that influence unlearning in routine changes that are not related to technology. Another issue to be investigated could be the influence of the individual's age on the effectiveness of unlearning processes.

A limitation of this study is the small number of interviewees involved. Also, the entire environment with an adverse organizational climate has to be stressed, which constituted the biggest barrier to the study and its execution. Thus, the findings presented in this paper cannot be extrapolated to the entire AL Company. It is clear that the results cannot be generalized but this was not the aim of the study. Instead, it aimed at contributing to the small number of empirical studies on unlearning. Finally, this exploratory research draws the attention to contextual differences that could be useful to be taken into account when studying unlearning processes in organizations in different parts of the world.

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Mobile payments: a proposal for a context-oriented approach based on socio-technical system theory

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Abstract. A recent review of mobile payment research by Dahlberg et al. (2015) concludes that there is a need to synthesise this research area by studying contexts in which innovation is carried out and to integrate different aspects of research. This article aims to provide a proposal for how to achieve such integration and context orientation by building on previous studies and offering an additional review. Our systematic literature review of mobile payments research is focused on papers published during 2006–2016. The main objective is to examine how mobile payments research has been conducted from the methodological and theoretical perspectives. Our findings show that research on mobile payments is a multidisciplinary research. Three main themes in the research (in line with previous studies) are customer adoption, technological aspects, and business aspects. Moreover, research is mainly analytical based on a deductive approach. To meet the challenge formulated in the previous research, we propose and apply a socio-technical system framework to achieve synthesis and context-specific consideration in future research on mobile payments.

Keywords. Literature review; Mobile payments; m-Payments; Socio-technical systems.

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1 Introduction

Research on mobile payments has been carried out for almost two decades. A review of academic research performed during the period 1999–2006 is presented in Dahlberg, Mallat, et al. (2008). The authors contribute to academic research by offering: (i) a proposed definition of mobile payments; (ii) development of a multi-dimensional framework based on Porter's Five Forces and contingency theory, which is applied to analyse the mobile payments market; (iii) identification of research fragmentation and a focus on two aspects of mobile payments: technology and customer adoption; and (iv) a proposal of 22 research directions for further research. This was one of the first literature reviews in the area of mobile payments and laid a foundation for research to come.

In 2015, a new critical review of mobile payments research by Dahlberg et al. (2015) was published. Here, the researchers reviewed papers published in the period 2006–2014. The major contributions by Dahlberg et al. (2015) are: (i) identification of research fragmentation and a focus on three aspects of mobile payments: technology, customer adoption, and mobile payments market and providers; (ii) analysis of recent research in the area in relation to the 22 research directions proposed in Dahlberg, Mallat, et al. (2008); (iii) authorship analysis; and (iv) critical comments and recommendations for further research. Their review made several critical comments on the way research in the area had been done and proposed, among other things, that there is a need to put more focus on the role of the contexts—or ecosystems—in which innovation is done as well to strive to integrate several critical dimensions, such as technology, strategy and adoption, in a coherent framework.

Our paper therefore aims to build a more coherent framework around ecosystems for mobile payments and thereby address some of the recommendations made by Dahlberg et al. (2015). Previous reviews (Dahlberg, Mallat, et al., 2008; Dahlberg et al., 2015) did not, however, have a focus on methodological and theoretical issues and we therefore decided to complement their reviews with our review that incorporates methodologies and theories. The primary objective of our paper is to examine how mobile payment research has been conducted from the methodological and theoretical perspectives, and thereby be able to propose a framework that enables the research community to address current research challenges. Our study will address the following aspects:

1. What are the most common research and methodological approaches?
2. What are the main research themes and research focuses in the mobile payments research?
3. Given our first two questions, we seek to develop a proposal for a research framework to enable the research community to address the system-oriented challenge proposed by Dahlberg et al. (2015).

The main contributions of our study are: (i) it provides a focused study of methodological and theoretical aspects of the mobile payments research in order to identify the evolution of methodological and theoretical approaches used over time and possible future trends; (ii) it offers a comparison of differences and similarities between this research results and the results of literature reviews previously implemented by Dahlberg, Mallat, et al. (2008) and Dahlberg et

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al., (2015) in order to verify identified trends and issues; and (iii) it presents an application of the analysis and the development of a classification framework.

In order to perform a systematic literature review, we defined a number of literature search and selection criteria, together with a classification framework. Then we classified the selected academic literature along different conceptual, methodological, theoretical, and contextual dimensions.

The main findings show that the research in the area of mobile payments is rather new and developing. It is possible to identify three dominant research perspectives or themes: customer adoption, business, and technological aspects. Hence, following Morillo et al. (2003), the research on mobile payments can be considered multidisciplinary, since the subject of research is analysed from different angles and using different disciplines without their full integration. In this research, we identified dependence between research, methodological, theoretical approaches and corresponding disciplines. Due to a clear dominance of three major themes, the research on the mobile payments is fragmented, with a range of uncovered aspects. This led us to propose an integrative research framework based on theories for innovation and change in the socio-technical system that may lead the research in this area to become better integrated and context-oriented.

The rest of the paper is structured as follows: the methodology and classification framework are presented in the next section. This is followed by a description of the major research findings. Then we provide a discussion on the research findings, make conclusions based on that and propose an integrative research framework.

2 Methodology

2.1 Prior literature review studies on mobile payments

One of the most cited papers on mobile payments is the literature review conducted by Dahlberg, Mallat, et al. (2008). This study provides an overview of papers published during the period 1999–2006. In 2013, Slade et al. (2013) performed a review of publications focused on mobile payments adoption. Dennehy and Sammon (2015) analysed the top 20 cited papers published between 1999 and 2014: the estimation of the top cited papers was based upon Google Scholar's ranking. The same year, Dahlberg et al. (2015) published their literature review of mobile payments research covering the period 2007–2014.

More recently, Taylor (2016) examined academic research papers with a focus on potential risks that mobile payments technologies cause in the retail industry. De Albuquerque et al. (2016) implemented a comprehensive review of peer-reviewed publications published between 2001 and 2011. This review included papers on mobile payments initiatives in developed and developing countries. However, wesupport Dahlberg et al.'s (2015, p. 266) argument that "mixing articles focusing on developing and developed markets could cause confusion about the progress of mobile payments research" due to completely different market environments. Consequently, our study focuses specifically on mobile payments research in developed economies. In addition, we

excluded the literature surveys discussed above from our literature review since we aimed to build a broad picture of previous research. However, we build on the findings of other reviews when discussing our results.

2.2 Literature search

We used a systematic literature review approach (Kitchenham et al., 2009; Kitchenham and Brereton, 2013) to ensure a methodologically rigorous overview of research results. The aim of this approach is "not just to aggregate all existing evidence on a research question; it is also intended to support the development of evidence-based guidelines for practitioners" (Kitchenham et al., 2009, p. 8). Our review should be seen as a complement to the literature reviews conducted by Dahlberg, Mallat, et al. (2008) and Dahlberg et al. (2015). We set the following conditions for the study:

1. *The target period*. Dahlberg, Mallat, et al. (2008) covered the period from 1999 to August 2006. The target period of the current research was set from September 2006 to December 2016.
2. *The literature search sources*. Similar to Dahlberg, Mallat, et al. (2008), the current research is focused on studies conducted in mobile payments that were published in academic journals and in some established conferences dedicated to information systems and electronic commerce. A list of included conferences and a comparison with Dahlberg, Mallat, et al. (2008) and Dahlberg et al. (2015) is provided in Table 1. A similar list of online academic and conference databases was used for a wide systematic literature scan (see Table 2). Books, book chapters, doctoral dissertations, and unpublished publications were excluded.
3. *The literature search process*. The descriptors "mobile payment", "m-payment", and "wireless payment" were used for the search. The descriptors were to be found in the title, abstract, or keywords of the article. In addition, a backwards search was used when reviewing references used in the articles. Papers were excluded from the research if the main focus of the research was mobile or electronic commerce, mobile services, mobile finance, or mobile banking, and mobile payments were just a minor part of the research. In addition, if it was possible to track that a conference paper had evolved into a journal paper then the conference paper was omitted.

Based on the search descriptors, about 3,260 papers were found. In order to limit the number of articles, we selected papers based on estimated selection criteria: conference papers from established conferences and articles from journals with a one year or five year impact factor higher than 1.0, or articles from journals with a lower impact factor but more than ten Web of Science or Google Scholar citations. This way we selected 145 papers.

Table 1. Conferences included in the literature search.

Conferences	**Dahlberg, Mallat, et al. (2008)**	**Dahlberg et al. (2015)**	**Our research (No. of papers)**
International Conference on Information Systems (ICIS)	✓	✓	✓ (1)
Hawaii International Conference on System Sciences (HICSS)	✓	✓	✓ (7)
European Conference on Information Systems (ECIS)	✓	✓	✓ (2)
Pacific Asia Conference on Information Systems (PACIS)	✓	✓	✓ (3)
Australasian Conference on Information Systems (ACIS)	✓	✓	✓ (2)
IEEE Conference Proceedings	✓	✓	✓ (11)
Bled Electronic Commerce Conference (BLED)	✓	✓	✓ (3)
International Conference on Electronic Commerce (ICEC)	✓	✓	✓ (9)
International Conference on Electronic Business (ICEB)	✓	✓	✓ (0)
IADIS International Conference on E-Commerce	✓	✓	✓ (0)
IADIS International Conference on WWW/Internet	✓	✓	✓ (0)
International Conference on Mobile Business (ICMB)	✓	✓	✓ (9)
Mobility Roundtable	✓	✓	✓ (9)
Others			✓ (4)

Table 2. A list of databases used for literature search.

Sources	**Dahlberg, Mallat, et al. (2008)**	**Dahlberg et al. (2015)**	**Our research**
ProQuest Direct	✓	✓	
EBSCO	✓	✓	✓
ScienceDirect	✓	✓	✓
IEEE Xplore	✓	✓	✓
ACM Digital Library	✓	✓	✓
AIS Electronic Library (AISeL)	✓	✓	✓
Google Scholar	✓	✓	✓
M-Lit	✓		

Scopus	✓	✓
Web of Science	✓	✓
Emerald Fulltext	✓	✓
Wiley Online Library	✓	✓
JSTOR		✓

2.3 Classification framework

Due to our focus on methodological and theoretical aspects, a corresponding classification framework was developed (see Table 3). All classification dimensions are discussed below in more detail; however, the most important are research strategy, type of research, methodology, research methods, and theories. Selected articles were classified based on the framework. In order to ensure the accuracy of classification, the review process consisted of two rounds.

Table 3. Classification framework.

Classification dimension	**Categories**
Bibliographic and related data	Author(s), title of the publication, publication date, title of the source, impact factor of the journal, number of citations in Web of Science and Google Scholar, type of publication (journal or conference paper)
Definition	Developed own definition, use of existing definitions, changed or summarised existing definitions, no definition used Use cases: Point of Sale (PoS) payment, public transport ticketing, parking fee payment, etc. Applied technology
Research themes	Research themes addressed by the articles
Discipline base	Discipline to which papers are related
Research strategy	Analytical: conceptual, mathematical, statistical Empirical: experimental, statistical, case study
Type of research	Comparative research, predictive research
Methodology	Qualitative, quantitative, mixed
Research methods	Conceptual work, desktop (secondary data) analysis, interviews, focus groups, survey, case study, development of systems and algorithms, mathematical modelling, experiment/simulation, prototype, usability test, empirical test, proof of concept
Theoretical perspective	Corresponding theories, models, and concepts that are used for analysis

Articles were classified and coded by bibliographic and related data. These included impact factor and number of citations in Web of Science and Google Scholar.

In order to capture what researchers imply by "mobile payments", we analysed the use of mobile payments definitions. Applying the same approach as Burgess et al. (2006), a definition was

counted only if it was explicitly stated and not implied by the descriptive content. Identified definitions were categorised into original, modified, or existing (Burgess et al., 2006). We also checked what types of use cases and technologies were associated with the mobile payments. Then, in order to identify the main research directions, the articles were classified according to the research themes that they address.

The term 'discipline' is defined as "a body of practice that is well supported by occupational groupings that identify with a defined territory of activity" (Burgess et al., 2006, p. 710). Criteria that help to identify a discipline are the disciplinary backgrounds of the authors, research strategies, theoretical models and concepts (Morillo et al., 2003; Woo et al., 2011).

Analysis of methodological approaches in the research of mobile payments includes several dimensions. The selected articles were categorised by theory-building research strategy based on the classification scheme provided by Wacker (1998). This scheme was previously applied in other research areas. The examples are structured literature reviews on supply chain management by Burgess et al. (2006) and seaport research by Woo et al. (2011). Wacker (1998) proposes categorising research strategies into analytical and empirical. Analytical research methods include "logical, mathematical, and/or mathematical-statistical methods" (Wacker, 1998, p. 373) and apply the deductive approach:

- *Analytical conceptual research.* This is usually case study-based. Examples of such research are (a) introspective research that "describes and explains relationships from past experience to develop theory" (Wacker, 1998, p. 373); (b) conceptual modelling based upon deduced relationships; and (c) hermeneutics research which "deduces facts" from observations (Wacker, 1998, p. 373).
- *Analytical mathematical research.* Examples of such research are normative analytical modelling research, descriptive analytical modelling, prototyping, experimentations and mathematical simulation. "[T]he models usually are built using formal logic and tested using artificially developed data" (Wacker, 1998, p. 374).
- *Analytical statistical research.* This is used to integrate "logical/mathematical models from analytical research and statistical models from empiric research into a single integrated theory" (Wacker, 1998, p. 374). These models are used in future empirical statistical tests.

The categories of empirical research are based upon an inductive approach and are the following (Wacker, 1998):

- *Empirical experimental research.* This is used to determine the effect of independent variables on the dependent variables in the controlled environment.
- *Empirical statistical research.* The main aim of this type of research is to statistically analyse data collected from large samples of the population. The main methods used for this type of research are interviews, surveys, historical/archival research, expert panels, and Delphi techniques.
- *Empirical case study.* This type of research is usually focused on a limited sample of

analysed companies (Wacker, 1998). The analysis includes a large number of variables and aims to identify new empirical relationships.

In terms of research type, we looked only at whether the paper is comparative or predictive:

- *Predictive research* aims to predict future behaviour (Adams et al., 2007).
- *Comparative research* is used to compare several case studies or developed algorithms (Adams et al., 2007).

Selected articles were classified and coded according to the methodology used (qualitative, quantitative, or mixed), research methods used in the research, and theoretical perspective (that is, theories, models, and concepts applied for analysis). It needs to be mentioned that papers in the research themes and research strategydimensions are mutually exclusive. In other dimensions, the same paper may belong to several categories.

3 Classification results

3.1 Descriptive statistics

Although the time frame was defined from September 2006 to December 2016, the literature review did not include any paper from 2006. In total, 145 papers were selected (94 journal articles and 51 conference papers). The distribution of analysed papers in the period 2007–2016 is illustrated in Fig. 1. It shows a considerable increase in the number of papers published in recent years, especially in 2014 and 2015.

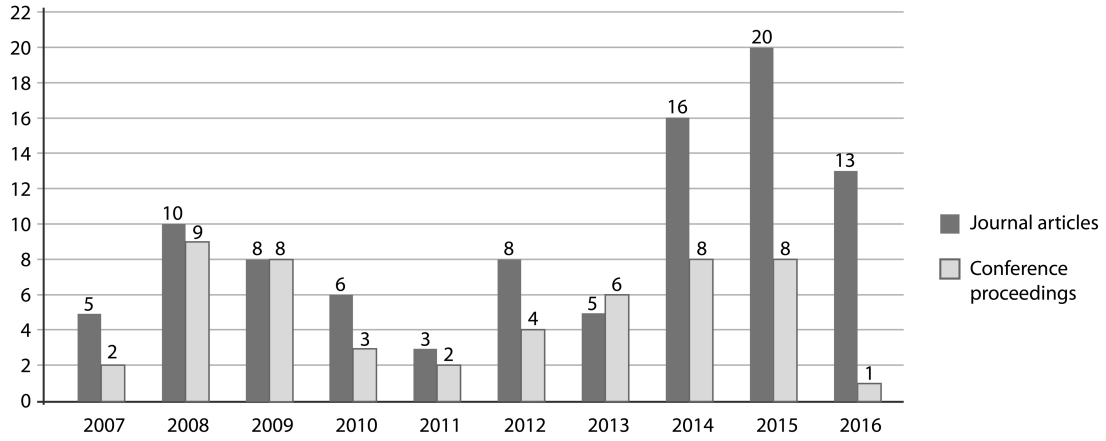

Fig. 1. Distribution of the selected papers over the period 2007–2016.

A list of journals that published at least two articles on mobile payments research is presented in Table 4. More than a half of journal articles have been published in these journals (54 out of 94). The most popular journal is *Electronic Commerce Research and Applications*. The majority of the journal publications (61 out of 94, or about 65%) were published in journals whose 5-

year impact factor is 1 and higher (only journals ranked by Web of Science were taken into account).

Table 4. Journals that publish research on the mobile payments.

Journal title	No. of papers	Impact factor in 2015	5-year impact factor in 2015
Electronic Commerce Research and Applications	12	2.139	2.831
Computers in Human Behavior	5	2.880	3.724
Computer Communications	4	2.099	1.732
Industrial Management and Data Systems	4	1.278	1.688
International Journal of Bank Management	4	n/a	n/a
Wireless Personal Communications	4	0.701	0.669
Info	3	n/a	n/a
Information Systems and e-Business Management	3	0.953	1.000
International Journal of Mobile Communications	3	0.765	1.040
Computer Law & Security Review	2	0.373	–
Computing	2	0.872	1.144
Information & Management	2	2.163	3.175
Journal of Information Technology	2	4.775	6.189
Mobile Information Systems	2	1.462	1.221
Transportation Research Part C: Emerging Technologies	2	3.075	3.631
Total	54		

3.2 Definition and scope of the mobile payments

In almost half of the articles (46%) no definition of mobile payments was used (see Table 5). The second largest group used existing definitions (23%). In 21% of papers, researchers have proposed their own definitions; a minority (10%) have changed or tried to summarise the existing definitions.

The two most referenced definitions are those proposed by Au and Kauffman (2008) and Dahlberg, Mallat, et al. (2008). They are provided in Table 6.

Table 5. Approaches to definition of mobile payments.

Approach	Frequency (papers)	Frequency (%)
Developed own definition	31	21%

Use of existing definition	33	23%
Changed or summarised existing definition	14	10%
No definition used	67	46%
Total	145	100%

Table 6. The most commonly used definitions of mobile payments.

Study	Definition
Au and Kauffman, 2008 (referred to in 11 publications)	A mobile payment or m-payment is any payment where a mobile device is used to initiate, authorise, and confirm an exchange of financial value in return for goods and services
Dahlberg, Mallat, et al., 2008 (referred to in 14 publications)	Mobile payments are payments for goods, services, and bills with a mobile device (such as a mobile phone, smartphone, or personal digital assistant) by taking advantage of wireless and other communication technologies.

Dahlberg, Mallat, et al. (2008, p. 165–166) have specified the following use cases of mobile payments: payments for digital content, tickets, parking fees, transport fares, and "to access electronic payment services to pay bills and invoices." In the majority of papers (95 papers), authors do not specify the use case of the mobile payments (see Appendix A). The most referenced use cases for mobile payments are payments at PoS (in 29 papers) and public transport ticketing (in 15 papers).

Wireless and communication technologies used for mobile payments were specified in 60% of the papers (see Appendix A). The most referenced technologies are: (i) near-field communication (NFC), (ii) SMS, and (iii) WAP and mobile internet. Other technologies have received less attention.

3.3 Research themes

The categorisation of the selected papers showed that the dominant research themes (see Fig. 2) are:

- Customer adoption (53 papers);
- Technological aspects (48 papers);
- Business aspects (32 papers).

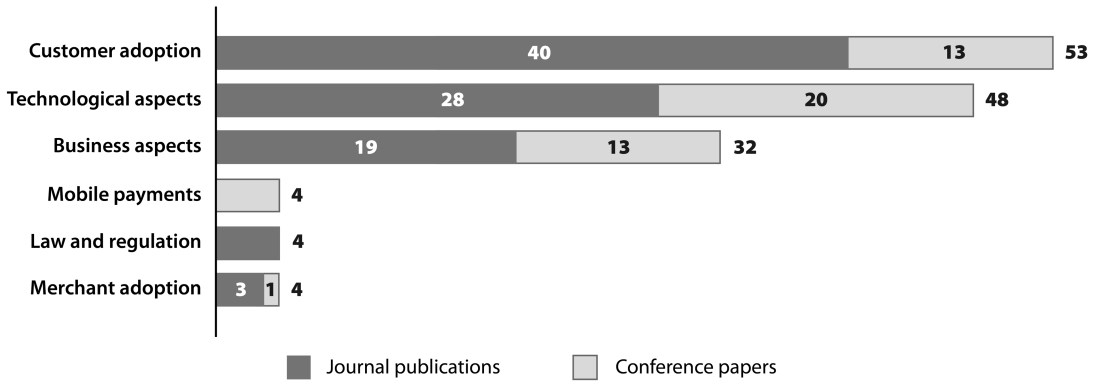

Fig. 2. Distribution of mobile payments articles by research themes.

Just a few articles (12 articles) have addressed other themes, which are law and regulation, merchant adoption, and mobile payments. Due to the small analysis sample, it is impossible to identify trends in these categories. For this reason, these papers are presented in the general analysis part but not discussed separately.

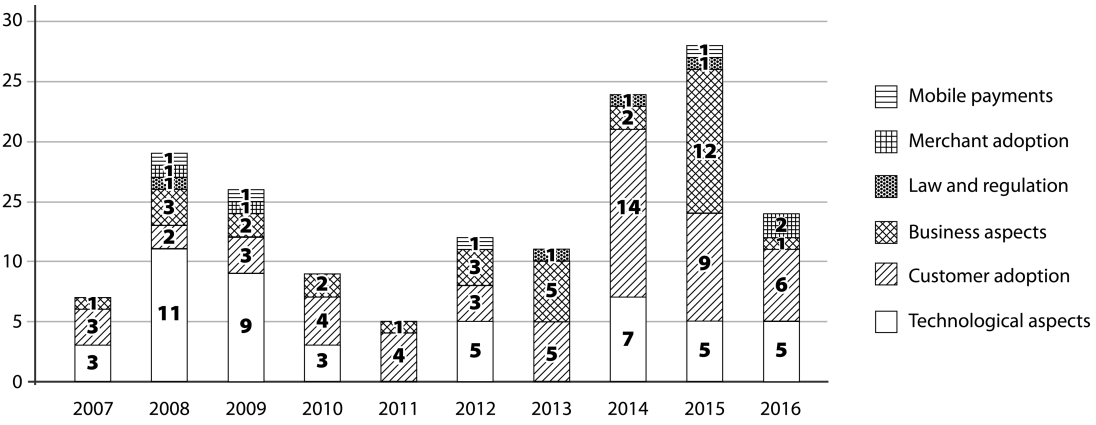

Fig. 3. Distribution of research themes by years.

One interesting finding is that the number of articles addressing technological aspects of mobile payments peaked in 2008 and has been decreasing since then (see Fig. 3). The average number of published papers on customer adoption remained at the same level (about three papers per year) throughout 2007–2013 and reached its maximum in 2014 (14 papers). The number of papers addressing business aspects peaked in 2015.

3.4 Discipline base

In this study, papers were categorised into seven disciplines which appeared the most relevant to mobile payments research. The disciplines are economics, organisational relations, strategic management, marketing/services, psychology/sociology, law, and software engineering (see Table 7).

Table 7. Discipline base in mobile payments research.

Discipline	CA*	TA	BA	Law	MA	MP	Total
Economics	0	0	7	1	1	1	10
Organisational relations	0	0	13	0	0	0	13
Strategic management	0	0	18	0	1	0	19
Marketing/services	2	0	5	0	2	1	10
Psychology/sociology	51	0	2	0	0	0	53
Law	0	0	0	3	0	0	3
Software engineering	0	48	0	0	0	2	50
Total							158**

**CA: Customer adoption; TA: Technological aspects; BA: Business aspects; Law: Law and regulation; MA: Merchant adoption; MP: Mobile payments.*

*** Within the 145 papers, some were situated in more than one discipline and were placed in multiple categories.*

The aggregated results show that dominant disciplines are psychology/sociology and software engineering (53 and 50 papers, respectively). Strategic management follows with 19 papers. A few papers have focused on other economic and business-related disciplines (i.e. economics, marketing/services, and organisational relations). However, business aspects was the only group of papers containing eight articles which were classified as situated in several disciplines.

Additionally, it is possible to notice some correlation between the research theme and the discipline. For example, almost all papers on customer adoption are based in psychology/sociology. In the same way, all papers on technological aspects are focused on software engineering. Papers on business aspects are based in various economic and business disciplines.

3.5 Research strategy and type of research

We have classified papers according to the theory-building research strategy using classification proposed by Wacker (1998). The proposed research strategy categories were identified in 98 papers; 47 papers dedicated to technological aspects of mobile payments are focused on the development of technical solutions and do not fall under the applied categorisation.

As presented in Table 8, the majority of the research on mobile payments (75.5%) is analytical, based on the deductive approach, the majority being statistical. About 25% of papers are empirical studies based on the inductive approach, dominated by case studies. The analytical statistical strategy has been applied in the majority of the research (in about 47% of papers) (see Fig. 4). Analytical conceptual and empirical case study research strategies were applied in 26.5% and 22.4% of papers respectively. Analytical mathematical and empirical statistical studies are not common and empirical experimental studies have never been used in mobile payments research.

Table 8. Research strategy in mobile payments research.

Strategy	Total	CA*	TA	BA	Law	MA	MP
Analytical (total)	*74 (75.5%)*						
Conceptual	26 (26.5%)	2	2	15	3	2	2
Mathematical	2 (2.0%)	0	0	1	0	1	0
Statistical	46 (46.9%)	46	0	0	0	0	0
Empirical (total)	*24 (24.5%)*						
Experimental	0 (0%)	0	0	0	0	0	0
Statistical	2 (2.0%)	2	0	0	0	0	0
Case study	22 (22.4%)	3	0	16	1	1	1
Total	98 (100%)	53	2	32	4	4	3
Of which:							
Comparative	36 (36.7%)	4	20	10	0	0	2
Predictive	1 (1.0%)	1	0	0	0	0	0

** CA: Customer adoption; TA: Technological aspects; BA: Business aspects; Law: Law and regulation; MA: Merchant adoption; MP: Mobile payments.*

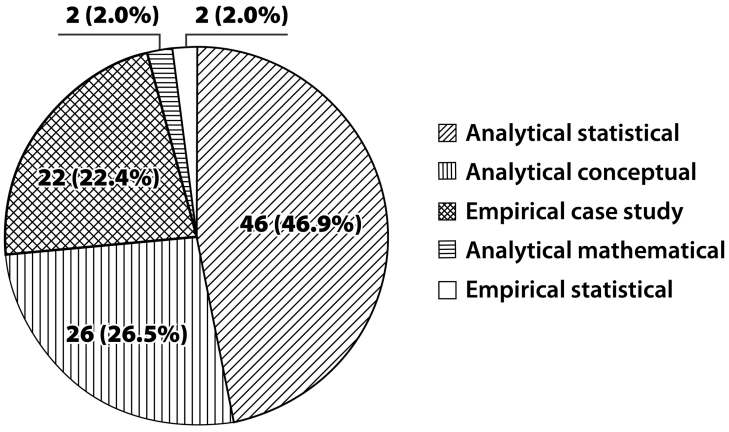

Fig. 4. Research strategies in mobile payments research.

An analytical statistical strategy is dominant in the customer adoption studies. The research strategies applied in studies on business aspects of mobile payments represent an almost equal split between analytical conceptual and empirical case studies.

Comparative studies are mainly used in studies on technological (20 papers out of total 50) and business (10 papers out of total 32) aspects of mobile payments. Only one study appeared to be predictive.

3.6 Methodology, research methods, and theoretical background

Regarding the methodology used, quantitative research is mainly applied to study consumer adoption. Qualitative research is the most common approach in studies on business aspects. A small number of qualitative or quantitative research in papers on mobile payments technology can be explained by a focus on solution development. A summary of research methodologies used is presented in Table 9.

Table 9. Research methodology used in mobile payments research.

Methodology (No. of papers)	**CA*** (53)	**TA** (48)	**BA** (32)	**Law** (4)	**MA** (4)	**MP** (4)	**Total** (145/100%)
Qualitative	5	0	23	2	2	1	33 (22.8%)
Quantitative	44	0	1	0	1	0	46 (31.7%)
Mixed	4	2	1	0	1	0	8 (5.5%)
Total	53	2	25	2	4	1	87 (60.0%)

** CA: Customer adoption; TA: Technological aspects; BA: Business aspects; Law: Law and regulation; MA: Merchant adoption; MP: Mobile payments.*

Furthermore, the analysed articles were categorised by research methods used (see Table 10; see details in Appendix B, Table B.1–B.6). The top five most used research methods are: (i) survey (used in 34.5% of papers); (ii) development of systems and algorithms (used in 29.7% of papers); (iii) conceptual work (used in 25.5% of papers); (iv) interviews (used in 22.8% of papers); and (v) case study (used in 19.3% of papers). In the majority of studies, researchers tend to apply a combination of different methods.

Table 10. Research methods used in mobile payments research.

Methods (No. of papers)	**CA*** (53)	**TA** (48)	**BA** (32)	**Law** (4)	**MA** (4)	**MP** (4)	**Total** (145/100%)
Survey	47	1	2	0	0	0	50 (34.5%)
Development of systems and algorithms	0	43	0	0	0	0	43 (29.7%)
Conceptual work	1	5	25	3	3	2	37 (25.5%)
Interviews	7	2	19	1	3	1	33 (22.8%)
Case study	3	0	21	2	1	1	28 (19.3%)
Desktop analysis	1	1	19	1	3	1	25 (17.2%)
Prototype	0	18	0	0	0	1	19 (13.1%)
Experiment/ simulation	5	10	1	0	0	0	16 (11.0%)
Usability test	0	6	0	0	0	1	7 (4.8%)
Focus groups	3	0	3	0	0	0	6 (4.1%)
Empirical test	3	0	0	0	0	0	3 (2.1%)
Mathematical modelling	0	0	1	0	1	0	2 (1.4%)
Proof of concept	0	0	1	0	0	0	1 (0.7%)

** CA: Customer adoption; TA: Technological aspects; BA: Business aspects; Law: Law and regulation; MA: Merchant adoption; MP: Mobile payments.*

Additionally, there is a clear preference of methods for two themes: (i) survey is the most common approach for studies on customer adoption and (ii) development of systems and algorithms, and prototyping are mostly used in papers on technology. Research on mobile payments business issues is rich in conceptual work and theoretical discussions and is mainly based on case studies, wherein data are collected with the help of interviews and secondary data sources (desktop analysis).

In total, theoretical background is present in the majority of papers (about 57%) (see Table 11). Theory is discussed in almost all papers on customer adoption and business aspects. It is not common to discuss theory in papers on technology. More details on the theoretical approaches used in papers on customer adoption and business aspects are discussed below (see Section 4.1 and Section 4.3).

Table 11. Theoretical base in research on mobile payments.

Theoretical base	CA*	TA	BA	Law	MA	MP	Total
Theory used	51	1	27	0	3	1	83 (57.2%)
No theory	2	47	5	4	1	3	62 (42.8%)
Total	53	48	32	4	4	4	145 (100%)

** CA: Customer adoption; TA: Technological aspects; BA: Business aspects; Law: Law and regulation; MA: Merchant adoption; MP: Mobile payments.*

4 Methodological and theoretical perspectives within identified research themes

This section is dedicated to more detailed analysis of the methodological and theoretical perspectives used within each of the identified mobile payments research themes (i.e. customer adoption, technological and business aspects). The distribution of papers on these themes during 2007–2016 is presented in Fig. 5.

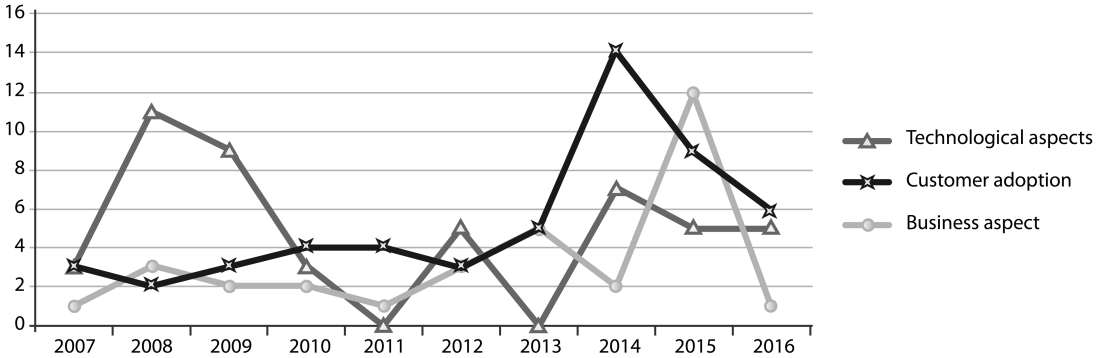

Fig. 5. Distribution of articles on the main themes during 2007–2016.

4.1 Customer adoption aspects of mobile payments

The theme of customer adoption represents one of the major streams in the academic research on mobile payments with a total of 53 publications (40 journal articles and 13 conference proceedings). The research, methodological, and theoretical aspects that are applied within this theme are discussed below.

Research and methodological aspects. The majority of publications are analytical statistical, using quantitative methodology (see Table 12). Survey is a prevailingmethod used for data collection. Different types of survey include questionnaires, which are printed and sent by post, published online, or performed over the telephone. Other types of data collection (i.e. desktop analysis, focus group discussions, and interviews) are less common. In three studies, users had the opportunity to empirically test mobile payments services. Finally, one group of researchers (Liebana-Cabanillas et al., 2014a, 2014b, 2014c; Liebana-Cabanillas et al., 2015; Ramos-de-Luna et al., 2016) has used a social network (Facebook) to perform a number of studies identifying factors influencing the intention to use mobile payments. The respondents were invited to watch a video illustrating the use of a mobile payments service and then to answer questions.

Table 12. Summary of research and methodology aspects (based on Tables 8, 9, and 10).

Dimension	Main trends
Research strategy	Analytical statistical – 86.8% (46 papers out of 53)
Research methodology	Quantitative – 83.0% (44 papers out of 53)
Research method	Survey – 88.7% (47 papers out of 53)

There are four comparative papers: (i) Cheng and Huang (2013) compare how different technologies (mobile internet and QR code) used for public transportation ticket purchases affect the adoption of a mobile ticketing system; (ii) Dahlberg and Öörni (2007) develop and compare two models for the adoption of different services (mobile payments and electronic invoicing); (iii) Slade et al. (2015) compare the results of the application of two adoption models (UTAUT2 and its extension); and (iv) Viehland and Leong (2007) compare the adoption of mobile payments in two countries (New Zealand and the USA). In addition, there is one predictive article: Brakewood et al. (2014) forecast the adoption of mobile payments in the mobile transport ticketing domain.

The dominant research problem that has been the focus for researchers is related to understanding how different factors influence customer intention to use or adopt mobile payments (42 papers out of 53). A few publications have investigated factors that influence (i) actual adoption (three papers); (ii) post-adoption (two papers); (iii) willingness to use smartphones for mobile payments (two papers); and (iv) sources of perceived risks (two papers) (see Appendix C, Table C.1).

Theoretical perspectives. The most common approach of researchers investigating customer adoption issues is building onto existing adoption models. The Technology Adoption Model (TAM) and its variations—theUnified Theory of Acceptance and Use of Technology (UTAUT) and UTAUT2—are the most commonly used approaches (see Table 13; details in Appendix C, Table C.2). The theory of Diffusion of Innovations (DoI) is used relatively less frequently compared to TAM. Adoption theories are also used in combination with other theories—for example, the Theory of Reasoned Action (TRA) and the Theory of Planned Behaviour (TPB).

Only a few articles use other theories to study adoption phenomena. Examples are works by

Cocosila and Trabelsi (2016), de Kerviler et al. (2016), Liu et al. (2013), and Yang et al. (2015) that have brought perceived value and perceived risk into focus under the analysis of customer adoption behaviour.

Table 13. Theoretical base used in research on customer adoption of mobile payments.

Discipline	Theories, models, concepts	Frequency
Psychological/sociological	Adoption theories	
	DoI (and other theories)	3
	TAM (and other theories)	19
	TAM and DoI (and other theories)	9
	UTAUT (and other theories)	3
	TAM and UTAUT (and other theories)	5
	UTAUT2 (and other theories)	3
	Other theories	9
Marketing/services	No theory used	2
	Total	53

The majority of researchers investigating the adoption of mobile payments extend the existing models with new constructs. The analysed constructs can be classified in three categories:

1. *Service characteristics*. The most used are perceived ease of use, usefulness, risk, security, compatibility, and cost.
1. *Consumer characteristics*. The most used are trust in actors and services and knowledge of technology.
2. *External factors*. The most used are social influence and subjective norm.

A large number of constructs have been proposed and analysed by researchers but a considerable number of them have been tested only once or twice. These constructs are omitted in the presented summary of results (see Table 14).

Table 14. Constructs used in adoption studies (details in Appendix C, Table C.3–C.5).

Construct	Frequency
Service characteristics	
Perceived ease of use	31
Perceived usefulness	29
Perceived risk (security, privacy, financial)	20
Perceived security	16
(Perceived) compatibility	16
Cost (perceived)	13
Performance expectancy	8
Convenience	7
Relative advantage	6
Effort expectancy	6

Added value services/additional value	3
Customer characteristics	
Trust in actors or services	25
Effect of demographic data	15
Personal innovativeness in information technology	11
Knowledge or previous experience of technology or service	10
Attitude towards use	9
Mobility/individual mobility	5
Self-efficacy	5
Hedonistic motivation (fun, enjoyment, entertainment)	5
Behavioural intention (to use/adopt)	3
External factors	
Social influence	15
Subjective norm	8
Facilitating conditions	6
External influence	3
Use situation/context	3

4.2 Technological aspects of mobile payments

Technological aspects of mobile payments comprise the second most researched theme in the academic research. We identified 48 publications (28 journal articles and 20 conference proceedings).

Research and methodological aspects. The majority of publications propose new technical systems, architectures, and protocols. These papers do not apply theory-building research strategies, qualitative or quantitative methodologies. However, within this theme there are 20 comparative papers. Thus, it is a common approach to perform a comparative analysis of newly proposed and existing solutions.

Table 15. Summary of research and methodology aspects (based on Tables 8, 9, and 10).

Dimension	**Main trends**
Research strategy	–
Research methodology	–
Research method	Development of systems and algorithms – 89.6% (43 papers out of 48) Prototype – 37.5% (18 papers out of 48) Simulation – 20.8% (10 papers out of 48)

Development of systems and algorithms is the main used method (see Table 15). In 18 studies, researchers have developed a prototype; six prototypes were evaluated through usability tests. Simulation of developed solutions is also commonly applied.

The major problem that has been examined in the papers is related to the security of mobile payments (see Fig. 6; details in Appendix D). Different aspects of security issues were discussed

in 40 articles out of 48. Proposals of new mobile payments systems and architectures (25 articles) represent the second most popular research topic; development of new protocols is addressed by 17 studies.

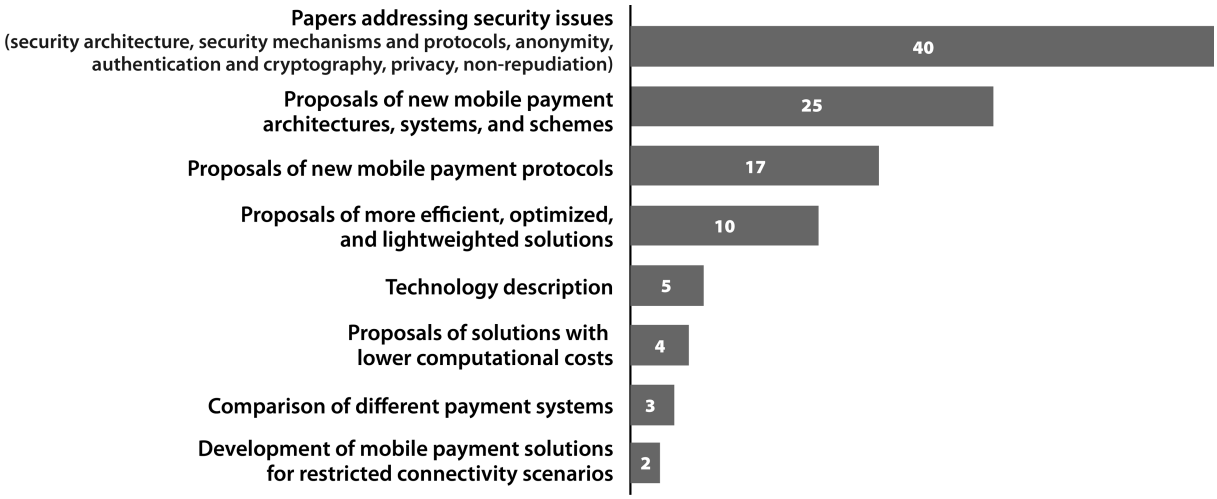

Fig. 6. Classification of papers on technology by topics.

Theoretical perspectives. Commonly, there is no theoretical background in the papers on technology. However, some papers include a review of related work that is primarily based on a review of the state of art in mobile payments in order to set the scene. This includes overviews of previously developed protocols, architectures, solutions and implemented research initiatives, comparisons of different technologies, and overviews of security levels.

4.3 Business aspects of mobile payments

The business aspects theme comprises 32 publications (19 journal articles and 13 conference proceedings). This is therefore the third most popular topic in the contemporary academic research on mobile payments.

Research and methodological aspects. The most common research strategies within papers on business aspects are empirical case studies and analytical conceptual (see Table 16). The majority of papers are based upon qualitative methodology. The studies within this theme are especially rich in conceptual theoretical works. Case studies have been the most common approach for both deductive and inductive theory-building. Moreover, ten papers are multiple case studies providing comparative analysis across the cases. Desktop analyses and interviews are the main methods used for data collection.

The main problem that has been in the focus of researchers is related to analysis of the business ecosystem of mobile payments, the main actors and their roles (23 papers out of 32). The second most addressed problem is related to different aspects of the business model (11 papers out of 32). Ten papers provide an analysis of mobile payments markets. The same number of papers explore collaboration issues in inter-firm relationships. The summary of addressed themes is presented in Fig. 7 (more details in Appendix E, Table E.1).

Table 16. Summary of research and methodology aspects (based on Tables 8, 9, and 10).

Dimension	Main trends
Research strategy	Empirical case study– 50.0% (16 papers out of 32) Analytical conceptual – 46.9% (15 papers out of 32)
Research methodology	Qualitative – 71.9% (23 papers out of 32)
Research method	Conceptual work – 78.1% (25 papers out of 32) Case study – 65.6% (21 papers out of 32) Desktop analysis – 59.4% (19 papers out of 32) Interviews – 59.4% (19 papers out of 32)

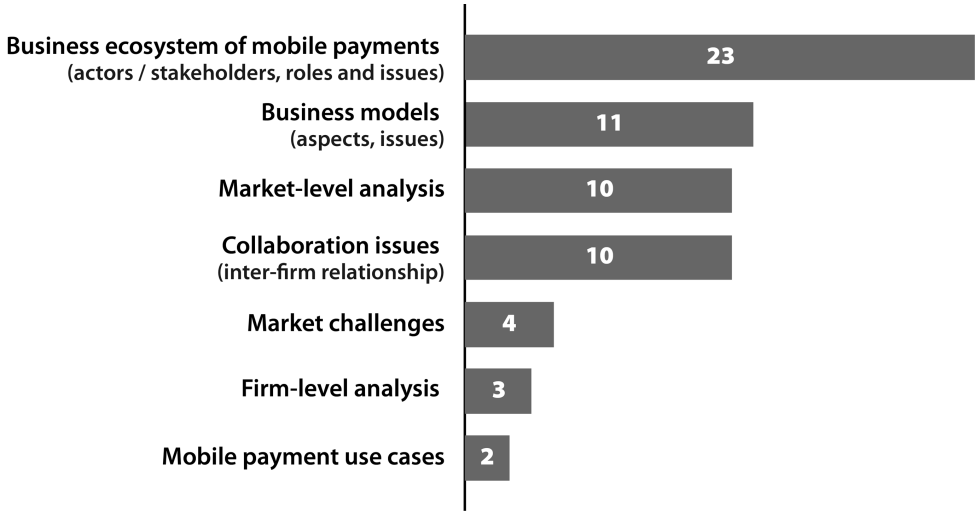

Fig. 7. Classification of papers on business aspects by topics.

Theoretical perspectives. The most frequently applied category of economic and business-related theories is rooted in strategic management (21 papers). It is closely followed by theories addressing inter-organisational relations (18 papers). A smaller number of papers (10) apply economic theories (see Table 17; more details in Appendix E, Table E.2).

Table 17. Theoretical base used in research on business aspects of mobile payments.

Discipline	Theories, models, concepts	Frequency
Economics	Network economies	3
	Industry evolution, dominant design	3
	Switching costs	2
	Other theories	2
Organisational relations	Business ecosystems	5
	Network perspective	2
	Co-opetition	2
	Other theories	5
	No theory	4
Strategic management	Business model	6
	Platforms, two-sided market	8

	Resource-based view	3
	Other strategy theories	4
Marketing/services	Different theories	3
	No theory	2
Psychology/sociology	Adoption theory	2
	Total	56*

* Some papers were situated in more than one discipline and used more than one theoretical perspective; they were therefore placed in multiple categories.

The authors of the majority of publications in this category (22 papers out of 32) have proposed new frameworks for analysis (see Table 18). Only a few of these models have been further applied in the studies of other researchers.

Table 18. Theoretical frameworks proposed by researchers studying mobile payments.

Proposed theoretical framework	**Applied in works of others**
Mobile payment models (Van Bossuyt and Van Hove, 2007)	
A robust framework for the analysis of economic issues for disruptive technologies (Au and Kauffman, 2008)	Ondrus et al., 2009
Dominant design emergence process (Dahlberg, Huurros, et al., 2008)	Ondrus et al., 2009
The mobile payment modelling approach (MPMA) (Pousttchi, 2008)	
M-payment business model framework (Pousttchi et al., 2009)	
Dynamic model of the diffusion stages of a mobile payment solution (Ondrus et al., 2009)	Ondrus and Lyytinen, 2011
Framework for the study of collaboration and competition in the digital payment ecosystem (Hedman and Henningsson, 2012)	
Mobile payments integration framework (Carton et al., 2012)	
Framework for the analysis of large-scale infrastructure management processes (Andersson et al., 2013)	
Co-opetition (Andersson et al., 2013)	
Digital payment framework (Kazan and Damsgaard, 2013)	
NFC ecosystem model (Ok et al., 2013)	
Discontinuance of collective action (de Reuver et al., 2015)	
Market (non)emergence at the convergence of distinct industries (Ozcan and Santos, 2015)	
Service business model canvas (Zolnowski et al., 2014)	
The mobile payment market cooperation (MPMC) framework (Hedman and Henningsson, 2015)	
A decision model for platform openness (Ondrus et al., 2015)	Gannamaneni et al., 2015; Ondrus, 2015
Partnership management canvas (Dennehy et al., 2015)	
Investment decision model (Kauffman et al., 2015)	

Proposed theoretical framework	Applied in works of others
Entry and expansion strategy framework (Staykova and Damsgaard, 2015)	
RISE model explaining how initiators create payment platform ecosystem (Zhong and Nieminen, 2015)	
StReS model to analyse the business ecosystem on three levels: structure, resources, and strategy (Guo and Bouwman, 2016)	

4.4 Trends in the evolution of the theoretical base

In the previous sections, we have provided an overview of the theoretical background used for customer adoption and business-related studies. It is possible to notice that the traditions of the corresponding discipline make an impact on the selection of theories within these two major themes. We discuss this in more detail below.

Customer adoption studies, being examples of psychological and sociological disciplines, are based upon adoption theories' concepts. During the period 1998–2006, the theoretical base comprised TAM, its extension (UTAUT), and DoI (Dahlberg, Mallat, et al., 2008). During 2007–2016, the range of the most commonly used theories was widened with UTAUT2 (see Fig. 8). Additionally, researchers were extending existing adoption models with constructs of other theories—for instance, TRA and TPB. Studies have confirmed that perceived ease of use, usefulness, trust, and security and privacy risks are the major factors affecting the intention to adoption (this is in line with Dahlberg, Mallat, et al., 2008; Dahlberg et al., 2015). However, the common approach is to use the existing theories but not to develop a specific theory specifically addressing mobile payments adoption.

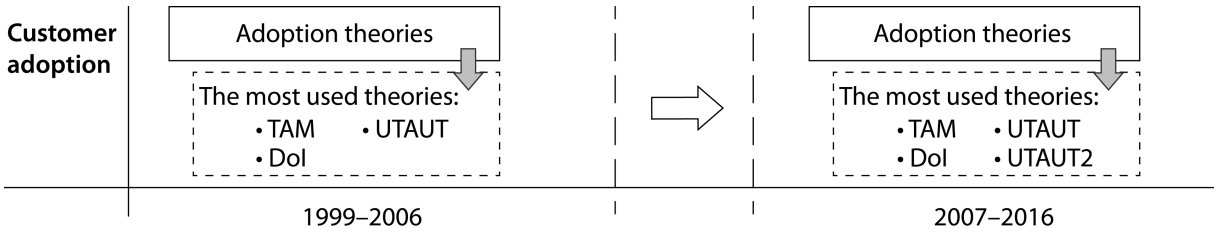

Fig. 8. Dynamic of theoretical base evolution within customer adoption theme.

The more interesting findings are related to use of a theoretical background in studies on business-related aspects of mobile payments (see Fig. 9). The first papers that were classified as dedicated to this theme within the period 1999–2007 used no theoretical background. These papers represented inductive research with proposed analysis frameworks based on empirical data. Just a few such papers appeared during 2008–2011. However, during this period, the common approach towards use of a theoretical background started to change: that is, researchers started using a set of theories for the development of specific analysis frameworks applicable in the domain of mobile payments. During this period, the business model was the most used concept.

Starting from 2012, researchers continued using a mix of theories for their developed frameworks. However, the focus of their interests shifted to the use of platform, ecosystem, and business network theories. One of the explanations for such a shift might be the limited ability of the

business model concept to explain complex business relationships between companies providing mobile payments services and complex strategic issues that business actors need to solve.

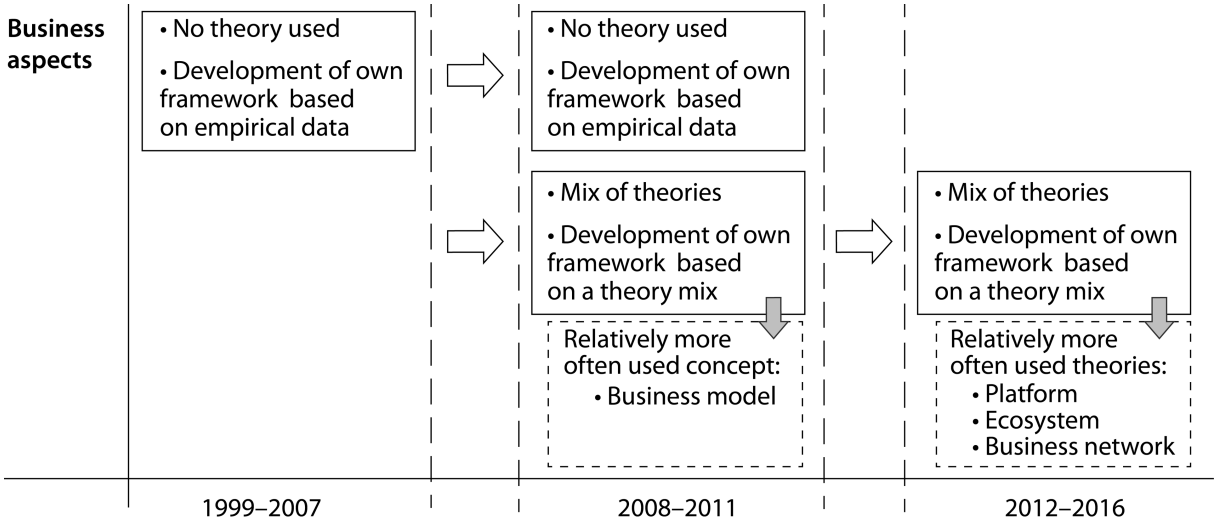

Fig. 9. Dynamic of theoretical base evolution within business aspects theme.

Summing up, the dynamics of theoretical base evolution in studies on business aspects demonstrate certain theoretical issues faced by researchers. It looks challenging to find a suitable theoretical background that could address the complex analysis of business aspects of mobile payments. One of the recent trends to solve this issue is to use a multi-level approach based upon a set of theories that allows analysis of complex business relations. Another notable trend is that, since the beginning, the researchers exploring business aspects have been focused on the creation of frameworks that could be applied specifically for the purpose of analysis of mobile payments. However, the majority of the developed frameworks were used only once. Nevertheless, it is possible to expect that the same two trends will continue for the future. These trends were also discussed by Dahlberg et al. (2015).

4.5 Summary of findings

The discussion of the most common research and methodological approaches in research on mobile payments is summarised in Table 19.

Table 19. Generalisation of the main trends in research strategy and methodology.

Dimension	Customer adoption	Technological aspects	Business aspects
Research strategy	Analytical statistical	–	Analytical conceptual Empirical case studies
Research methodology	Quantitative	–	Qualitative
Research method	Survey	Development of systems and algorithms	Conceptual work Case study Desktop analysis Interviews

The generalisation shows that within each research theme there is a specific well-established approach that prevails in terms of selection of a research strategy, type of methodology, and

methods. This might be related to the multidisciplinary nature of research in the mobile payments area, where researchers tend to use the dominant research strategy and methodology within each specific research tradition. However, despite clearly dominant research methods within each theme, researchers use a mix of different research methods to explore the research questions in a more comprehensive way; this may explain the lack of progress that Dahlberg et al. (2015) point out.

When studying Table 19 on methodological and theoretical approaches to research in this field, we get a clear picture of how differentiated the research actually is. This confirms the conclusions in the literature review by Dahlberg et al. (2015) and provides a deeper explanation of why is has been difficult to integrate and synthesise research results in this field. Our next task is therefore to provide a proposal for an integrative framework that may help move research efforts forward.

5 Discussion

This paper presents an extensive systematic review of academic literature on mobile payments published during 2006–2016. In this section, we discuss the research findings and add a proposal for a research framework that can serve as an umbrella to integrate and synthesise research in this field.

5.1 Issue of definition and scope of mobile payments

Apparent confusion regarding the definition of mobile payments is shown in Table 5. In some works, it is unclear what exactly authors consider when they refer to mobile payments, especially when the definition is lacking. This is the case in 46% of papers. At the same time, a large number of researchers try to develop their own definition or to change existing definitions; only a minority (about a quarter) uses existing definitions. This suggests that the field of mobile payments is characterised by high degrees of change and a large number of very diverse actors. This means that definitions are likely to change depending on technological development and/or the prime focus on different actors such as banks, payment service providers, Fintech, telecom operators, and so on. This has also been highlighted by some researchers (Dahlberg, 2015; Dahlberg et al., 2015; Oliveira et al., 2016). It can also be expected that this lack of a shared definition will continue as research extends the scope and explores other use cases than PoS payments and transport ticketing.

It needs to be mentioned that Dahlberg, Mallat, et al. (2008, p. 166) contributed a lot to clarifying what mobile payment is by additionally stating that a mobile payment can be performed with "a mobile payment instrument such as a mobile credit card or a mobile wallet." This distinguished mobile payments from "any specific type of electronic or mobile money, the use of mobile devices to access electronic payment services, and electronic banking (unless there was a separate mobile payment 'instrument', or an account reserved for mobile payments)" (Dahlberg et al., 2015, p. 265). We adhere to that definition.

5.2 Research themes

In the current research, classification of papers by the major research themes has shown that studies on customer adoption and technology remain dominant in academic research (see Table 20). Another notable trend is a considerable increase in the number of studies on business

aspects compared to the period 1998–2006. The same trends were noted by Dahlberg et al. (2015). However, it is possible to claim that, despite the fact that researchers have broadened their scope, the research focus remains rather narrow and fragmented. A number of other themes remain unaddressed. This is in line with the conclusions of Dahlberg et al. (2015).

Table 20. Comparison of trends in number of papers within the main research themes.

Theme	Dahlberg, Mallat, et al. (2008a) 1998–2006	Dahlberg et al. (2015) 2007–2014	The current research 2007–2016
Customer adoption	20	34	53
Technological aspects	29	25	48
Business aspects	5	20	32

5.3 Research focus

Generalisation of the research focus and research questions (see Fig. 10) shows that:

- Customer adoption studies are focused on investigating service and customer characteristics and external factors that affect the process of mobile payments adoption.
- Studies on technological aspects are focused on the development of new service algorithms, protocols and systems, and their characteristics (security, privacy, interoperability, etc.).
- Studies on business aspects include analysis of business models, ecosystems, and external environmental factors.

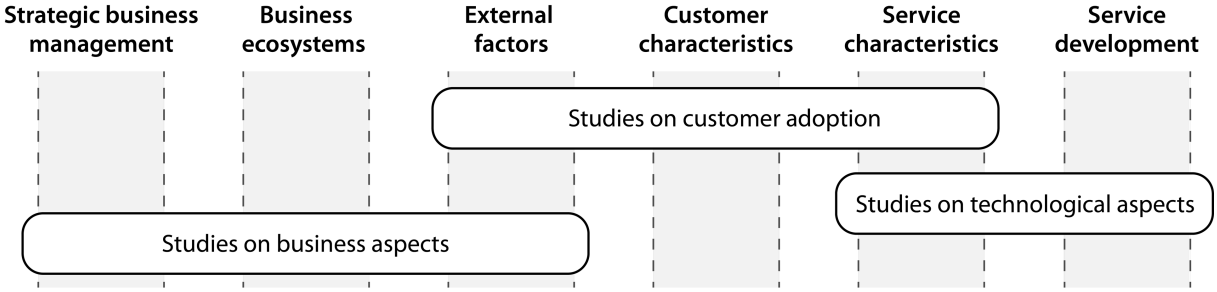

Fig. 10. Research focus and the main themes of mobile payments research.

The generalised scheme of research focus (Fig. 10) illustrates the fragmentation of research and its rather narrow focus. This finding is in line with the findings of Dahlberg et al. (2015).

5.4 A proposal for an integrative research framework

It is clearly shown in our review that theoretical and methodological approaches to research on mobile payments are highly diverse and difficult to integrate, which is in line with the conclusions by Dahlberg et al. (2015). Our conclusion from these findings is that we need a research framework than can integrate these diverse research approaches. There is a need to integrate research that differs in terms of theoretical approaches, selection of methodologies, definitions of units of analysis, and themes or focuses. Our proposal is to connect our field of research to more general theoretical frameworks on industrial transformation in socio-technical systems.

We pose the question of whether the socio-technical system approach may be used to develop our understanding of research on payments. We will now develop these ideas further in connection to the literature review done in this paper.

Theories on socio-technical systems were introduced to enable analysis of how a combination of social and technological factors explains innovation in and transformation of industries (Emery and Trist, 1965). However, over time, these theories have evolved to analyse large technical systems such as energy systems (Hughes, 1983, 1987) and, more recently, multi-level perspectives on transformation (Geels, 2004; Rip and Kemp, 1998). The multi-level perspective theory adds three aspects that make it particularly suitable for studies of mobile payment services and transformations of the payments industry. Firstly, it acknowledges parallel development patterns in different parts of the system, such as the landscape, the technological regime, and niches (Geels, 2004). These different levels make it possible to include landscape factors such as policies and regulations, technological regime factors such as card payment services and systems, and niche-related change factors such as mobile technologies and Fintech entrepreneurs all in the same model, even if a particular research project may and perhaps should delimit itself. Secondly, it puts a particular focus on the interplay between factors that conserve the status quo and those that stimulate radical transformation. Thirdly, it acknowledges both supply-driven aspects related to providers and demand-driven aspects related to users.

Geels' multi-level perspective model (2004, p. 915) highlights three different but mutually interdependent layers where change can be driven or be inhibited depending on each layer's characteristics. The outer layer is called *the landscape* and incorporates rules and institutions—such as regulative, normative, and cognitive (Scott, 1995)—that aim to coordinate and govern action in the system (Geels, 2004, p. 905). The middle layer is called *the socio-technical regime*. This is the most important part since this is where technologies, science, users and markets, socio-cultural aspects, and policies meet. These five dimensions serve to coordinate actions and interactions in the system (Geels, 2004, p. 906). These two layers then incorporate critical dimensions in a system such as the payment system. The third, inner part of the model is called *technological niches* and enables the analysis to incorporate factors related to radical innovation and transformation of the entire foundation of a system (Geels, 2004, p. 912).

Our choice of deploying the multi-level perspective (Geels, 2004) is motivated by the basic characteristics of the payment industry. Payment services have characteristics such as strong regulation and supervision by the state in the form of a policy regime; particular technological regimes related to different types of payment service; a clearly defined and important user and market regime in terms of both payees and payers; a strong and important socio-cultural regime related to the view of money and innovation; and a science regime related to research and development connected to digitalisation, Fintech, and payments.

Using Geels' model (2004, p. 915), we can now link it to identified research themes. We illustrate use of the model by using the main findings related to methodological approaches and theories (see Tables 18 and 19). This is presented in Table 21.

We can draw several conclusions from Table 21. Firstly, there is a lack of studies that incorporate all layers in a socio-technical system approach. Despite the fact that we used only a limited set of business papers from Table 18 to illustrate the model, the remaining papers can be associated with only one of the layers.

Secondly, there is a clear dominance of research in the middle layer − the socio-technical regime − to the detriment of the other two layers (i.e. the landscape and technological niches). Indeed, all papers on customer adoption and the majority of papers on technological aspects, with few

exceptions (Ghiron et al., 2009; Pasquet et al., 2008; Rodrigues et al., 2014), are related to the middle level. The three mentioned papers are focused on experimental projects in niche markets.

Thirdly, there is a lack of research on two regimes of the middle layer. These are policy and socio-cultural aspects.

Summing up, the socio-technical system approach offers an integrative research framework that helps to synthesise the current state of the art in the research on mobile payments. It illustrates the fragmentation of research and points to the areas that require future research: there is a lack of research at the level of the landscape and technological niches, and a lack of papers on some socio-technical regimes. Studies in these directions would widen the research scope and the number of research themes and would help to overcome the problem of the existing research fragmentation. Additionally, we suggest that future research projects should consider different layers of the socio-technical system. This approach would provide a more holistic research picture and would contribute to a better integration of research findings in the area of mobile payments.

Table 21. A multi-level perspective on the research on mobile payments.

Layer	**Dimension**	**Research themes/Research articles**
Landscape	Rules and institutions	–
Socio-technical regime	Technology	- *Technological aspects* Focus on service development, technical standards
	User and market	- *Customer adoption* - *Business aspects*, e.g.: Co-opetition (Andersson et al., 2013); Digital payment framework (Kazan and Damsgaard, 2013); NFC ecosystem model (Ok et al., 2013); Discontinuance of collective action (de Reuver et al., 2015); Market (non)emergence at the convergence of distinct industries (Ozcan and Santos, 2015); Service business model canvas (Zolnowski et al., 2014); The mobile payment market cooperation (MPMC) framework (Hedman and Henningsson, 2015); A decision model for platform openness (Ondrus et al., 2015); Partnership management canvas (Dennehy et al., 2015); Investment decision model (Kauffman et al., 2015); Entry and expansion strategy framework (Staykova and Damsgaard, 2015); RISE model explaining how initiators create payment platform ecosystem (Zhong and Nieminen, 2015); StReS model to analyse the business ecosystem on three levels: structure, resources, and strategy (Guo and Bouwman, 2016)
	Science	*Literature reviews*
	Socio-cultural aspects	–
	Policy	–

Technological niches	Radical innovation in niches	- *Technological aspects* Focus on development of radical innovation, experimental projects in small niche markets - *Business aspects*, e.g.: A robust framework for the analysis of economic issues for disruptive technologies (Au and Kauffman, 2008)

6 Conclusions

This study was focused on the analysis of methodological and theoretical issues in research on mobile payments in the period during 2007–2016. The research dimensions included research strategy, discipline base, type of research, methodology used and methods, and theoretical perspective.

Based on the literature reviewed, it is possible to identify some principal characteristics. Research on mobile payments is a multidisciplinary research that is mainly focused on the three main themes: customer adoption, and technological and business aspects. The research strategy, methodology, and methods are specific within each of the main themes and are closely related to the dominant discipline base. The research focus within the main themes remains narrow. Dahlberg, Mallat, et al. (2008) and Dahlberg et al. (2015) contributed with an elaborated list of unaddressed research questions and directions for future research.

Current research on mobile payments lacks a systematic approach and the slow progress of the field is likely to be explained by a multitude of focused studies that are difficult to relate to each other and to the overall understanding of the industrial system for mobile payments. We therefore used a socio-technical system approach to introduce a perspective that may shed light on the ecosystem, a challenge identified by Dahlberg et al. (2015). By deploying a socio-technical, multi-level perspective (Geels, 2004), we were able to categorise the research identified in our literature review in a new way with the ambition of laying the foundation for future projects aiming to integrate and synthesise research findings in this area.

It is possible to specify major limitations of the contemporary research on mobile payments. As mentioned, one of the major limitations is the research fragmentation: (i) in terms of addressed themes (only three have been dominant during 1999–2016); (ii) in terms of discipline bases; and (iii) in terms of the research focus within each theme that is fragmented and narrow. We therefore propose a socio-technical, multi-level perspective to overcome these shortcomings.

The first contribution of this research is an in-depth investigation of methodological and theoretical aspects of research on mobile payments to show the dynamics and evolution of methodological approaches and theoretical perspectives. This also helps to estimate possible future trends in the mobile payments research area. A second contribution is a proposal for an integrative research framework that can help the field to overcome some of the problems pointed out in other studies.

To sum up, the most common research and methodological approaches are related to customer adoption, technologies and business, and are based on a large variety of methodologies. This has led to too narrowly focused research projects and a lack of integration and synthesis, which in the end has harmed scientific progress in the field. Our proposal to overcome these problems is to establish a foundation that may allow integration and synthesis; we therefore propose a

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socio-technical framework as this potential foundation. This framework may enable the research community to address the system-oriented challenge proposed by Dahlberg et al. (2015).

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Appendix A. Use cases and technologies addressed in research

Table A.1. Mobile payment use cases discussed in selected papers.

Use case (No. of papers)	CA* (53)	TA (48)	BA (30)	Law (4)	MA (4)	MP (4)	Total (145)
Mobile payments (use case not specified)	42	19	28	3	0	3	95
PoS mobile payment	4	17	3	0	4	1	29
Public transport ticketing	6	2	5	0	1	1	15

Parking fee payments	1	0	1	0	0	0	2
Vending machines	1	1	1	0	1	1	5
Mobile content	0	0	1	0	0	1	2
Purchases in online shops	1	2	1	0	0	1	5
Event ticketing	0	0	1	0	0	0	1
P2P	0	1	3	0	0	0	4
Vehicular ad-hoc network, vehicle-to-vehicle and vehicle-to-roadside communication	0	2	0	0	0	0	2

** CA: Customer adoption; TA: Technological aspects; BA: Business aspects; Law: Law and regulation; MA: Merchant adoption; MP: Mobile payments.*

Table A.2. Mobile payment technologies discussed in selected papers.

Technology	CA* (23 out of 54 papers)	TA (34 out of 48 papers)	BA (25 out of 32 papers)	Law (3 out of 4 papers)	MA (1 out of 4 papers)	MP (2 out of 4 papers)	Total** (88 out of 146 papers)
NFC	15	17	16	1	1	0	50
SMS	7	2	9	2	0	1	21
WAP/mobile internet	2	10	3	2	0	1	18
QR code	2	0	0	1	0	0	3
Mobile networks	0	5	0	3	0	0	8
Bluetooth	1	2	0	1	0	0	4
UICC	0	1	0	0	0	0	1
Mobile payment card terminals (Square, iZettle)	0	0	4	0	0	0	4
App based	0	0	4	0	0	1	5
RFID	0	0	0	1	0	0	1

** CA: Customer adoption; TA: Technological aspects; BA: Business aspects; Law: Law and regulation; MA: Merchant adoption; MP: Mobile payments. ** The technology behind the mobile payment services is specified in 60% of papers (or in 88 out of 146 papers).*

Appendix B. Research methodology and methods

Table B.1. Research methods used in studies on mobile payments' customer adoption.

Methods	No. of papers	References
Total No. of papers	*53*	
Conceptual work (Theoretical discussion, speculation, theory-building)	1	Petrova, 2008
Desktop analysis	1	Silic et al., 2014
Interviews	7	Arvidsson, 2014; Chen, 2008; Kim et al., 2010; Moroni et al., 2015; Shin, 2009; Silic et al., 2014; Zhao and Kurnia, 2014
Focus groups	3	Di Pietro et al., 2015; Mallat, 2007; Shin, 2009
Survey	47	Arvidsson, 2014; Augsburg and Hedman, 2014; Brakewood et al., 2014; Chen, 2008; Chen and Huang, 2013; Cocosila and Trabelsi, 2016; Dahlberg and Öörni, 2007; de Kerviler et al., 2016; Di Pietro et al., 2015; Duane et al., 2014; Gerpott and Kornmeier, 2009; Goeke and Pousttchi, 2010; Kim et al., 2010; Koening-Lewis et al., 2015; Leong et al., 2013; Li et al., 2014; Liébana-Cabanillas et al., 2014a; Liébana-Cabanillas et al., 2014b; Liébana-Cabanillas et al., 2014c; Liébana-Cabanillas et al., 2015; Liu et al., 2011; Liu et al., 2013; Lu et al., 2011; Mallat et al., 2009; Molina-Castillo et al., 2016; Morosan and DeFranco, 2016; Moroni et al., 2015; Oliveira et al., 2016; O'Reilly et al., 2014; Pham and Ho, 2015; Ramos-de-Luna et al., 2016; Schierz et al., 2010; Shaw, 2014; Shin, 2009; Slade et al., 2015a; Slade et al., 2015b; Tan et al., 2014; Teo et al., 2015; Theodora et al., 2010; Viehland and Leong, 2007; Xin et al., 2013; Yang et al., 2012; Yang et al., 2015; Zhou, 2011; Zhou, 2013; Zhou, 2014a; Zhou, 2014b
Case study	3	Amoroso and Magnier-Watanabe, 2012; Petrova, 2008; Silic et al., 2014
Development of systems and algorithms	0	
Mathematical modeling	0	
Experiment/ simulation	5	Liébana-Cabanillas et al., 2014a; Liébana-Cabanillas et al., 2014b; Liébana-Cabanillas et al., 2014c; Liébana-Cabanillas et al., 2015; Ramos-de-Luna et al., 2016
Prototype	0	
Usability test	0	
Empirical test	3	Moroni et al., 2015; Zhou, 2011; Zhou, 2014b
Proof of concept	0	

Table B.2. Research methods used in studies on mobile payments technology aspects.

Methods	No. of papers	References
Total No. of papers	*48*	
Conceptual work (Theoretical discussion, speculation, theory-building)	3	Basili et al., 2014; Clarke, 2008; Pasquet and Gerbaix, 2016
Desktop analysis	0	
Interviews	2	Ondrus and Pigneur, 2009; Rodrigues et al., 2014
Focus groups	0	
Survey	1	Rodrigues et al., 2014
Case study	0	
Development of systems and algorithms	43	Ahamad et al., 2014; Almuairfi et al., 2014; Ammayappan, 2015; Bottoni and Deni, 2007; Clarke, 2008; Conti et al., 2009; Fan and Huang, 2010; Fun et al., 2008; Ghiron et al., 2009; Godbole and Pais, 2008; Gold et al., 2015; Grønli et al., 2015; Hassinen et al., 2008; Hwang et al., 2007; Isaac and Zeadally, 2014; Isaac et al., 2012; Jiang et al., 2009; Kadambi et al., 2009; Konidala et al., 2012; Kousaridas et al., 2008; Kumar and Rabara, 2010; Lee et al., 2007; Lei et al., 2009; Li et al., 2012; Lin et al., 2008; Luo et al., 2016; Martínez-Peláez et al., 2015; Massoth and Bingel, 2009; Munch-Ellingsen et al., 2015; Ou and Ou, 2009; Pasquet et al., 2008; Popescu, 2009; Rahimian and Habibi, 2008; Rodrigues et al., 2014; Sung et al., 2015; Veeraraghavan, et al., 2016; Wang et al., 2008; Yang, 2014; Yang and Chang, 2012; Yang and Lin, 2016; Zhang et al., 2008; Zhu and Rice, 2009; Zhu et al., 2012
Mathematical modeling	0	
Experiment/ simulation	10	Ammayappan, 2015; Bottoni and Deni, 2007; Godbole and Pais, 2008; Isaac et al., 2012; Lee et al., 2007; Lei et al., 2009; Ondrus and Pigneur, 2009; Yang, 2014; Zhu and Rice, 2009; Zhu et al., 2012
Prototype	18	Ahamad et al., 2014; Bottoni and Deni, 2007; Conti et al., 2009; Ferreira et al., 2009; Ghiron et al., 2009; Hassinen et al., 2008; Isaac and Zeadally, 2014; Isaac et al., 2012; Kadambi et al., 2009; Konidala et al., 2012; Kousaridas et al., 2008; Lee et al., 2007; Massoth and Bingel, 2009; Munch-Ellingsen et al., 2015; Pasquet et al., 2008; Rahimian and Habibi, 2008; Rodrigues et al., 2014; Zhang et al., 2008

Methods	No. of papers	References
Usability test	6	Ferreira et al., 2009; Ghiron et al., 2009; Isaac et al., 2012; Massoth and Bingel, 2009; Rahimian and Habibi, 2008; Rodrigues et al., 2014
Empirical test	0	
Proof of concept	0	

Table B.3. Research methods used in studies on mobile payments' business aspects.

Methods	No. of papers	References
Total No. of papers	*32*	
Conceptual work (Theoretical discussion, speculation, theory-building)	25	Andersson et al., 2013; Au and Kauffman, 2008; Carton et al., 2012; Dahlberg, Huurros, et al., 2008; Dennehy et al., 2015; de Reuver et al., 2015; Gaur and Ondrus, 2012; Guo and Bouwman, 2016b; Hedman and Henningsson, 2012; Hedman and Henningsson, 2015; Kanniainen, 2010; Kauffman et al., 2015; Kazan and Damsgaard, 2013; Liu et al., 2015; Ok et al, 2013; Ondrus, 2015; Ondrus et al., 2015; Ondrus and Lyytinen, 2011; Ozcan and Santos, 2015; Pousttchi, 2008; Pousttchi et al., 2009; Staykova and Damsgaard, 2015; Van Bossuyt and Van Hove, 2007; Zhong and Nieminen, 2015; Zolnowski et al., 2014
Desktop analysis	19	Andersson et al., 2013; Gannamaneni et al., 2015; Ghezzi et al., 2010; Guo and Bouwman, 2016b; Hedman and Henningsson, 2012; Hedman and Henningsson, 2015; Juntunen et al., 2012; Kanniainen, 2010; Kazan and Damsgaard, 2013; Liu et al., 2015; Magnire-Watanabe, 2014; Ondrus, 2015; Ondrus et al., 2015; Ondrus and Lyytinen, 2011; Ondrus et al., 2009; Ozcan and Santos, 2015; Staykova and Damsgaard, 2015; Zhong and Nieminen, 2015
Interviews	19	Andersson et al., 2013; Apanasevic, 2013; Dahlberg, Huurros, et al., 2008; de Reuver et al., 2015; Gannamaneni et al., 2015; Ghezzi et al., 2010; Guo and Bouwman, 2016b; Hedman and Henningsson, 2012; Hedman and Henningsson, 2015; Juntunen et al., 2012; Kazan and Damsgaard, 2013; Liu et al., 2015; Magnire-Watanabe, 2014; Markendahl, 2013; Ondrus and Lyytinen, 2011; Ondrus et al., 2009; Ozcan and Santos, 2015; Staykova and Damsgaard, 2015; Zhong and Nieminen, 2015
Focus groups	3	Andersson et al., 2013; Dennehy et al., 2015; Carton et al., 2012

Methods	No. of papers	References
Survey	2	Carton et al., 2012; Pousttchi, 2008
Case study	21	Andersson et al., 2013; Apanasevic, 2013; Carton et al., 2012; Dahlberg, Huurros, et al., 2008; de Reuver et al., 2015; Gannamaneni et al., 2015; Ghezzi et al., 2010; Guo and Bouwman, 2016b; Hedman and Henningsson, 2012; Hedman and Henningsson, 2015; Juntunen et al., 2012; Kazan and Damsgaard, 2013; Magnire-Watanabe, 2014; Markendahl, 2013; Ondrus et al., 2015; Ondrus and Lyytinen, 2011; Ondrus et al., 2009; Ozcan and Santos, 2015; Staykova and Damsgaard, 2015; Zolnowski et al., 2014; Zhong and Nieminen, 2015
Development of systems and algorithms	0	
Mathematical modeling	1	Kauffman et al., 2015
Experiment/ simulation	1	Kauffman et al., 2015 (simulation)
Prototype	0	
Usability test	0	
Empirical test	0	
Proof of concept	1	Dennehy et al., 2015

Table B.4. Research methods used in studies on mobile payments' law and regulation aspects.

Methods	No. of papers	References
Total No. of papers	*4*	
Conceptual work (Theoretical discussion, speculation, theory-building)	3	Kemp, 2013; Vandezande, 2014; Liu, 2015
Desktop analysis	1	Lim, 2008
Interviews	1	Lim, 2008
Focus groups	0	
Survey	0	
Case study	2	Lim, 2008; Liu, 2015
Development of systems and algorithms	0	
Mathematical modeling	0	
Experiment/ simulation	0	
Prototype	0	
Usability test	0	
Empirical test	0	

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Methods	No. of papers	References
Proof of concept	0	

Table B.5. Research methods used in studies on mobile payments' merchant adoption.

Methods	No. of papers	References
Total No. of papers	*4*	
Conceptual work (Theoretical discussion, speculation, theory-building)	3	Apanasevic et al., 2016; Guo and Bouwman, 2016a; Mallat and Tuunainen, 2008
Desktop analysis	3	Apanasevic et al., 2016; Guo and Bouwman, 2016a; Mallat and Tuunainen, 2008
Interviews	3	Apanasevic et al., 2016; Guo and Bouwman, 2016a; Mallat and Tuunainen, 2008
Focus groups	0	
Survey	0	
Case study	1	Apanasevic et al., 2016
Development of systems and algorithms	0	
Mathematical modeling	1	Wiechert et al., 2009
Experiment/ simulation	0	
Prototype	0	
Usability test	0	
Empirical test	0	
Proof of concept	0	

Table B.6. Research methods used in studies on mobile payment services.

Methods	No. of papers	References
Total No. of papers	*4*	
Conceptual work (Theoretical discussion, speculation, theory-building)	2	Dahlberg, 2015; Hu et al., 2008
Desktop analysis	1	Zhong, 2009
Interviews	1	Olsen et al., 2012
Focus groups	0	
Survey	0	
Case study	1	Zhong, 2009
Development of systems and algorithms	0	
Mathematical modeling	0	

Methods	No. of papers	References
Experiment/ simulation	0	
Prototype	1	Olsen et al., 2012
Usability test	1	Olsen et al., 2012
Empirical test	0	
Proof of concept	0	

Appendix C. Papers on mobile payment adoption

Table C.1. Classification of papers on customer adoption of mobile payments by topics.

Addressed question	Frequency	References
Understanding and explaining how different factors influence the intention to use or to adopt mobile payments	42	Arvidsson, 2014; Augsburg and Hedman, 2014; Chen, 2008; Chen and Huang, 2013; Cocosila and Trabelsi, 2016; Dahlberg and Öörni, 2007; de Kerviler et al., 2016; Di Pietro et al., 2015; Gerpott and Kornmeier, 2009; Goeke and Pousttchi, 2010; Kim et al., 2010; Leong et al., 2013; Li et al., 2014; Liébana-Cabanillas et al., 2015; Liébana-Cabanillas et al., 2014a; Liébana-Cabanillas et al., 2014b; Liébana-Cabanillas et al., 2014c; Liu et al., 2011; Liu et al., 2013; Lu et al., 2011; Mallat et al., 2009; Morosan and DeFranco, 2016; Moroni et al., 2015; Oliveira et al., 2016; Pham and Ho, 2015; Ramos-de-Luna et al., 2016; Schierz et al., 2010; Shaw, 2014; Shin, 2009; Silic et al., 2014; Slade et al., 2015a; Slade et al., 2015b; Tan et al., 2014; Teo et al., 2015; Theodora et al., 2010; Viehland and Leong, 2007; Xin et al., 2013; Yang et al., 2012; Zhang et al., 2011; Zhao and Kurnia, 2014; Zhou, 2011; Zhou, 2014b
Investigation if model constructs influence actual use of mobile payments	3	Amoroso and Magnier-Watanabe, 2012; Koening-Lewis et al., 2015; Mallat, 2007
Post-adoption – continuance use and retention of consumers	2	Zhou, 2013; Zhou, 2014a
Willingness to use smart phones for mobile payments	2	Duane et al., 2014; O'Reilly et al., 2012
Examination of the sources of perceived risks	2	Yang et al., 2015; Cocosila and Trabelsi, 2016
Evaluation/forecasting of demand for mobile payment	1	Brakewood et al., 2014

Addressed question	Frequency	References
Analysis of customer requirements	1	Petrova, 2008
Explanation of people's behaviour towards the mobile payments	1	Molina-Castillo et al., 2016
Examination of the sources of perceived value	1	Cocosila and Trabelsi, 2016

Table C.2. Theoretical perspectives used in research on customer adoption of mobile payments.

Discipline	Theories, models, constructs	References	Frequency
Psycholo-gical/sociological	TAM (and other theories)	Chen and Huang, 2013; Duane et al., 2014; Gerpott and Kornmeier, 2009; Goeke and Pousttchi, 2010; Kim et al., 2010; Leong et al., 2013; Li et al., 2014; Liébana-Cabanillas et al., 2015 (TRA and TPB); Liu et al., 2011; Molina-Castillo et al., 2016 (other); Ramos-de-Luna et al., 2016 (TRA and TPB); Petrova, 2008; Schierz et al., 2010; Shaw, 2014; Tan et al., 2014; Zhou, 2013; Theodora et al., 2010; Viehland and Leong, 2007; Zhang et al., 2011	19
	DoI (and other theories)	Dahlberg and Öörni, 2007 (TPB); Mallat, 2007; Pham and Ho, 2015	3
	TAM and DoI (and other theories)	Arvidsson, 2014; Augsburg and Hedman, 2014; Chen, 2008; Di Pietro et al., 2015 (UTAUT); Lu et al., 2011; Mallat et al., 2009; Moroni et al., 2015; Yang et al., 2012; Zhou, 2011	9
	UTAUT (and other theories)	Shin, 2009; Slade et al., 2015a (other); Teo et al., 2015	3
	TAM and UTAUT (and other theories)	Amoroso and Magnier-Watanabe, 2012; Koening-Lewis et al., 2015; Liébana-Cabanillas et al., 2014a (TRA); Liébana-Cabanillas et al., 2014b (TRA); Liébana-Cabanillas et al., 2014c (TRA)	5
	UTAUT2 (and other theories)	Morosan and DeFranco, 2016; Oliveira et al., 2016 (DoI and other); Slade et al., 2015b	3

Discipline	Theories, models, constructs	References	Frequency
	Other theories	Cocosila and Trabelsi, 2016; de Kerviler et al., 2016; Liu et al., 2013; O'Reilly et al., 2012; Xin et al., 2013; Yang et al., 2015; Zhao and Kurnia, 2014; Zhou, 2014a; Zhou, 2014b	9
Marketing/ services	No theory used	Brakewood et al., 2014; Silic et al., 2014	2
		Total	53

Table C.3. Constructs used in adoption studies related to service characteristics.

Construct	Frequency*	References
Perceived ease of use	31	Amoroso and Magnier-Watanabe, 2012; Arvidsson, 2014; Augsburg and Hedman, 2014; Chen, 2008; Chen and Huang, 2013; Dahlberg and Öörni, 2007; Di Pietro et al., 2015; Duane et al., 2014; Goeke and Pousttchi, 2010; Kim et al., 2010; Koening-Lewis et al., 2015; Leong et al., 2013; Li et al., 2014; Liébana-Cabanillas et al., 2015; Liébana-Cabanillas et al., 2014a; Liébana-Cabanillas et al., 2014b; Liébana-Cabanillas et al., 2014c; Liu et al., 2011; Mallat et al., 2009; Molina-Castillo et al., 2016; Moroni et al., 2015; Pham and Ho, 2015; Ramos-de-Luna et al., 2016; Schierz et al., 2010; Shaw, 2014; Shin, 2009; Tan et al., 2014; Theodora et al., 2010; Viehland and Leong, 2007; Zhang et al., 2011; Zhou, 2011
Perceived usefulness	29	Amoroso and Magnier-Watanabe, 2012; Augsburg and Hedman, 2014; Chen, 2008; Chen and Huang, 2013; Di Pietro et al., 2015; Duane et al., 2014; Goeke and Pousttchi, 2010; Kim et al., 2010; Koening-Lewis et al., 2015; Leong et al., 2013; Li et al., 2014; Liébana-Cabanillas et al., 2015; Liébana-Cabanillas et al., 2014a; Liébana-Cabanillas et al., 2014b; Liébana-Cabanillas et al., 2014c; Mallat et al., 2009; Molina-Castillo et al., 2016; Moroni et al., 2015; Pham and Ho, 2015; Ramos-de-Luna et al., 2016; Schierz et al., 2010; Shaw, 2014; Shin, 2009; Tan et al., 2014; Theodora et al., 2010; Viehland and Leong, 2007; Zhang et al., 2011; Zhao and Kurnia, 2014; Zhou, 2011
Perceived risk (security, privacy, financial)	20	Amoroso and Magnier-Watanabe, 2012; Chen, 2008; Chen and Huang, 2013; Cocosila and Trabelsi, 2016; de Kerviler et al., 2016; Gerpott and Kornmeier, 2009; Koening-Lewis et al., 2015; Li et al., 2014; Liébana-Cabanillas et al., 2015; Liébana-Cabanillas et al., 2014a; Liébana-Cabanillas et al., 2014b; Liébana-Cabanillas et al., 2014c; Liu et al., 2013; Morosan and DeFranco, 2016; Slade et al., 2015a; Slade et al., 2015b; Tan et al., 2014; Yang et al., 2015; Zhang et al., 2011; Zhao and Kurnia, 2014

Construct	Frequency*	References
Perceived security	16	Arvidsson, 2014; Dahlberg and Öörni, 2007; Di Pietro et al., 2015; Goeke and Pousttchi, 2010; Lu et al., 2011; Mallat, 2007; Moroni et al., 2015; Petrova, 2008; Pham and Ho, 2015; Ramos-de-Luna et al., 2016; Schierz et al., 2010; Shin, 2009; Silic et al., 2014; Viehland and Leong, 2007; Yang et al., 2012; Zhou, 2011
(Perceived) compatibility	16	Arvidsson, 2014; Augsburg and Hedman, 2014; Chen, 2008; Dahlberg and Öörni, 2007; Di Pietro et al., 2015; Kim et al., 2010; Li et al., 2014; Lu et al., 2011; Mallat, 2007; Mallat et al., 2009; Moroni et al., 2015; Pham and Ho, 2015; Ramos-de-Luna et al., 2016; Schierz et al., 2010; Yang et al., 2012; Zhao and Kurnia, 2014
Cost (perceived)	13	Arvidsson, 2014; Cocosila and Trabelsi, 2016; Goeke and Pousttchi, 2010; Leong et al., 2013; Lu et al., 2011; Mallat, 2007; Moroni et al., 2015; Petrova, 2008; Pham and Ho, 2015; Tan et al., 2014; Yang et al., 2012; Zhao and Kurnia, 2014; Zhou, 2011
Performance expectancy	8	Gerpott and Kornmeier, 2009; Morosan and DeFranco, 2016; Oliveira et al., 2016; Teo et al., 2015; Slade et al., 2015a; Slade et al., 2015b; Zhou, 2014a; Zhou, 2014b
Convenience	7	Augsburg and Hedman, 2014; Chen, 2008; Dahlberg and Öörni, 2007; Kim et al., 2010; Petrova, 2008; Teo et al., 2015; Viehland and Leong, 2007
Relative advantage	6	Arvidsson, 2014; Augsburg and Hedman, 2014; Dahlberg and Öörni, 2007; Lu et al., 2011; Mallat, 2007; Yang et al., 2012
Effort expectancy	6	Morosan and DeFranco, 2016; Oliveira et al., 2016; Slade et al., 2015a; Slade et al., 2015b; Teo et al., 2015; Zhou, 2014b
Added value services/ additional value	3	Augsburg and Hedman, 2014; Petrova, 2008; Pham and Ho, 2015

** Constructs were included if they were mentioned at least three times.*

Table C.4. Constructs related to customer's characteristics.

Criteria	Frequency*	References
Trust in actors or services	25	Amoroso and Magnier-Watanabe, 2012; Arvidsson, 2014; Dahlberg and Öörni, 2007; Duane et al., 2014; Goeke and Pousttchi, 2010; Leong et al., 2013; Li et al., 2014; Liébana-Cabanillas et al., 2015; Liébana-Cabanillas et al., 2014a; Liébana-Cabanillas et al., 2014b; Liébana-Cabanillas et al., 2014c; Lu et al., 2011; Mallat, 2007; O'Reilly et al., 2012; Petrova, 2008; Pham and Ho, 2015; Shaw, 2014; Shin, 2009; Slade et al., 2015a; Slade et al., 2015b; Xin et al., 2013; Zhao and Kurnia, 2014; Zhou, 2011; Zhou, 2013; Zhou, 2014a; Zhou, 2014b

Criteria	Frequency*	References
Demographic data (age[a], gender[b], income[c], education[d], ethnicity[e])	15	Arvidsson, 2014[a,c,d]; Brakewood et al., 2014[a,b,c,d,e]; Dahlberg and Öörni, 2007[a,c,d]; Leong et al., 2013[a,b,d]; Liébana-Cabanillas et al., 2015[a]; Liébana-Cabanillas et al., 2014a[a]; Liébana-Cabanillas et al., 2014b[b]; Liu et al., 2013[a,b,c]; Mallat, 2007[a]; Shin, 2009[a,b,c]; Tan et al., 2014[b]; Xin et al., 2013[b,e]; Zhao and Kurnia, 2014[a,b,d]; Zhou, 2013[a]; Zhou, 2014a[a]
Personal innovativeness in information technology	11	Chen and Huang, 2013; Duane et al., 2014; Gerpott and Kornmeier, 2009; Kim et al., 2010; Leong et al., 2013; Oliveira et al., 2016; Pham and Ho, 2015; Ramos-de-Luna et al., 2016; Slade et al., 2015a; Tan et al., 2014; Yang et al., 2012
Knowledge or previous experience of technology or service	10	Dahlberg and Öörni, 2007; Gerpott and Kornmeier, 2009; Kim et al., 2010; Koening-Lewis et al., 2015; Leong et al., 2013; Li et al., 2014; Liébana-Cabanillas et al., 2014c; Theodora et al., 2010; Xin et al., 2013; Zhao and Kurnia, 2014
Attitude towards use	9	Amoroso and Magnier-Watanabe, 2012; Di Pietro et al., 2015; Gerpott and Kornmeier, 2009; Liébana-Cabanillas et al., 2014a; Liébana-Cabanillas et al., 2014b; Liébana-Cabanillas et al., 2014c; Ramos-de-Luna et al., 2016; Schierz et al., 2010; Shin, 2009
Mobility/ individual mobility	5	Kim et al., 2010; Mallat et al., 2009; Petrova, 2008; Ramos-de-Luna et al., 2016; Schierz et al., 2010
Self-efficacy	5	Duane et al., 2014; Molina-Castillo et al., 2016; Shaw, 2014; Shin, 2009; Tan et al., 2014
Hedonistic motivation (fun, enjoyment, entertainment)	5	de Kerviler et al., 2016; Koening-Lewis et al., 2015; Morosan and DeFranco, 2016; Oliveira et al., 2016; Slade et al., 2015b
Behavioural intention (to use/adopt)	3	Amoroso and Magnier-Watanabe, 2012; Oliveira et al., 2016; Koening-Lewis et al., 2015

** Constructs were included if they were mentioned at least three times.*

Table C.5. Constructs related to external factors.

Criteria	Frequency*	References
Social influence	15	Amoroso and Magnier-Watanabe, 2012; Gerpott and Kornmeier, 2009; Koening-Lewis et al., 2015; Leong et al., 2013; Liébana-Cabanillas et al., 2014a; Liébana-Cabanillas et al., 2014b; Liébana-Cabanillas et al., 2014c; Morosan and DeFranco, 2016; Oliveira et al., 2016; Shin, 2009; Slade et al., 2015a; Slade et al., 2015b; Teo et al., 2015; Yang et al., 2012; Zhao and Kurnia, 2014

Criteria	Frequency*	References
Subjective norm	8	Dahlberg and Öörni, 2007; Liébana-Cabanillas et al., 2014a; Liébana-Cabanillas et al., 2014b; Liébana-Cabanillas et al., 2014c; Ramos-de-Luna et al., 2016; Schierz et al., 2010; Yang et al., 2012; Zhang et al., 2011
Facilitating conditions	6	Amoroso and Magnier-Watanabe, 2012; Koening-Lewis et al., 2015; Morosan and DeFranco, 2016; Oliveira et al., 2016; Slade et al., 2015b; Teo et al., 2015
External influence	3	Liébana-Cabanillas et al., 2014a; Liébana-Cabanillas et al., 2014b; Liébana-Cabanillas et al., 2014c;
Use situation/ context	3	Mallat, 2007; Mallat et al., 2009; Viehland and Leong, 2007

** Constructs were included if they were mentioned at least three times.*

Appendix D. Papers on mobile payment technology

Table D.1. Classification of papers on technology by topics.

Addressed question	Frequency	References
Papers addressing security issues: security architecture, security mechanisms, security protocols, authentication and cryptography, anonymity, privacy, non-repudiation	40	Ahamad et al., 2014; Almuairfi et al., 2014; Ammayappan, 2015; Bottoni and Deni, 2007; Clarke, 2008; Conti et al., 2009; Fan and Huang, 2010; Ferreira et al., 2009; Fun et al., 2008; Godbole and Pais, 2008; Gold et al., 2015; Hassinen et al., 2008; Hwang et al., 2007; Isaac and Zeadally, 2014; Isaac et al., 2012; Kadambi et al., 2009; Konidala et al., 2012; Kumar and Rabara, 2010; Lee et al., 2007; Lei et al., 2009; Li et al., 2012; Lin et al., 2008; Luo et al., 2016; Martínez-Peláez et al., 2015; Munch-Ellingsen et al., 2015; Jiang et al., 2009; Ou and Ou, 2009; Pasquet et al., 2008; Pasquet and Gerbaix, 2016; Popescu, 2009; Sung et al., 2015; Veeraraghavan, et al., 2016; Wang et al., 2008; Yang, 2014; Yang and Chang, 2012; Yang and Lin, 2016; Yang et al., 2010; Zhang et al., 2008; Zhu and Rice, 2009; Zhu et al., 2012

Addressed question	Frequency	References
Proposals of new mobile payment architectures, systems, and schemes	25	Ahamad et al., 2014; Basili et al., 2014; Ferreira et al., 2009; Ghiron et al., 2009; Grønli et al., 2015; Hwang et al., 2007; Kadambi et al., 2009; Konidala et al., 2012; Kousaridas et al., 2008; Kumar and Rabara, 2010; Lee et al., 2007; Lin et al., 2008; Luo et al., 2016; Martínez-Peláez et al., 2015; Popescu, 2009; Rahimian and Habibi, 2008; Rodrigues et al., 2014; Sung et al., 2015; Veeraraghavan, et al., 2016; Yang and Chang, 2012; Yang and Lin, 2016; Yang et al., 2010; Zhang et al., 2008; Zhu and Rice, 2009; Zhu et al., 2012
Proposals of new mobile payment protocols	17	Ahamad et al., 2014; Ammayappan, 2015; Bottoni and Deni, 2007; Fan and Huang, 2010; Fun et al., 2008; Godbole and Pais, 2008; Isaac and Zeadally, 2014; Isaac et al., 2012; Kumar and Rabara, 2010; Lei et al., 2009; Li et al., 2012; Jiang et al., 2009; Rodrigues et al., 2014; Wang et al., 2008; Yang, 2014; Zhang et al., 2008; Zhu and Rice, 2009
Proposals of more efficient, optimized, and lightweighted solutions	11	Godbole and Pais, 2008; Grønli et al., 2015; Isaac and Zeadally, 2014; Isaac et al., 2012; Lee et al., 2007; Lei et al., 2009; Ou and Ou, 2009; Popescu, 2009; Yang, 2014; Zhu and Rice, 2009; Zhu et al., 2012
Technology description	5	Basili et al., 2014; Massoth and Bingel, 2009; Ondrus and Pigneur, 2009; Pasquet et al., 2008; Yang et al., 2010
Proposals of solutions with lower computational costs	4	Fan and Huang, 2010; Li et al, 2012; Lin et al., 2008; Yang and Chang, 2012
Comparison of different payment systems (debit/credit card, contactless credit/debit card/, electronic cash, and mobile NFC payment)	3	Bottoni and Deni, 2007; Konidala et al., 2012; Massoth and Bingel, 2009
Development of mobile payment solutions for restricted connectivity scenarios	2	Isaac et al., 2012; Li et al, 2012

Appendix E. Papers on business aspects of mobile payments

Table E.1. Classification of papers on business aspects by topics.

Addressed question	Frequency	References
Business ecosystem of mobile payments (actors/stakeholders, strategies, roles and issues)	23	Andersson et al., 2013; Au and Kauffman, 2008; Carton et al., 2012; Dennehy et al., 2015; Gannamaneni et al., 2015; Ghezzi et al., 2010; Guo and Bouwman, 2016b; Hedman and Henningsson, 2012; Hedman and Henningsson, 2015; Kanniainen, 2010; Kazan and Damsgaard, 2013; Liu et al., 2015; Magnier-Watanabe, 2014; Markendahl, 2013; Ok et al, 2013; Ondrus, 2015; Ondrus et al., 2015; Ondrus et al., 2009; Ozcan and Santos, 2015; Pousttchi, 2008; Staykova and Damsgaard, 2015; Van Bossuyt and Van Hove, 2007; Zhong and Nieminen, 2015
Business models (aspects, issues)	11	Au and Kauffman, 2008; Carton et al., 2012; Dennehy et al., 2015; Gannamaneni et al., 2015; Juntunen et al., 2012; Ondrus, 2015; Ondrus and Lyytinen, 2011; Ondrus et al., 2009; Pousttchi, 2008; Pousttchi et al., 2009; Zolnowski et al., 2014
Collaboration issues (inter-firm relationship)	10	Andersson et al., 2013; Apanasevic, 2013; de Reuver et al., 2015; Gannamaneni et al., 2015; Hedman and Henningsson, 2012; Hedman and Henningsson, 2015; Magnire-Watanabe, 2014; Ondrus, 2015; Ondrus et al., 2015; Ozcan and Santos, 2015
Market-level analysis	10	Apanasevic, 2013; Au and Kauffman, 2008; Dahlberg, Huurros, et al., 2008; Ghezzi et al., 2010; Liu et al., 2015; Magnire-Watanabe, 2014; Markendahl, 2013; Ondrus et al., 2009; Ozcan and Santos, 2015; Staykova and Damsgaard, 2015
Market challenges	4	Au and Kauffman, 2008; Apanasevic, 2013; Liu et al., 2015; Staykova and Damsgaard, 2015
Firm-level analysis	3	Au and Kauffman, 2008; Gaur and Ondrus, 2012; Kauffman et al., 2015
Mobile payment use cases	2	Ok et al, 2013; Pousttchi, 2008

Table E.2. Theoretical perspectives used in research on business aspects of mobile payments.

Discipline	Theories, models, concepts	References	Frequency
Economics	Network economies	Au and Kauffman, 2008; Apanasevic, 2013; Ondrus et al., 2009	3
	Industry evolution, dominant design	Dahlberg, Huurros, et al., 2008; Ondrus et al., 2009; Ozcan and Santos, 2015	3
	Switching costs	Au and Kauffman, 2008; Apanasevic, 2013	2
	Other theories	Magnire-Watanabe, 2014; Ozcan and Santos, 2015	2

Organisa-tional relations	Business ecosys-tems	Guo and Bouwman, 2016b; Hedman and Henningsson, 2012; Hedman and Henningsson, 2015; Liu et al., 2015; Zhong and Nieminen, 2015	5
	Network per-spective	Andersson et al., 2013; Markendahl, 2013	2
	Coopetition	Andersson et al., 2013; Apanasevic, 2013	2
	Other theories	Dennehy et al., 2015; de Reuver et al., 2015; Hedman and Henningsson, 2015; Liu et al., 2015; Ozcan and Santos, 2015	5
	No theory	Ghezzi et al., 2010; Kanniainen, 2010; Ok et al, 2013; Pousttchi, 2008	4
Strategic management	Business Model	Apanasevic, 2013; Juntunen et al., 2012; Ondrus and Lyytinen, 2011; Ondrus et al., 2009; Pousttchi et al., 2009; Zolnowski et al., 2014	6
	Platforms, two-sided market	de Reuver et al., 2015; Gannamaneni et al., 2015; Kazan and Damsgaard, 2013; Ondrus, 2015; Ondrus et al., 2009; Ondrus et al., 2015; Staykova and Damsgaard, 2015; Zhong and Nieminen, 2015	8
	Resource-based view	Gaur and Ondrus, 2012; Guo and Bouwman, 2016b; Zhong and Nieminen, 2015	3
	Other strategy theories	Hedman and Henningsson, 2015; Kauffman et al., 2015; Ozcan and Santos, 2015; Staykova and Damsgaard, 2015	4
Marketing/ services	Different theories	Au and Kauffman, 2008; Carton et al., 2012; Zhong and Nieminen, 2015	3
	No theory	Ghezzi et al., 2010; Van Bossuyt and Van Hove, 2007	2
Psychology/ sociology	Adoption theory	Apanasevic, 2013; Au and Kauffman, 2008	2
		Total	56*

* Some papers were situated in more than one discipline and used more than one theoretical perspective; they were therefore placed in multiple categories.

Biographies

Tatjana Apanasevic. Tatjana Apanasevic received the Bachelor in Business administration and management and Master degree in economic information science from Vilnius University, Vilnius, Lithuania, retrospectively in 1998 and 2000, the M.S. degree in media management from KTH Royal Institute of Technology in 2012, and the PhD degree in information and communication technology from KTH Royal Institute of Technology in 2018. Her research interest includes analysis of economic and business aspects of mobile payments, NFC-based services, and mobile ticketing services. Dr. Apanasevic's awards and honors include a scholarship from Jan Wallanders och Tom Hedelius fund and Tore Browaldhs fund.

Niklas Arvidsson. Niklas Arvidsson was born in Stockholm, Sweden, 1964. He received the MBA degree in Financial Economics from the Stockholm School of Economics, Sweden, in 1991 and the Ph.D. degree in International Business the Stockholm School of Economics, Sweden, in 1999. From 2000 to 2005, he was Senior Consultant with Service Management Group (SMG) as well as an independent consultant, and from 2005 to 2007 a researcher at the National Institute of Working Life. Since 2007, he has been an Associate Professor at the Royal Institute of Technology in Stockholm. He is the author of three books, many academic articles, and is regularly interviewed in national and international media. His research interests include innovation in the payment system, cashless societies, management and governance of innovation, scenario analysis, sustainable technologies, and digital currencies.

Jan Markendahl. Associate Professor Jan Markendahl, Royal Institute of Technology (KTH), Stockholm. Jan holds a position as Associate Professor in Wireless Infrastructure Deployment and Economics at KTH. After more than 20 years in the industry Jan joined KTH 2003 as research program manager. He has a PhD degree from 2011 in Techno-economic analysis of wireless networks and services. 2014 Jan got the Docent degree enabling him to be main advisor for PhD students. So far three PhD and four Licentiate degrees have been awarded to his Phd students. Jan has managed techno-economic research projects and tasks in EU and national projects. He has made research contributions in the following areas: low cost wireless infrastructure, spectrum valuation, mobile payment and NFC services, IoT and M2M communication services and analysis of business models and ecosystems. Currently he works with business aspects of IoT, smart cities and sharing economy

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How do a firm's age and size affect its organizational innovation?

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Abstract. This research explores the impact of the firm characteristics of size and age on organizational innovation (ORI). The study is based on data gathered from a sample of manufacturing companies from the central region of Russia. To make the research more specific, the ORI is broken down into three subtypes, namely, innovation in management practices, innovation in workplace organization, and innovation in external relations. The ORI subtypes demonstrate various levels of dependence on a firm's size and age. The study did not find evidence that the size of a firm has any significant impact on the ORI, while the age impacts each of the ORI subtypes. The study contributes to the ORI literature by advancing the concept of the ORI investigating the impact of a firm's characteristics on the ORI.

Keywords. Organizational Innovation; Innovation Management; Firm Characteristics; Size; Age.

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1 Introduction

A significant part of a firm's overall strategy is innovation management. The innovation activity in a firm aims to increase the productivity of each business function of the firm (Nandakumar et al., 2011; Forsman, 2009; Wang and Ahmed, 2004; Dukeov, 2008). A successful firm must always consider the business environment as a dynamic and continuously changing system (Bergman et al., 2006). To adapt the firm to a changing environment often requires introducing innovations. These could be new products, processes, management systems or elements of corporate culture (Damanpour, 1992). Different kinds of innovations within a firm are often closely interrelated. The introduction of technological innovation, which encompasses product and process innovation, is complementary to the adoption of non-technological innovation, which encompasses marketing and organizational innovation (ORI) (Koren and Palcic, 2015).

According to many studies, technological innovation acts as a driver for non-technological innovation within a firm (Henderson and Clark, 1990; Dougherty, 1993; Danneels, 2002). These studies usually suggest that non-technological innovation is the consequence of technological innovation which forces a firm to change its performance (Armbruster et al., 2008). However, to be successful in innovation management in general, firms must continuously develop appropriate non-technological innovation, and ORI in particular, to transform the overall effect of innovation activity into profit (Teece, 2010). Some researchers have stated that ORI underlies the efficient implementation of other types of innovation and is regarded as one of the most significant factors increasing competitive advantages for the firm (Geels and Schot, 2007; Lokshin et al, 2009).

Various research on ORI topic has been conducted for about four decades. Nevertheless, numerous related matters have not still found solid explanations, and a high level of inconsistency in the results seems to characterize the studies in this field (Damanpour and Daniel Wischnevsky, 2006). There are a few reasons why the ORI attracts the interest of scholars. First of all, a deeper understanding of the role that ORI plays in the context of the overall innovation activity of a firm is demanded. Secondly, from a managerial perspective, it would be good to know what the antecedents of ORI are, in order to raise the level of ORI activity in a firm. Nowadays technology often moves ahead of organizational trends and meets barriers created by these out-of-day trends (Apsalone et al., 2017).

A number of studies (e.g., Rosenbusch et al., 2011; Bradley et al. 2012; Laforet 2011) proved that ORI played a significant role in firm development. There have also been various discussions in the literature on how to identify and measure ORI in firms (Armbruster et al., 2008). In any case, regardless of the research focus, ORI is considered to have a crucial impact on the overall ability of a firm to innovate.

Among a number of factors that have an impact on the innovation of firm, are firm characteristics such as the firm's age and size (e.g., Heimonen, 2012; Gopalakrishnan and Damanpour, 2000).

The impact of a firm's age and size on the ORI is much less covered in the literature compared to this impact on technological innovation (e.g., Alabbas and Abdel-Razek 2016). At the same time, the ORI theory suffers from a lack of supporting studies in general, and in particular, ones exploring the impact of a firm's characteristics on ORI (Camisón and Villar-López, 2014). In spite of the fact that there exist some studies that focus on the relation between a firm's characteristics and ORI (Damanpour, 1991; Wolfe, 1994; Van de Ven et al., 2000), a strong relationship between ORI and a firm's characteristics has not always been confirmed and needs to be further explored (Koren and Palcic, 2015). Drazin and Schoonhoven (1996) proposed

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that inconsistency in the results of innovation studies have appeared because many of them do not specify the context and types of innovation under consideration and have generalized the conclusions to a large extent (Gopalakrishnan and Damanpour, 1997). Thus, more research in the area of ORI and its determinants is needed (Armbruster et al., 2008).

This study examines the relationship between ORI and a firm's characteristics. Our study contributes to the theory of ORI by considering this relation in the context of ORI components to answer the question as to what impact the latter could have on ORI development in a firm. The study is based on a sample of 123 industrial firms from the central region of Russia. Our work is also in line with Eurostat (2012) studies and other studies (e.g., Heimonen, 2012; Yildiz et al., 2013; Le Bas et al., 2015; DeTienne and Koberg, 2002; Damanpour, 1987; Gopalakrishnan and Bierly, 2006) that have been carried out in the same area.

2 Conceptual framework and research hypotheses

2.1 Organizational innovation

At the beginning of the 20th century, Joseph Schumpeter (Schumpeter, 1934) introduced the term "new industrial organization". According Schumpeter's theory, there are five types of innovations: the introduction of new goods, the introduction of new methods of production, the implementation of a new supply source of raw materials or half-manufactured goods usage, the opening of new markets, and new forms of industrial organization. The latter is nowadays understood as organizational innovation (ORI). In the innovation management literature, ORI has gained a minor role in studies as it is a relatively new concept to be researched and implemented (Klette and Kortum, 2004). Therefore, it still represents a broad concept which deals with issues covered by strategic management, human research management, knowledge management and other non-technological areas of firm control and evolvement (Gera and Gu, 2004). All these areas can be considered indicators of the internal diffusion of various practices and elements of knowledge management. (Armbruster et al., 2008). In comparison with product or marketing innovations, ORI is not directly implemented in the market place. Nevertheless, the effect of ORI may be visible as the increasing level of competitiveness of a firm that introduces product, process, or marketing innovations supported by simultaneously introduced ORI. This simultaneous introduction of different types of innovations may lead to the synergy of various effects (Som et al., 2012).

Scholars have provided various classifications of organizational innovation in an attempt to explain and specify their characteristics in different contexts (Lam, 2004). Thus, quite a large number of definitions for ORI can be found, not to mention interpretations of the term (e.g., Mothe and Thi, 2010). One can also consider different levels of ORI. For example, these may take the form of appropriate solutions on the level of particular departments or functions of a company. They can also relate to the overall structure or the functional principles of the firm. They may well be innovations that have an impact the firm's relationship with its environment (Wengel et al., 2002).

Despite many studies arguing that ORI should be considered as a firms' response to technological innovation forming a pre-condition environment for it, ORI can also play its own independent role in a firm's development and can be considered a distinct form of innovation (Tidd at al., 2005).

Firstly, ORI might aim at implementing new procedures in processes, operations, or behaviour

in a firm (Som et. al., 2012). These procedures could be the first introduction of a total quality management system or a PDCA cycle, or could involve just-in-time or teamwork practices that directly impact the organizational performance of the firm (Wheelwright and Clark, 1992; Reed et al., 2000; Ichniowski et al., 1997). The crucial criterion here is that the introduction should be for the first time (OECD-EUROSTAT 2005, p.51).

Often these are called procedural ORIs in comparison to structural ORIs which deal with increasing the efficiency of responsibilities, accountability, divisional structure of functions, and knowledge dissemination in a firm on its various levels (Som et al., 2012). Thirdly, ORI might reduce the organizational barriers of the external environment, thus facilitating enlarging the scale of the firms' external relations with customers, suppliers, research organizations, and governmental and non-governmental institutions (Heidenreich, 2009; Rammer et al., 2009).

In our paper, we will adhere to the OSLO Manual definition of ORI: "An organizational innovation is the implementation of a new organizational method in the firm business practices, workplace organization or external relations," (OECD-EUROSTAT 2005, p.51). According to this document, ORI may be intended to increase a firm's performance by reducing administrative or transaction costs, enhancing labour productivity by improving workplace satisfaction, gaining access to non-tradable assets (such as non-codified external knowledge), or reducing the costs of supplies. An organizational innovation should be based on strategic decisions taken by the management of the firm to implement organizational methods in business practices, workplace organization or external relations which are new for the firm.

2.2 Subtypes of ORI

As it was shown in the previous paragraph, ORI can be broken down into a few specific innovation subtypes that relate to business practices, workplace organization or external relations. Many studies on ORI (e.g., Murphy, 2002; Uhlaner et al., 2007; Eurostat, 2012), in accordance with the OSLO Manual, consider three subtypes of ORI. Often, the studies are dedicated to specific forms of ORI. For instance, Mothe and Thi (2010) focus on management practice and production approaches. Dukeov at al. (2017) consider an external relation subtype form of ORI.

2.2.1 Internally oriented subtypes of organizational innovation

The first subtype of ORI is related to innovations in management practices (IMP). These deal with the introduction of new management practices. IMP means the implementation of methods for organizing work routines that are new for the firm. These methods deal with the first introduction of, among other things, knowledge management related approaches, Total Quality Management, Lean Production, Six Sigma, the Theory of Constraints, Kaizen or supply system elements, e.g. first implementation of practices for codifying knowledge, e.g. "establishing databases of best practices, lessons and other knowledge, so that they are more easily accessible to others" (OECD-EUROSTAT, 2005, p.51). According to many scholars (e.g., Prahalad and Hamel, 1990; Grant, 1996; Spicer and Sadler-Smith, 2006), knowledge management related practices in general enhance firms' competitiveness and ability to innovate and in turn their ORI. Firms are more active in introducing innovations when a firm effectively absorbs knowledge from outside as well as when it makes it circulate intensively within the internal environment (Nonaka and Takeuchi, 1995).

The second subtype of ORI is linked with innovations in the workplace organization (IWO).

These innovations focus on new methods of organizing the work of employees, e.g. centralization, decentralization or re-organizing the organizational structure, as well as integration or diversification of different business activities (OECD-EUROSTAT, 2005; Som et al., 2012). An example of an IWP "is the first

implementation of an organizational model that gives the firm's employees greater autonomy in decision making and encourages them to contribute their ideas" (OECD-EUROSTAT, 2005, p.52). This subtype of ORI aims to improve the overall performance and results by increasing work efficiency (Mothe and Thi, 2010). However, there is variation between the results of studies that focus on IWO. For example, Ichniowski et al. (1997) propose that the overall impact of this subtype of ORI on the overall performance is positive, whereas, e.g., Bresnahan et al. (2002) argue that it is not that obvious, and IWO can be efficient only in combination with other types of innovation or technologies. Mothe and Thi, (2010), proved a strong positive relationship between IWO and the propensity of a firm to perform well.

2.2.2 Externally oriented subtypes of organizational innovation

The external relation subtype (IER) of ORI encompasses "new ways of building relations with a firm's external environment including other firms, public institutions, research organizations, customers and suppliers in order enhance the efficiency of production, procuring, distribution, recruiting and ancillary services" (OECD-EUROSTAT, 2005, p.52). The IER demonstrates how a firm is able to make use of networking activities, which can be a crucial capability in the context of the knowledge-based global economy (Mothe and Thi, 2010; Sapprasert and Clausen, 2012). External relations provide a firm with potential access to partners' complementary skills and that might create synergy in production and management areas (Kogut, 1988; Kogut and Zander, 1993; Cassiman and Veugelers, 2002), or exclude duplication in R&D activities, reduce risks involved in venture projects (Jacquemin, 1988; Sakakibara, 1997), promote benefits from economies of scale or scope (Kogut, 1988), and facilitate receiving new scientific and technological knowledge for the firm's own R&D activities (Sakakibara, 1997, 2001). Despite the recognized effects of IER, studies have demonstrated controversial results on what impact this subtype of ORI has on the overall performance of the firm and its innovation activity. Some have shown positive relations between a firm's cooperation with universities (Belderbos et al., 2004; Lööf and Heshmati, 2002), whereas Mothe and Thi, (2010) observed a slightly negative interconnection between supplier related ORI and a firm's overall performance. Klomp and van Leeuwen (2001) presented evidence of a positive impact of client relation activities on the overall performance of a firm.

2.3 Organizational innovation and firm characteristics

By and large, the subtypes of ORI are different in their nature and depend on firm characteristics, for example, the age and size of the firm (Som at al., 2012). Due to this, it is important to see how firm-level characteristics are related to organizational innovation and, in turn, how they influence the firm's performance by means of ORI. The relationship between a firm's characteristics, in particular its age and size, and their effect on innovation activity has been debated for a long time (Damanpour, 2006). Some have used these variables to come up with conceptual conclusions regarding the relationship between a firm's level of innovation activity and its age and size (e.g., Reger et al., 1992). Nevertheless, there is no consensus as yet and several independent studies have found controversial insights (DeTienne and Koberg, 2002). Gopalakrishnan and Damanpour

(1997) argue that inconsistency in the results may appear because ORI is considered in many studies as an indivisible concept, while age and size might have differentiated impacts on specific subtypes of ORI.

Appendix 1 demonstrates findings and the empirical characteristics of relevant prior studies

2.3.1 Firm age and organizational innovation types

The literature has demonstrated arguments both for the negative and the positive dependence of innovation intensity on the firm age. For example, Damanpour (1987), found that the older a firm is, the less flexible its organizational structure becomes, and the more such a firm becomes inertial in its management system implementation. The level of bureaucracy in a firm increases over the years, new and strong formal procedures appear, and authority becomes centralized (Kelly and Amburgey, 1991). According to Van de Ven (1986), as a firm ages, internal barriers that prevent innovation grow. Studies on the business life-cycle have proposed that the development of a young firm involves the innovative development of the organization (Churchill, 2000; Davidsson and Delmar, 1997; Scott and Bruce, 1987).

In contrast, there are many older companies that are highly innovative and demonstrate a very high level of performance (Huergo and Jaumandreu, 2004). Studies of those firms might provide new insights into how a firm can go through the process of economic and technological change within the firm over a long period (Hafkesbrink and Schroll, 2014).

As ORI comes to be essential for a firm that struggles for its competitiveness, IMP is a key factor in the creation and diffusion of new knowledge (Montoro-Sanchez, 2011). The development of knowledge management systems, organizational learning approaches, and the introduction of new management approaches, (e.g., Total Quality Management, Lean Production, Six Sigma, the Theory of Constraints, Kaizen) as it was mentioned above are more often characteristics of more mature firms as young firms often have neither resources nor the time to implement these systems and approaches (Temtime, 2003). Thus, we propose the following hypothesis.

> *H1a.* **Firm age has a positive effect on innovations in the management practices (IMP) in the firm.**

In order to survive in the market place, older firms are forced to develop innovations in their workplace organisation (IWO), which is a subtype of overall organisational innovation (ORI). In the literature, employee satisfaction is considered a powerful mechanism for increasing the overall performance of a firm. The level of employee satisfaction in older firms is lower than in younger firms (Antoncic and Antoncic, 2011). Thus, older firms in comparison to young ones need to be more active in maintaining their level of employee satisfaction. This level can be maintained in numerous ways, such as by running training programmes, implementing knowledge sharing systems, increasing flexibility, reducing formalities in decision-making processes, eliminating some formal procedures (Tansel and Gazioglu, 2014; Hafkesbrink and Schroll, 2014). Taking into consideration these considerations, we propose the next hypothesis.

> *H1b.* **Firm age has a positive effect on innovations in the workplace organization (IWO) in a firm.**

Nevertheless, firms can hardly innovate in isolation. This means that in order to receive new knowledge, old firms are forced to continuously elaborate their network (Montoro-Sanchez, 2011), which increases the probability of elaborating their ORI in the area of external relations (Dufour and Son, 2015).

Compared to younger firms, older ones more actively try to establish relations with partners in the area of research and development (Coad et al., 2016). Younger firms often have insufficient experience to process the weak signals that they receive from the business environment in order to adjust their external relations to the forthcoming situation. For this reason, they do not come with appropriate innovations external relations (IER) in time (Ismail, N. and Jenatabadi, H., 2014).

According to Gopalakrishnan and Bierly (2006), young firms that focus on developing their technological competences are active in enlarging their external connections to gain access to niche-based knowledge, although older firms are active in all kinds of external relations. This allows us to articulate the following hypothesis:

> *H1c.* **The firm age has a positive effect on innovations in external relations (IER) in a firm.**

2.3.2 Firm size and organizational innovation types

Firm size is another characteristic of a firm that numerous scholars have approached in an attempt to prove Schumpeter's proposition that large firms are more active in technological innovation because they have more resources available, including financial, human, organizational, and intellectual resources (Acs and Audretsch, 1988; Bhattacharya and Bloch, 2004; Freeman and Soete, 1997; Santarelli and Piergiovanni, 1996; Tether, 1998). When compared to small firms, larger ones are more active in receiving patents for engineering solutions (Brouwer and Kleinknecht, 1999; Damanpour, 1987). As some studies argue, the firm size is among the most important determinants for innovation activity (Blau and McKinley, 1979; Camisón-Zornoza et al., 2004; Damanpour, 1996).

However, Wagner, E. and Hansen, E. (2005) studied the wood industry and found that firm size does not influence a firms' ORI activity.

Nelson (1993) found that small firms demonstrate a very high level of R&D activities. Tether (1998) argues that large firms introduce a considerable number of high-value innovations while small firms are active in the introduction of lower-value innovations.

Damanpour (1996) suggested that in large and more complex firms size stimulates knowledge flows within the firm, thus accelerating innovation. Large firms have more access to information regarding innovation which in turn allows them to select appropriate innovations to adapt from a broad selection (Fennel, 1984).

Many scholars have proved a positive relationship between the size of a firm and the rate of adoption of innovations in the broad sense of this term (Aiken et al., 1980; Kim, 1980). Large firms have more resources in terms of both scale and scope overall, which allows them to be more active in introducing all types of innovations (Damanpour, 1987).

In an intensive literature review we found that discussions on firm age in ORI were scarce. Nevertheless, Kimberly and Evanisko (1981); Zmud (1984); and Damanpour (1987) argue that size has a positive impact on both technolodical and organizational innovation. At the same time, there are some researchers who did not find any evident impact of firm size on innovation activity (Mohr, 1969; Utterback, 1974). The complexity of large firms might create barriers to implementing innovations, as well as extending the way from innovation identification to its adoption, thus reducing the positive effect of a firm's size on innovation (Kohn and Scott, 1982). To our best knowledge, the studies that investigate the relationship between a firm's size and

organizational innovation do not investigate in detail the relationship between the firm size and different subtypes of organizational innovation.

As far as the IMP subtype of innovation is considered, Temtime (2003) found that large firms implement TQM practices more intensively compared to small firms, although the relation between firm size and TQM practice implementation is not very strong. This result goes along with Hajjem (2017) and Youssef at al. (2002). DeTienne, D. and Koberg, C. (2002) who found that the size of industrial firms has no any significant influence on management practices. The greater resources of larger firms sometimes cover the potential loss of profit due to their passiveness in innovation (Downs and Mohr, 1976). Besides the above-mentioned findings, Gopalakrishnan and Damanpour, 1997, argue that the complicated organizational structure of some large firms might reduce the dynamics of information flows. Thus, the impact of firm size on its IMP seems to be multidirectional and the following hypothesis is proposed:

> H2a**. Firm size has effect on the innovations in management practices (IMP) in a firm.**

Damanpour (1992) found that large firms experience greater needs regarding innovations in the workplace organisation because small and medium sized firms in general have a more flexible structure. In large firms, the level of employee satisfaction is lower compared to smaller ones, which is evidence of the neglect of employee-care policies in large firms (Tansel and Gazioglu, 2014). Medium-size firms are less bureaucratic in making decisions on implementing IWO, as the risks negative effects resulting from changes are less costly (Damanpour, 1992; Kimberly et.al., 1988). The organizational structure of a small firm is usually less sophisticated compared to a large one. Thus, it could dynamically relocate resources if needed to be innovative in some areas of IWO (Van de Ven et al., 2000). The controversial insights we found in the literature allow us to propose the following hypothesis:

> *H2b.* **Firm size has effect on innovations in the workplace organisation (IWO) in a firm.**

The literature lacks evidence on the impact of firm size on the IER subtype of ORI. The evidence that has been released is highly contradictory. According to Anwar and Hasnu (2017) firms' external relations moderate more by the specific industry then by the firm size.

Kalkan et al. (2011) and Campos-Climent and Sanchis-Palacio (2015), carrying out their research in different contexts, found that there is no relation between size and firm performance including any innovation activity.

Coad et al., (2016) found that smaller firms have neither the need or the resources for placing orders with outsourced partners for research and development, thus they fall behind larger firms in their IER activities.

Youssef at al. (2002), stated that because the majority of small and medium size firms lack well developed TQM and Customer Relationship Management (CRM) systems they usually are more limited compared to large firms in establishing new forms of relationships with their customers. These findings are supported by Lun and Quaddus (2011) and Fort et al., (2013), who argued that IER in the context of customer relations are more sophisticated and better developed in many aspects in large firms compared to smaller ones because small firms have a lower capacity to establish relations with customers and consumers. Medium-sized and large firms are more likely to make use of e-business related IER in establishing new forms of customer relations (Bordonaba-Juste, 2012). In contrast, Kilenthong et al., (2016) has shown that smaller firms are slightly more active compared to large firms in IER related to customer relations.

As for other kinds of cooperation, the larger a firm is the more actively it cooperates technologically with its suppliers (Minguela-Rata et al.,2014) and with R&D partners (Badillo et al., 2017). Small firms cannot easily establish international cooperation because usually they suffer from a lack of resources (Zhou, 2018).

To be active in IER, a firm has to experience a need for network development (Gopalakrishnan and Bierly, 2006). On the other hand, it seems that no substantial evidence that a comprehensive network has a direct link with IER activity exists. Ono and Stango, (2005) found that outsourcing models differ for large and super-large firms, which points to differences in network patterns. They suggested that the decisions on which pattern to choose depend on a combination of factors rather than only the characteristic of firm size. Thus, the influence of firm size on innovations in external relations does exist to a certain extent but it is not obvious in its direction. We thus propose the following hypothesis:

H2c. **Firm size has an effect on innovations in external relations (IER) in a firm**.

3 Methodology

The data analyzed in this paper results from a survey conducted in Russia during the second half of 2016. The survey investigated the relationship between organisational innovations (ORI) on one side and firm characteristics on the other.

The population consisted of manufacturing firms based in the Central Region of Russia. The questionnaire was administrated in electronic form to every tenth firm on the list which made a total of 550 firms. All the respondents at the moment of the survey held a top managerial position (CEO, CFO, or similar). After two weeks, a reminder was sent to those who had not replied by that time. As a result of the field work 145 completed surveys were collected. Twenty-two surveys were discarded because the answers to some questions were missing, which would not allow those questionnaires to be processed completely. The overall response rate was slightly above 25 per cent.

We employed a survey method for our study. We developed the dependent variables measuring ORI performance based on the definitions presented in the Oslo Manual (OECD-EUROSTAT, 2005). The scales for measuring ORI were taken from the previous studies with minimal adaptation. Similar scales for measuring ORI were used by Eurostat (2012), Kam Sing Wong (2013), Camisón and Villar-López (2014), Merono-Cerdan and Lopez-Nicolas (2013), Mothe and Thi, (2010). Respondents were asked to compare the innovation performance of their firm in comparison with the innovation performance of their competitors using a seven-point Likert scale, where 1 corresponds to "strongly disagree" and 7 corresponds to "strongly agree", (Camison, 2014; Eurostat, 2012; Dadura and Lee, 2011). A firm size was measured by the number of employees on a 5-point scale: 1 = fewer than 50; 2 = 50–150; 3= 150–500; 4 = 500–1000; 5 = more than 1000 (e.g., Damanpour, 2006). The firm age was measured by the number of years since the foundation of the firm (Camison, 2014).

While designing the questionnaire, a few intensive interviews with both academicians and practitioners were conducted in order to check the presented concepts and the way in which respondents perceive the questions.

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4 Results

An exploratory factor analysis was applied in the first stage of the data analysis to combine the observed variables used for measuring ORI into factors. We interpreted the obtained factors as ORI subtypes. To test the hypotheses on factorial validity of the identified factors a confirmatory factor analysis was carried out. The results of the confirmatory factor analysis proved the validity of the identified factors. At the last stage of the analysis, regression equations were calculated to determine the relations between firm size and age on the one side and the ORI subtypes on the other.

Before applying the exploratory factor analysis, the Kaiser-Meyer-Olkin (KMO) test was run for the sample. The KMO value obtained for the data set was 0.91, which demonstrates more than adequate quality for processing by factor analysis (Cerny and Kaiser, 1977). The exploratory factor analysis demonstrated that a 3-factor solution provided the best fit. The first factor (4 items) includes items which are related to innovation in management practices. These are: a system that enables the employees to gain access to non-codified external knowledge (NSEC); new practices of improving learning and knowledge sharing within the firm (PLKS); new management systems for general production or supply operations (MSPS); new methods that reduce costs of suppliers (MRCS). The second factor (3 items) includes items related to innovation in the workplace organization. The items associated with it are: a new workplace organizing method that reduces administrative and internal transaction costs (RATC); a new approach of improving workplace satisfaction (IWC); new methods for distributing responsibilities and decision making among employees for the division of work within and between firm activities (and organizational units), as well as new concepts for the structuring of activities (MDR). The third factor includes only one item and it deals with innovation in external relations. This item was articulated as new methods in a firm external relations that involve the implementation of new ways of organizing relations with other firms or public institutions (MER).

The result of the exploratory factor analysis is illustrated in Fig.1 and Table.1. Three subtypes of ORI have been indicated initially. The exploratory factor analysis demonstrated that these three ORI subtypes are supported by different items. The cumulative explanation factor is 75.6.

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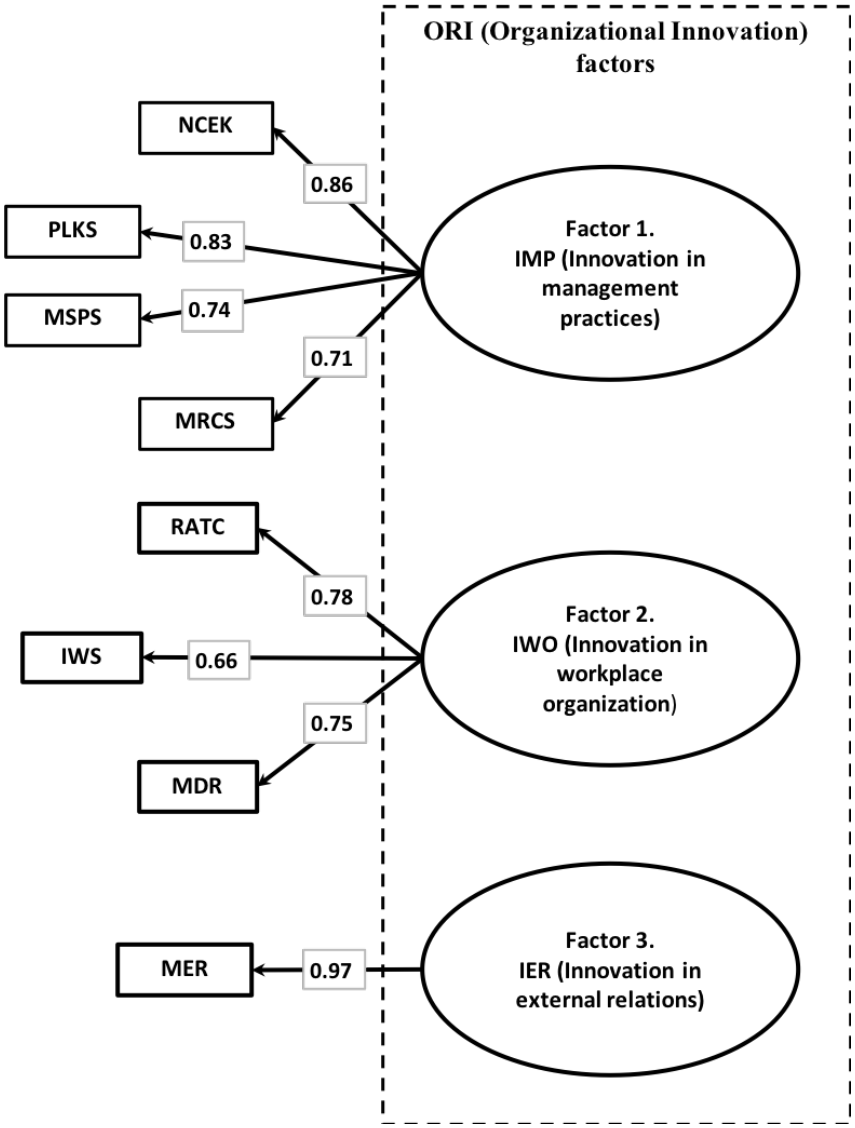

Fig. 1. The graphical model of the exploratory factor analysis

To test the hypotheses for the factorial validity of the identified factors, a confirmatory factor analysis was carried out. The results of an exploratory factor analysis (3 factors, 8 items) were used as an a priori hypothetical structure of the scales. The values for the model fit measures are as follows: Chi-square/df = 1.77; CFI = 0.86; GFI = 0.936; AGFI = 0.87; SRMR = 0.98; RMSEA = 0.04; PCLOSE = 0.96. These measures indicate an acceptable model fit (Hair et al. 2010).

Further, the scale reliability was tested for internal consistency by using the Cronbach's alpha method. The Cronbach's alpha for the data set equals 0.87 which suggests high reliability of the scales in terms of their internal consistency (DeVellis, R.F., 2012). In addition to the calculation of the Cronbach's alpha for each scale, the Cronbach's alpha ratio was calculated for each of the scale provided one item masked. The results showed scale reliability as none of the items were superfluous.

Table 2 demonstrates the results of a correlation and regression analysis that was applied in order to determine the impact of firm age and size on ORI activities. A linear regression model was calculated for each pair of considered variables.

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Table 1. Organizational Innovation. Results of the factor analysis applied to OI variables.

ORI sub-type				Factors		
Innovation in management practices	IMP	Mean	Std. Dev.	1	2	3
A system that enables employees gain access to non-codified external knowledge	NCEK	4.07	1.86	0.86		
New practices improving learning and knowledge sharing within the firm	PLKS	4.10	1.68	0.83		
New management systems for general production or supply operations	MSPS	4.11	1.64	0.74		
New methods that reduce costs of suppliers	MRCS	3.95	1.64	0.71		
Innovation in workplace organization	IWO					
A new workplace organizing method that reduces administrative and internal transaction costs	RATC	3.97	1.65		0.78	
A new approach to improving workplace satisfaction	IWS	3.80	1.65		0.66	
New methods for distributing responsibilities and decision making among employees for the division of work within and between firm activities (and organizational units), as well as new concepts for the structuring of activities	MDR	3.43	1.63		0.75	
Innovation in external relations	IER					
New methods in a firm's external relations that involve the implementation of new ways of organizing relations with other firms or public institutions	MER	4.29	1.61			0.97
	% Total			54.41	11.38	9.84
	Cumulative			54.41	65.79	75.63

Further, the scale reliability was tested for internal consistency by using the Cronbach's alpha method. The Cronbach's alpha for the data set equals 0.87 which suggests high reliability of the scales in terms of their internal consistency (DeVellis, R.F., 2012). In addition to the calculation of the Cronbach's alpha for each scale, the Cronbach's alpha ratio was calculated for each of the scale provided one item masked. The results showed scale reliability as none of the items were superfluous.

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The results prove that firm age impacts some ORI subtypes. Nevertheless, this impact is not very strong and for some relations the regression coefficients do not demonstrate significant values.

Among the ORI subtypes that encompass the "innovation in management practices" factor (IMP), the highest value of regression coefficient (0.67) received the item that deals with systems that enable employees to gain access to non-codified external knowledge. This could mean in general that the older firm is, the more information systems are put into use. Obviously, those systems being implemented have a positive impact on the ORI activities in the firm. The next ORI item, "new practices of improving learning and knowledge sharing within the firm" scored a regression coefficient of 0.56.

We did not find any significant relationship between firm age and the two other items of the IMP, namely "new management systems for general production or supply operations" and "new methods that reduce the costs of suppliers". This is evidence that firms do not develop systems and methods on a systematic basis by getting older.

As for the value of the IMP calculated as an average of the incorporated items (NCEK, PLKS, MSPS, and MRCS), the regression coefficient of the relationship between a firm's age and IMP received a value of 0.4 ($p<0.1$).

As for the second ORI subtype "innovation in workplace organization" (IWO), the only item of ORI that proved to have a statistically significant impact from the firm age variable with a regression coefficient of 0.44 was the item "new workplace organizing method that reduces administrative and internal transaction costs". As for the value of the IWO calculated as an average of the three incorporated items (RATC, IWC, and MDR), no substantial relation was found between the firm's age and IWO.

Finally, the third ORI factor "innovation in external relations" that encompasses only one variable "new methods in a firm's external relations that involve the implementation of new ways of organizing relations with other firms or public institutions" received a regression coefficient of 0.43 ($p<0.1$).

The ORI subtypes do not experience strong influence from firm size. Only two subtypes of ORI out of eight demonstrated statistically significant relation with a firm size. They are "New practices of improving learning and knowledge sharing within the firm" and "New management systems for general production or supply operations" with the regression coefficient 0.56. Thus, is the evident that a firm's size has very limited impact on ORI as a whole. Graphically, the significant relations are presented in Fig.2.

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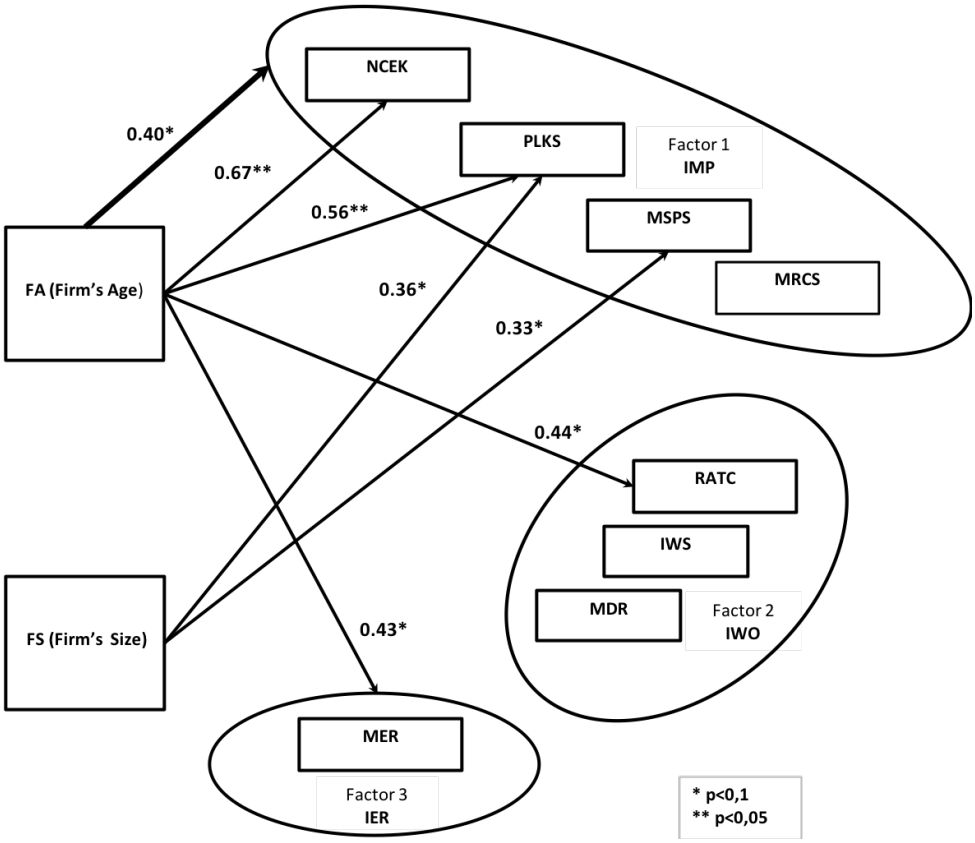

Fig. 2. Graphical model of the significant relations found.

Based on the results of the analysis, we can state that the proposed hypotheses:

H1a. ***Firm age has a positive effect on innovations in the management practices (IMP) in the firm - accepted.***

H1b. ***Firm age has a positive effect on innovations in the workplace organization (IWO) in a firm – accepted.***

H1c. ***The firm age has a positive effect on innovations in external relations (IER) in a firm – accepted.***

H2a. ***Firm size has effect on the innovations in management practices (IMP) in a firm – rejected.***

H2b. ***Firm size has effect on innovations in the workplace organisation (IWO) in a firm – rejected.***

H2c. ***Firm size has an effect on innovations in external relations (IER) in a firm. - rejected.***

Table 2. Results of the correlation and regression analysis.

		Structural path	Correlation coefficient	Regression coefficient	t-value	p-value
IMP (Factor 1)	FS (Firm's Size)	**FA → IMP**	**0,209**	**0,402**	**1,925**	**0,058**
		FA → NCEK	**0,262**	**0,669**	**2,442**	**0,017**
		FA →PLKS	**0,246**	**0,559**	**2,286**	**0,025**
		FA →MSPS	0,137	0,110	1,246	0,216 n.s.
		FA →MRCS	0,043	0,091	0,386	0,701 n.s.
	FA (Firm's age)	FS → IMP	0,124	0,213	1,127	0,263 n.s.
		FS →NCEK	0,086	0,196	0,777	0,439 n.s
		FS →PLKS	**0,179**	**0,362**	**1,639**	**0,095**
		FS →MSPS	**0,174**	**0,329**	**1,593**	**0,100**
		FS →MRCS	-0,019	-0,036	-0,172	**0,864 n.s**
IWO (Factor 2)	FA (Firm's Age)	**FA → IWO**	**0,182**	**0,319**	**1,664**	**0,100**
		FA → RATC	**0,198**	**0,436**	**1,817**	**0,073**
		FA → IWS	0,141	0,295	1,278	0,205 n.s.
		FA → MDR	0,107	0,226	0,964	0,338 n.s.
	FS (Firm's Size)	FS → IWO	0,132	0,206	1,198	0,235 n.s.
		FS →RATC	0,138	0,270	1,250	0,215 n.s.
		FS →IWS	0,056	0,105	0,508	0,613 n.s.
		FS →MDR	0,129	0,243	1,169	0,246 n.s.
IER (Factor 3)	FA (Firm's Age)	**FA → MER**	**0,197**	**0,427**	**1,806**	**0,075**
	FS (Firm's Size)	FS →MER	-0,031	-0,060	-0,281	0,780 n.s.

5 Discussion

The main contribution of the study is in investigating the relation between a firm's age and size and its ORI. It should be noticed that unlike the largest part of the literature on innovation, our study focuses on organizational innovation. For the purpose of our study, the ORI activity was considered at the level of the ORI subtypes.

Studies on how the probability of innovation depends on a firm's age and size play an important role in understanding ORI behavior (Huergo and Jaumandreu, 2004).

Some of the studies that have dealt with the problem of the impact of a firm's age on its ability to innovate (Van de Ven,1986; Damanpour, 1987; Kelly and Amburgey, 1991; Huergo and Jaumandreu, 2004; Acemoglu et al., 2013; Cucculelli, 2014; Coad et al., 2016) have reported this relation as negative. On the other hand, Audretsch and Mahmood (1995) suggest that innovation provides heterogeneous mechanisms that ensure a firm's survival as they mature. The research has underlined the role of organizational change to implement new organizational forms and management practices to ensure a firm's survival and its further development (Freeman and Perez, 1988). For example, Sapprasert and Clausen (2012) reported a positive relation between a firm's age and its organisational innovation (ORI) supporting the proposition by Audretsch and Mahmood (1995). Our findings are coherent with these studies though they come from

a different industrial and national context. We found that the intensity of the organisational innovation relates positively to the firm's age.

Firm size is usually considered an important factor in the innovation process (Vaona and Panta, 2008). Furthermore, contrarily to our findings, several studies have found a positive relation between ORI and firm size (e.g. Sapprasert and Clausen, 2012). However, it is technological innovation that the majority of studies in this field consider in the context of firm size (Blau and McKinley, 1979; Camison-Zornoza et al., 2004). Due to this, the evidence on the relationship between a firm's size and its ORI activity is not complete (Damanpour, 1992; Damanpour, 1996; Camison-Sullivan and Kang, 1999; Zornoza et al., 2004). Our findings show that a firm's size has no impact or has a very weak impact on the ORI subtypes. This supports those scholars who argue that firm size does not significantly influence the ORI (Mohr, 1969; Utterback, 1974; Kohn and Scott, 1982) and/or its subtypes (Downs and Mohr, 1976; Tansel and Gazioglu, 2014). Due to the ambiguity of the results for firm size and age these variables have sometimes applied as control variables in innovation research (Roxas et al., 2014).

Alternative explanation for a positive relationship between a firm's age and the ORI in contrast to a negative relationship between a firm's age and technological innovation can be derived from the finding by Bianchini et al. (2018). Surprisingly, they found a strong reverse effect of the quality of corporate governance on technological innovation. The former, like our results, refers to the organizational rather than the technological domain and corporate governance strengthens with the maturity of a firm. Hence these findings support the negative relationship between a firm's age and technological innovation. We could assume that our research outcome indicates organizational consolidation as a firm matures in the case that this consolidation involves ORI activity. Mature firms have often gained the capacity to develop more management systems, generate more knowledge, and are more active in developing external relations. Consequently, we may assume that that organisational innovation (ORI) can be described by three subtypes. These three ORI subtypes are known as ORI in management practices, ORI in workplace organization, and ORI in external relations. The three subtypes singled out are very much in line with the existing conventional understanding of the nature of ORI (e.g., Murphy, 2002; OECD-EUROSTAT, 2005; Uhlaner et al., 2007)

Our study also provides practical implications for innovation management. On the one hand, the importance of innovation for the progress of particular firms and specific industries, and, on the other hand, the inverse relationship between the age of the firm and the intensity of innovation that was revealed in some studies, can be considered as the starting point for developing practical recommendations aiming at stimulating innovation. Possibly the most radical proposal based on this assumption is the suggestion by Acemoglu et al. (2013) to tax the mature firms which are considered less innovation-intensive and then to relocate collected funds to more innovative recent entrants In the light of our results, such a proposal might be counterproductive as our study indicates that the intensity of ORI increases along with organizational maturity. Moreover, it is a response to the challenge of offsetting the barriers to future growth that have been accumulated by aged firms. The existence of such barriers was postulated by Geroski (1995), who considered them to be stronger than those to market entry. Hence one can expect, a significant economic impact from ORI activity in mature enterprises because these entities, and not new entrants, account for the bulk of economic output and employment.

Some studies (e.g., Le Mens et al., 2014) argue that a firm's adaptive capacity decreases with age. Our findings in the context of the ORI subtype "innovation in external relations" suggest the opposite. The factor corresponding to the given subtype is represented by a single but a significant variable and is well associated with a firm age. Based on these findings, openness can be considered as an important strategy for survival of complex aged organizational systems with increased entropy. It provides another rationale for open innovation that has gained its share of

attention in mature economies over the last 15 years. From this perspective, open innovation should be approached by older firms as a kind of external arrangement for survival as it should be facilitated primarily for the exploitation of external knowledge rather than more traditionally to acquire external knowledge (Torkkeli et al., 2009).

This study has some inherent limitations that are worth noting. Despite the relatively limited number of responses collected the results are indicative. On the other hand, to develop the results, comparative data from firms of specific industries should to be examined. The analysis of firm ORI performance covered a time period of three years. In order to strengthen the findings, the period of time for the analysis could be enlarged. The number of indicators for each of the scales should be increased. However, our study increases the understanding on the shared theory of ORI and firm performance.

One more limitation is that the results only provide knowledge about the direction of the innovation intensity change but not the shape of the function that underlies it. For example, this function might be U shaped. According re Audretsch and Mahmood (1995) the initial stage of a firm's development is by definition innovation-intensive. Juxtaposing the assumption that ORI is intensive in the initial stage with our results would produce a U-shaped function that is likely skewed to the one or another side.

This study provides several research avenues to understanding the mechanisms underlying the positive relationship between ORI and a firm's maturity, as well as its influence on a firm and industrial dynamics.

The first research avenue is to address the issue of complexity, which is generally missed in the research into the relationship between innovation and a firm's age and size. This issue could be addressed by the incorporation into the research model of structural complexity, which Damanpour (1996) proposed as a candidate as a direct antecedent of organizational innovation. In this case, a firm's age, and probably also its size, have an impact on organizational innovation because structural complexity increases as the firm matures. If developing this approach, a set of dependent variables of structural complexity instead of age and size as proxies should considered as independent variables of the ORI subtypes applied in the our study.

The second research direction could be to clarify barriers to firm survival (Geroski, 1995) which organisational innovation is most probably intended to offset. The conclusions based on the results of our study could also be enriched with an account of idiosyncratic characteristics of an industry and a country. The inherent limitation of our study was set by the sample representing only Russian manufacturing firms. Following the evolutionary approach by Nelson and Winter (1982), conditions for survival depend on the technological and industrial context. Particularly, for a better understanding the role of the ORI and its subtypes in offsetting barriers to a firm's survival, we need to have a better understanding of organizational change occurring in day-to-day operations. In this respect, a firm's age in relation to the ORI could be considered just as a proxy for the dynamics of the routine regime.

An interesting extension of this research direction would be to simultaneously model the dynamics of organizational and technological innovation in consistency with the firm's life-cycle. We can assume that at different stages, the intensity of ORI activity would vary. The discrepancy between our findings related to the positive impact of a firm's age on its ORI activity and the negative character of this impact in the case of technological innovation (e.g. Kelly and Amburgey, 1991; Cucculelli, 2014; Coad et al., 2016) requires alternative explanations which should be tested. The first is that the intensity of ORI may be contrary to that of technological innovation, similar to the negative relation found by Bianchini et al. (2018) regarding corporate governance and technological innovation. To prove this means to challenge the existence of a close association or even symbiotic relationship between organizational and technological innovation.

The alternative explanation that should be tested is that ORI simply fails to offset the negative influences on technological innovation accumulated as a firm ages.

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Appendix 1. Findings and the empirical characteristics of relevant prior studies.

Table 1. Companies and institutions interviewed

A Source	Research type	The main results pertained to the study	Research base
Acs and Audretsch, 1988	Empirical	Large firms compare to SMEs are more active in technological innivation	Analysis of 4476 innovations occurred in the U.S. manufacturing industries in 1982
Aiken et al., 1980	Empirical	The relation between the size of a firm and the rate of innovation adaption is positive	750 questionnaires administered to managers of various firms in Belgium
Antoncic and Antoncic, 2011	Empirical	The level of employee satisfaction in older firms is lower than in younger firms	149 firms in Slovenia
Anwar and Hasnu, 2017	Empirical	Firms' external relations are moderating more by the specific industry then by the firm size	Empirical analysis of seven years financial data of 307 joint stock firms from 12 industries
Badillo et al., 2017	Empirical	Regarding research and development activities small firms cooperate less frequently than big ones	The data from the surveys done in 2010 and 2013 by the Technological Innovation Panel
Bhattacharya and Bloch, 2004	Empirical	Firm's size, market structure, profitability and growth have strong impact on innovative activity in small to medium sized manufacturing businesses	The sample includes 1213 business units of Australian manufacturing firms
Blau and McKinley, 1979	Empirical	Firm's size is among the most important determinants for innovation activity having the positive impact on it	The sample consists of 77 large firms of Manhattan
Bordonaba- Juste, 2012	Empirical	Medium-sized and large firms are more likely to use e-business in establishing new forms of customer relations	3272 e-business firms from 9 countries
Brouwer and Kleinknecht, 1999	Empirical	When compared to small firms, large ones are more active in formalizing TI, e.g. receiving patents for engineering solutions	The sample of 1728 manufacturing businesses in Europe
Camison-Zornoza et al., 2004	Meta-analysis	The firm's size is among the most important determinants for innovation activity having the positive impact on it	The sample was made up of 87 correlations drawn from 53 empirical studies published in the most important journals on business administration.
Campos-Climent and Sanchis-Palacio, 2015	Empirical	Results show the absence of a significant positive relationship between size and performance in agro-food firms.	Agro-food firms in Spain

A Source	Research type	The main results pertained to the study	Research base
Coad et al., 2016	Empirical	Compare to the younger firms, older ones more actively try to establish relations with partners related to research and development. Small firms have neither need no resources for placing orders with outsourced partners for research and development.	The data source is the Technological Innovation Panel between 2004 and 2012 of Spanish manufacturing and service firms
Damanpour, 1984	Empirical	Libraries adopt technical innovations at a faster rate than administrative innovations. The degree of organizational innovation is inversely related to organizational performance. Organizational and technical innovations have a higher correlation in high-performance organizations than in low-performance organizations. The adoption of administrative innovations tends to trigger the adoption of technical innovations more readily than the reverse.	The sample of 85 public libraries in the U.S.
Damanpour, 1996	Meta-analysis	In large and more complex firms size as such stimulates knowledge flow within the firm, thus accelerating innovation.	21 studies that include 36 correlations
Damanpour, 2006	Empirical	Each a firm organizational characteristics accounts for unique variance in the adoption of innovation. There is no difference in the direction of effects of any antecedent, but did find differences in the significance of effects of several antecedents, on the phases of innovation adoption	The sample of approximately 1200 public organizations in the U.S.
Damanpour, 2008	Empirical	The both innovation characteristics and manager characteristics influence the adoption of innovation; however, they do not reveal significant moderating effects of manager characteristics on the relationship between innovation characteristics and innovation adoption	The sample of 1276 managers/chief administrative officers of municipalities with populations of 10000 or more in the U.S.

A Source	Research type	The main results pertained to the study	Research base
Damanpour, 2010	Meta-analysis	The firm's size has the impact on some of innovation types, but the influence is primarily due to the effect of size on process, not product, innovations	28 independent samples from the 20 primary studies
Davidsson and Delmar, 1997	Empirical	The development of a young firm involves the innovative development of the organization	8562 firms that in November 1996 were in the private sector of Sweden and had at least 20 employees
DeTienne and Koberg, 2002	Empirical	characteristics influence the adoption of innovation; however, they do not reveal significant	192 managers across the U.S.
Dufour and Son, 2015	Case study	In order to receive new knowledge, old firms are forced to elaborate continuously their network, which increases the probability of elaborating organizational innovation in the area of external relations	Case study
Fennel, 1984	Empirical	Large firms have more access to information regarding innovation that allows them to select appropriate ones to adapt from the broader selection	The sample of 173 firms of the Sate of Illinois, U.S.
Fort et al., 2013	Empirical	Small firms have lower capacity in establishing relations with the customers and consumers	The U.S. Census Bureau's dataset
Gopalakrishnan and Damanpour, 1997	Empirical	Age and size have differentiated impacts on specific subtypes of the organizational innovations. The complicated organizational structure of some large firms might decrease the dynamics of information flow	1075 reported innovations from commercial banking industry
Gopalakrishnan and Bierly, 2006	Empirical	Young firms that focus on developing their technological competences are active in enlarging their external connections to gain access to niche-based knowledge, though the old firms are active in all kinds of external relations. A firm's size and age influences the success of firm knowledge strategies	The population of 27 firms from the drug delivery sector of the pharmaceutical industry
Hafkesbrink and Schroll, 2014	Conceptual	Employee satisfaction is considered as a powerful mechanism for increasing the overall performance of a firm.	n/a

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A Source	Research type	The main results pertained to the study	Research base
Hafkesbrink and Schroll, 2014	Conceptual	Studies of those firms might provide new insights on how a firm could go through the process of economic and technological changes within the firm over a long period	n/a
Hajjem, 2016	Empirical	The size of industrial firms has no any significant influence on management practices	47 Tunisian firms certified or undergoing certification according to ISO 9001: 2000
Huergo and Jaumandreu, 2004	Empirical	The probability of innovating widely varies according a firm's activity. Small size of a firm reduces the probability of innovation. Young firms demonstrate the highest probability of innovation while the aged firms tend to show lower innovative probabilities	The panel includes 582 firms in Spain surveyed during the years of 1991-1998
Ismail and Jenatabadi, 2014	Empirical	Younger firms often have no experience enough to process the weak signals that they receive from the business environment in order to adjust their external relations to forthcoming situation	30 airline companies that have being operated in the Asia Pacific region in 2006–2011.
Kalkan et al. 2011	Empirical	There is no relation between size and firm performance	125 firms which use information technologies in their operations in Isparta, Turkey
Kelly and Amburgey, 1991	Empirical	The level of bureaucracy in a firm increases over the years, new and strong formal procedures appear, as well as authority becoming centralized	136 air carriers in the U.S.
Kilenthong et al., 2016	Empirical	Smaller firms are slightly more active compare to large firms in establishing some activities related to customer relations. Age of a firm does not matter in a firm's activity with customers	752 business owner structured interviews
Kim, 1980	Empirical	The relation between the size of a firm and the rate of adoption of innovation is positive	The sample consists in 31 manufacturing organizations

A Source	Research type	The main results pertained to the study	Research base
Kimberly and Evanisko, 1981		A firm's size has a positive impact on both TI and NTI. Medium-size firms are less bureaucratic in taking decisions on implementing IWO, as the risks of having negative effect from changes are less costly	The sample of approximately 1000 U.S. hospitals
Kohn and Scott, 1982.	Conceptual	The complexity of large firms might create barriers to implementing innovation as well as extending the way from innovation identification to its adoption, thus reducing the positive effect of a firm's size upon innovativeness	n/a
Lun and Quaddus, 2011	Empirical	Customer relations in many aspects are more sophisticated and developed in large firms compare to small ones.	98 container transport operators in Hong Kong
Minguela-Rata et al., 2014	Empirical	The larger a firm is the more active it cooperates technologically with suppliers	1952 companies representing the Spanish manufacturing industries
Mohr, 1969	Empirical	There is no impact of firm size on innovation activity	94 agencies full-time local health departments in Illinois, Michigan, New York, Ohio, and Ontario (U.S.)
Montoro - Sanchez, 2011	Empirical	Organizational innovation related to management practices is the key factor in the creation and diffusion of new knowledge. In order to receive new knowledge, old firms are forced to elaborate continuously their network which increases the probability of elaborating organizational innovation in the area of external relations).	The sample is based on the CIS survey and includes 784 European companies
Ono and Stango, 2005	Empirical	Outsourcing models differ for large and super-large firms, which points to differences in network patterns. Large companies are much active in outsourcing in comparison to small ones.	The sample of approximately 10000 Credit Units operating in the U.S. in 1994–2003 according the National Credit Union Administration
Reger et al., 1992	Empirical	A firm's age and size has a strong effect on innovation activity.	The sample of 530 bank holding companies of the U.S.

A Source	Research type	The main results pertained to the study	Research base
Santarelli and Piergiovanni, 1996	Empirical	Firm size is another characteristic of a firm that numerous scholars approached in trying to prove Schumpeter's proposition that large firms are more active in TI as they have more resources available, including financial, human, organizational, and intellectual.	The database(PRODIN89) comprises all innovations reported in the complete 1989 volume of a sample composed by 25 Italian technical firms
Som at al., 2012	Empirical	Age and size of a firm have the strong impact on organizational innovation activity though the effect of the impact depends on the organizational innovation sub-type.	CIS Europe-wide study carried in the years of 2010-2012 with the sample of 127674 firms
Tansel and Gazioglu, 2014.	Empirical	Aged firms are forced to develop the Organizational innovation related to working place improvement. In large firms, the level of employee satisfaction is on a lower level compared to smaller ones, which is evidence of the underestimation of management-employee approaches and the neglect of employee-care policies in large firms	The study uses the data from the 1998 Workplace Employee Relations Survey (WERS), of the Department of Trade and Industry in Britain.
Temtime, 2003	Empirical	The large firms implement TQM practices more intensively compared to small firms, though the relation between firm size and TQM practice implementation is not very strong	54 SMEs in the Republic of Botswana
Tether, 1998	Empirical	argues that large firms introduce a considerable amount of high-value innovations while small firms are active in the introduction lower-value innovations. Firm size is another characteristic of a firm that numerous scholars approached in trying to prove Schumpeter's proposition that large firms are more active in TI as they have more resources available, including financial, human, organizational, and intellectual	The database of significant innovations introduced in the UK during the 1980s

A Source	**Research type**	**The main results pertained to the study**	**Research base**
Van de Ven, 1986,	Conceptual	The internal barriers that prevent innovation activity grow, as a firm ages	n/a
Vaona and Panta, 2008	Empirical	A firm's size has positive impact on innovation process	The sample is based on CIS 2 data at the industry level for 22 manufacturing sectors in 8 European countries.
Wagner and Hansen, 2005	Empirical	The firm size does not influence firms' ORI activity	35 U.S. firms based in different states
Walker, 2010	Empirical	Organizational innovation does not have a direct impact on organizational performance.	136 respondents from unitary and upper tier authorities in the UK
Zhou, 2018	Empirical	Small firms cannot easily establish international cooperation because usually they experience lack of the resources	535 manufacturing firms
Zmud, 1984	Empirical	The size has a positive impact on both TI and non-technological innovations	57 software development manager who were responsible for managing an internal software group

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Embracing systematic futures thinking at the intersection of Strategic Planning, Foresight and Design

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Abstract. In this conceptual paper, we review the literature spanning the Strategic Planning, Foresight and Design disciplines with the emphasis placed on how innovation stakeholders may engage with the future in order to explore the challenges to decision-making they highlight. From this review, and a series of facilitators identified by the authors in previous design and futures thinking field research, critical perspectives are presented that illustrate how systematic futures thinking can inform decision-makers concerning the innovation challenges and opportunities emerging over medium and longer-term (5-15 years) time horizons of social and technology environments. Combining Foresight and Design in an approach we call "Foresight by Design", as part of Strategic Planning processes, can help the emergence of new and more creative possibilities, foster the inclusion and alignment of diverse stakeholders, and provide for ongoing learning through prototyping and experimentation by using design tools and approaches to achieve deeper insight and alignment around current reality, to facilitate a more productive conversation across difference, to aid in specifying a portfolio of desirable futures, and to engage ecosystem partners in active experimentation that generates new knowledge and learning.

Keywords. Innovation; Foresight; Design Thinking; Futures Thinking.

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1 Introduction

Amid accelerating environmental complexity and uncertainty, meeting the demands of rapid social, technological and environmental change draws continued attention to how organizations envision their preferred futures and strategic direction (Hamel & Valikangas, 2003). Driven by globalization, digitization, commoditization and politicization, business leaders struggle to create and maintain competitive advantage through innovation activities, while operating in an ever-more interconnected world, where few can retain a competitive edge independently of others (Ireland & Hitt, 1999). Across nearly all sectors of the economy, the axiom is that organizations have to respond to change in fundamentally new ways if they are to be successful in the future.

One of the particular areas of concern relates to time horizons. In spite of the wide-spread acknowledgement of growing uncertainty over the rapidly changing external macro-business environment, most product or service solutions continue to be informed by current market needs, and over the short-term (1-3 year) time horizon (Heger & Rohrbeck, 2012; A. Wilkinson, Mayer, & Ringler, 2014). More recently, this development has prompted a call for business leaders and educators to become more forward thinking, and to develop the organization's innovation and creative capabilities to remain feasible in the long-term (Kock, Heising, & Gemünden, 2015; Koen et al., 2002; Meroni, 2008; Van der Laan & Yap, 2016). Making decisions based on simply projecting today's market trends into the future is untenable (Saritas & Smith, 2011; Vecchiato, 2015).

Three areas deeply concerned with these issues, in both theory and practice, are Strategic Planning, Foresight and Design. In each, scholars focused on thinking about the future are devoting increased attention to exploring the important question of what constitutes the most effective organizational processes for crafting successful long-term direction (Hamel, 2002; Heskett, 2009; Hofer & Schendel, 1978; Rohrbeck, Battistella, & Huizingh, 2015; Slaughter, 2002). But they have often done so without reference to parallel work underway in other disciplines. In this article, we address this omission by examining independently, key themes at work in these three fields, and the opportunity that integrating aspects of this work across the three areas might hold for improving the adaptability and innovation capacity of organizations though improved strategic planning processes that incorporate both Foresight and Design tools and approaches.

From our review, we draw attention to gaps in understanding of how practitioners learn to navigate disruption, make sense of complexity, and deal with uncertainty to envisage the medium and longer-term futures (5-15 years) of social and technology environments. Derived from our own previous design and futures thinking field research, key conceptual foresight facilitators are identified, which form the basis for an approach to systematic futures thinking we refer to as "Foresight by Design".

1.1 Foresight by Design – context and definition

One key contribution of this article is to propose for consideration how work at the intersection of these three fields could be fruitful. It argues for a new strategic and collaborative function "Foresight by Design", which combines design-led and systematic futures thinking of preferable and desirable futures, in ways that embrace their synthesis (Buhring, 2017; Buhring & Koskinen, 2017; Liedtka, 2017). Specifically, we argue that strategic decision-making processes can benefit from an integration of Foresight and Design techniques, thus advancing the strategic innovation decision-making conversation beyond short-term product and services aimed at meeting current

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market needs. Just as Futurists and Foresight consultants conduct environmental scanning to detect new events and drivers of change over the ten-year plus time horizons (Day & Schoemaker, 2006), and as Government Policy makers and large Corporations in durable goods and process industries apply long-range futures thinking (Fuerth, 2009), organizations practicing "Foresight by Design" can better prepare to deal with uncertainty over the medium and longer-term time horizon (5-15 years), as Figure 1 suggests.

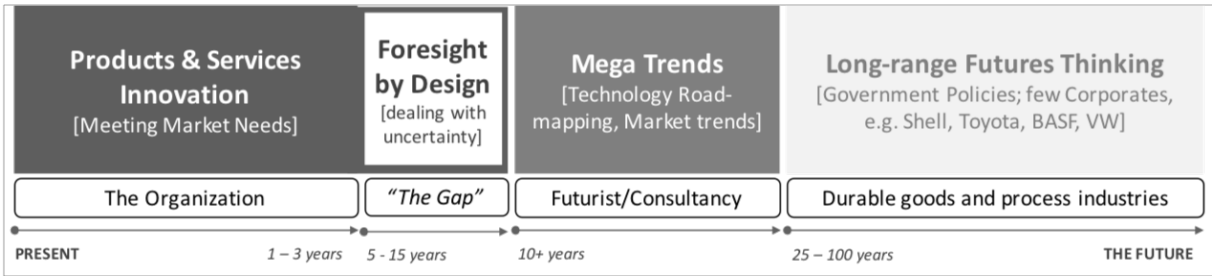

Fig. 1. "Foresight by Design" – addressing the 'systematic futures thinking' gap across the medium to longer-term time horizon

This kind of futures thinking would offer multi-disciplinary stakeholders a common language for employing Design thinking methodologies and Foresight techniques to inform strategic opportunities for innovation that build on shared visions of preferable or desirable futures. In this context, futures thinking can be seen as activities focused on detecting medium to longer-range opportunities and possibilities for strategic innovation (Rohrbeck, 2012, p. 445). We begin with a broader look at the literature on formal planning processes, their evolution, and the areas in need of additional research and practice improvement that scholars observe.

1.2 The Role of Strategic Planning

Reports of the "fall of strategic planning" (Mintzberg, 1994) are greatly exaggerated, argue Vaara and Whittington (2012) in their definitive review of scholarship around strategy as practice, published in the Annals of the Academy of Management. Despite long-standing and widespread disillusion with their organizations' strategic planning processes among executives, they remain one of the most widely used management tools. Wolf and Floyd (2017, p. 1758), in the most comprehensive review of the Strategic Planning literature to-date spanning three decades of research, define strategic planning as a "more or less formalized, periodic process that provides a structured approach to strategy formulation, implementation, and control," whose purpose is to "influence an organization's strategic direction for a given period and to coordinate and integrate deliberate as well as emerging strategic decisions." They note continuous evolution in the conceptualization of the topic, with recent emphasis on more social perspectives: while earlier studies emphasized formal techniques like SWOT and competitor analysis, and long run forecasting, strategic change and adaptation are seen as increasingly important. Both they and Vaara and Whittington (2012), highlight several important emerging areas in need of the development of both better theory and practice: (1) strategy as emergent rather than planned a priori; (2) the involvement of broader groups of stakeholders in planning processes, and (3) the failure to translate strategic plans into organizational outcomes.

Other scholars have explored similar weakness in planning processes. The success of a strategic plan is reliant on adequate information that informs the objectives, strategies, decision-making, and measuring of results against a set of goals (Miller & Cardinal, 1994). The lack of certainty

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results from a state of having limited knowledge over the existing externalities, the future outcome, or possible outcomes (Simon, 1955). Furthermore, strategic decisions are primarily derived from interpreting information about the past and present (Mintzberg, 1994), in an environment where single point predictions are often inaccurate.

Developing an organization's strategic innovation direction against a rapidly evolving business environment poses challenges, as Mintzberg's classic indictment of planning (1994) alleges. Clark and Fujimoto (1991) also argue that the process-driven approach to strategic planning can impose constrains on creativity and the ability to imagine more disruptive innovations. Studies in the field of Strategic Management have noted that strategic planning and strategic thinking are two distinct thinking modes. Strategic thinking is intuitive, experimental and disruptive, and applied to formulate a vision of where the organization should be heading (Heracleous, 1998; Liedtka, 1998), versus strategic planning as being more formal, procedural and analytic. Yet, creativity and imagination must be considered as important factors when the objective is to detect emerging opportunities, or threats, resulting from macro drivers of change in a company outside environment. Thus, incorporating more strategic thinking into planning processes is a major concern.

Other work grounded in the social constructionist perspective has argued for a view of strategic planning as a communicative process (Spee & Jarzabkowski, 2011), in which talk and text intersect in a recursive way that reduces variance in employees' interpretations. In a similar vein, Johnson, Prasantham, Floyd and Bourque (2010) assert that planning tools like scenarios often fail due to social dynamics, not fit, and that managing managerial anxiety through the building of community (which they refer to "communitas") and mitigating the effects of hierarchy ("anti-structure") are key to accomplishing this. In each of these areas that challenge planning, we will argue, a "Foresight by Design" approach can make significant contributions.

1.3 The Role of Foresight

Most scholars situate Foresight activities as one segment of strategic planning processes (Cuhls, 2003; Voros, 2003). The Foresight discipline encompasses a wide range of approaches and activities designed to help business stakeholders deal with uncertainty (Inayatullah, 2008). Slaughter (2002), in Voros (2003, p.4), positions foresight applied in business as a pragmatic approach to addressing the strategic questions of how to survive in an increasing competitive environment. Foresight methodologies use techniques such as macro trend analysis and expert knowledge to explore alternative futures (Figure 2) and classify them into possible *(might happen)*, plausible *(could happen)*, probable *(likely to happen)*, and preferable *(wanting to happen)* (Hancock & Bezold, 1993; Voros, 2001).

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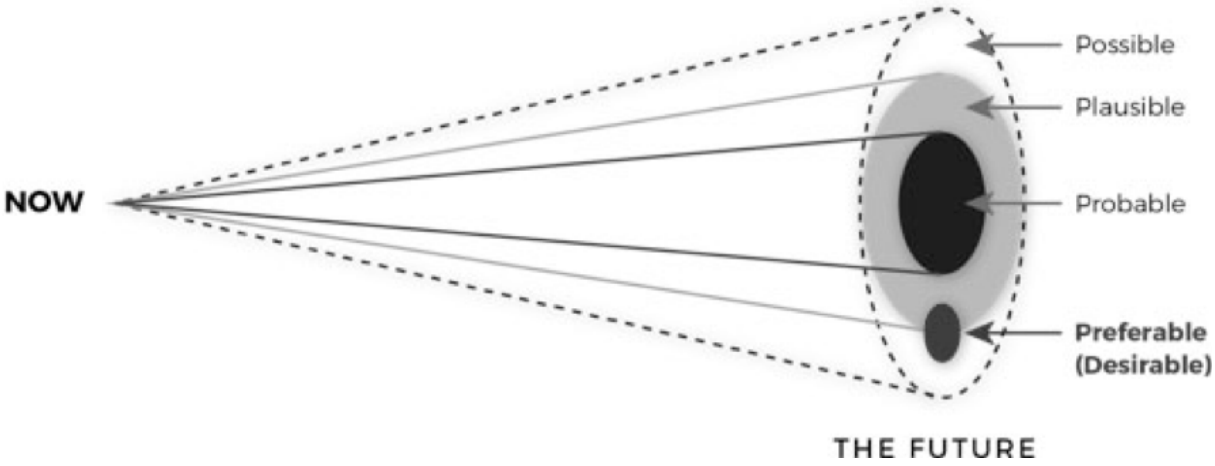

Fig. 2. The "future cone" - adapted from Hancock and Bezold (1993)

The objective of Foresight is to consider different ways (alternative futures) in which the external environment may evolve over the next 5 - 15 years, or even longer (Dator, 2009; Slaughter, 2002; Voros, 2003). To illustrate its significance, innovation stakeholders ask, "what would the response to uncertainty have to be if a future were to unfold that was distinctively different from the one anticipated in the current strategic innovation plan"? Foresight methodologies express these types of inquiries in form of futures scenario statements that help prepare for, or actively shape the future (Bishop, Hines, & Collins, 2007). These methodologies are usually qualitative rather than quantitative in nature (Cuhls, 2003). The practice of Foresight is effective when decision-makers expand beyond subjective views of reality and consider more closely the relationship between objective reality (fact-based, measurable and observable) and possible futures (Mietzner & Reger, 2005). Thinking about different possibilities through futures scenario building allows decision-makers at the strategic end of innovation to envisage different future possibilities and outcomes. Consequently, a systematic approach to futures thinking is based on futures scenarios that explore holistic, integrated, and alternative futures, that contain tangible images of how preferable and desirable futures might be shaped. Contrary to the conventional practice of extrapolating trends from the present, as in forecasting, futures scenarios are speculative images of preferable and desirable futures that form a necessary foundation of the scenario planning process (Slaughter, 2000; L. Wilkinson, 1997).

Like Strategic Planning, Foresight approaches have called for broader inclusion of more "non-expert" stakeholders (Cuhls, 2003) and have evolved to incorporate more of a social dimension (Chan & Daim, 2012). Preferable futures, Voros (2003, p.14) notes, "are more emotional than cognitive". Inayatullah (2008) argues for a deeper level of futures thinking, beyond just adding skills through Foresight training, to enhance employees' confidence that they can create the future that they desire. Similarly, Wilkinson, Mayer and Ringler (2014) describe a highly participatory, multi-stakeholder process they term "Transformational Foresight". Both they and Hines and Zindato (2016) explicitly call for greater integration of Design practices in Foresight work.

Combining Design and Foresight offers the promise of helping decision-makers deal more effectively with uncertainty as part of the strategic planning process; based on different possibilities, decision-makers can select and integrate the most preferable and desirable futures. After a brief introduction to the literature on Design, we will return to look more deeply at what the specifics

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of combining Foresight and Design might mean for enhancing the effectiveness of Strategic Planning processes.

1.4 The Role of Design

Though originally focused on the new product development field, the role of Design in business has gradually expanded beyond merely creating and communicating better products and services. Design is now understood by its totality of activities in form of competencies and capabilities that span the entire innovation eco-system, involving interdisciplinary stakeholder teams responsible for creating sustainable value propositions that ensure the organization's future (Bohemia, Rieple, Liedtka, & Cooper, 2014; Buhring, 2017; Heskett, 2001; Lojacono & Zaccai, 2004).

At its core, Design is a hypothesis-driven process, focused on learning and iteration. A central tenet of successful Design is that it sits at the intersection of possibilities, constraints, and contingencies (Buchanan, 1992). "Design Thinking", a term popularized by the innovation consultancy IDEO, incorporates three additions to traditional Design theory. The first is the emphasis on being user-driven; Design Thinking's focus on the particular is human-centered (to a degree that its predecessors in Design theory were not) with the development of empathy considered critical to successful use of the method (Patnaik, 2009). The second addition is an emphasis on the inclusion of a more heterogeneous set of voices in the Design process, with an attendant preference for co-creation and designing *with* rather than *for*. The third is the addition of a specific set of tools and activities, drawn primarily from Graphic-, Service-, Participatory- and Product Design fields. These tools include a variety of ethnographic research techniques like observation and interviewing, journey mapping, job-to-be-done (JTBD); ideation tools like brainstorming and concept development techniques; visualization tools like mind mapping and storyboarding for prototyping; and methods for the design of experiments to test the portfolio of solutions developed. Thus, Design Thinking accompanies traditional Design approaches with a toolkit that facilitates its operationalization in practice (Liedtka, 2011).

Design is increasingly positioned as an organizational competence that looks beyond one-time creative outputs (products or services), toward Design as an organizational activity that can lead to sustained innovation and competitiveness (Boztepe, 2016; Heskett, 2001; Mozota, 1998). Related research (Buhring & Koskinen, 2017) builds on studies of extreme users inspired by von Hippel's notion of lead users (Djajadiningrat, Gaver, & Fres, 2000), practices in crowdsourcing (Kurvinen, Koskinen, & Battarbee, 2008), and experience prototyping techniques (Buchenau & Suri, 2000). A recent trend in Design is also propounding fiction as a way to envisage or create futures (Bleecker, 2009; A. Dunne & Raby, 2013).

Progressive organizations over the past two decades have noted the favorable use of Design as a problem-solving approach, sparking the popularity of Design Thinking processes and applications toward transformative innovations in a global economy (D. Dunne & Martin, 2006; Liedtka, 1998; Oster, 2008), with the further potential for unifying interdisciplinary stakeholder conversations that enhance a collective's ability to align, learn, and change together (Liedtka, 2017).

1.5 Combining Foresight and Design in Service to Strategic Planning

Looking across these three literatures, we hypothesize that systematic futures thinking activities, in the form of "Foresight by Design", can improve strategic planning by combining Foresight's more objectively trend-based techniques with Design's subjective human-centered focus and toolkit. In this section, we offer evidence for that view by first looking at the aims of each of the three activities, and then at the tools they offer to practitioners. Finally, we consider

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the different ways each enters the futures conversation and what that suggests for the particular aspects of the future they are likely to focus on.

Beginning then, with the intent behind the deployment of each, we start with Foresight. Cuhls (2003) notes that the aims of foresight approaches include (among others): enlarging the choice of opportunities, ascertaining new needs and possibilities, defining desirable and undesirable futures, and stimulating continuous discussion. Not surprisingly, accomplishing each one of these aims is clearly essential to successful strategy-making processes operating in uncertain environments. Interestingly, these are also core aims of Design processes as well. Much of the Design Thinking tool kit aims at discovering unmet user needs and preferred futures, enlarging the opportunity space by reframing the problem, and creating a dialogue-based inquiry process to facilitate co-creation across diverse stakeholder groups (Ogilvie & Liedtka, 2011).

Even more interesting, given these shared ambitions, is the extent to which the tools related to each field are *not* shared, as a listing of selected tools in each illustrates:

- Strategic Planning: SWOT (strengths, weaknesses, opportunities, & threats), industry and competitor analysis, cognitive mapping
- Foresight: Delphi methods, environmental scanning, causal layered analysis, scenarios
- Design Thinking: ethnographic interviewing and observation, journey mapping, Job-to-be-done (JTBD), brainstorming, prototyping, and experimentation

The only tool overlapping all three methods is the use of scenarios, and even here, the deployment of that tool varies across the fields, as Hines and Zindato (2016) illustrate. In Design practice, typically, scenarios are developed to communicate, validate and endorse design decisions about user actions (Evans, 2003; Martin, 2009). In Foresight, scenarios are developed as stories about alternative futures at macro scale, or across whole systems (Hines & Zindato, 2016; Rasmussen, 2005).

In Design practice, the use of scenarios at varying stages of the innovation process is, more commonly, closely aligned with detecting insights from users addressing their current needs (Martin, 2009). While in Foresight practice, scenarios are used to create stories about how futures might develop, and what should be done to prepare for these eventual changes in the organizations' surrounding environment (Chan & Daim, 2012; Slaughter, 1995). Thus, each of the three literatures, though sharing intentions, approaches the question of the future in very different ways. This suggests that combining these toolkits, in ways that they work together, could be powerful. They are likely to be specifically useful in relation to the three challenges highlighted in the Strategic Planning literature earlier in our discussion: involvement, emergence, and translation to action.

More support for the synergistic value in their combination is revealed by an examination of their respective starting points for entry into the futures conversation. Using Buchanan's (1992) observation about the importance of the intersection of possibility, constraint, and contingency in thinking well about the future, we observe differences that are potentially valuable in bridging. Traditionally, foresight processes focus on the contingency dimension as entry point, building future scenarios based on key trends and uncertainties in order to lay out a set of plausible futures. Design takes possibilities as its starting point, laying out a portfolio of concepts based on the question "what if anything were possible? Traditional strategic planning processes often begin with the constraints of current capabilities and resources, and what would need to change to create a different future.

Each element - possibilities, constraints, and contingencies - is critical to the development of

strategic innovation intent toward a powerful future in a changing environment, but an over-emphasis on any of them risks problems: beginning with constraints which can trap practitioners in status quo thinking and stunt their imagination (as Mintzberg and others suggest). But conceiving of possibilities without considering constraints, though stimulating to creativity, is unlikely to lay the groundwork for successful implementation of new ideas. And an early emphasis on uncertainty carries the risk of paralyzing decision-makers or making them reactive, creating a sense of powerlessness to actively shape a strategic innovation vision of the future. Hence, a successful future-focused process must accomplish all three elements, and in an iterative way that allows possibilities to surface, considers constraints without disabling imagination, and factors in uncertainties without creating powerlessness. This dilemma also relates to (Hancock & Bezold, 1993) future cone. Whereas the Design Thinking realm is likely to generate preferred scenarios (in the eyes of users), Foresight is likely to generate possible scenarios (based on trends and embracing uncertainties), while the traditional planning process is generating probable ones (based on today's constraints) and preferred ones (based on the organization's needs). Again, the gestalt of bridging the three practice fields is evident.

Thus, the role of Design and its creative thinking, scenario-building, visualization, and prototyping competencies may help produce tangible images that further advance collective visions of strategic innovation futures as preferable, and indeed desirable (Buhring, 2017; Buhring & Koskinen, 2017; Heskett, 2001; Koh, Slingsby, Dykes, & Kam, 2011; Manzini & Vezzoli, 2003). The advantages of futures thinking, moreover, can lead to the creation of future value, and the development of perceptions about futures that may inform the decisions or strategies needed to prepare for alternative possibilities (A. Wilkinson et al., 2014). While most organizations fail to look beyond a narrow set of factors, evidence suggests that firms who have recognized the value of futures thinking and strategic design approaches as an important resource in the innovation process, are indeed those who achieve sustainable competitive advantages (Grant, 2010; Heskett, 2009; Mankoff, Rode, & Faste, 2013; Martin, 2009).

Consequently, across both fields an obvious relationship evolves around the use of scenarios as evidence-based narratives, which are ultimately designed to help innovation teams, and their organization, identify and make better informed choices in the present. To this end, the linkage between Design and Foresight principles become hybrid futures thinking techniques that inform both the 'what?' is changing over the medium to longer-term horizon (5-15 years), and the 'how?' this may translate into creative and innovative images and narratives of possible futures.

As Design and Foresight grow closer together in service to enhanced planning processes (Buhring, 2017; Evans, 2012; Hines & Zindato, 2016), a deeper understanding is needed of how this collaboration would operate in practice, the topic to which we now turn.

2 Key Conceptual Futures Thinking Factors

Derived from cross-disciplinary insights, and our own research in Design and Foresight studies, the hypotheses around the broader role of the strategic design conversation, is to include systematic futures thinking as a transformational approach to producing visions of desirable futures. Resulting from theoretical and applied field research, a series of conceptual 'high-level' futures thinking factors were identified as:

1. Achieving insights and alignment around current reality
2. Facilitating a productive Design conversation

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3. Specifying a portfolio of desirable futures
4. Active experimentation to gather new knowledge and learning

2.1 Achieving Insight and Alignment around Current Reality

Though the future might appear to be the most logical initial emphasis in Foresight work, one contribution of Design to Foresight is to insist on grounding discussions of the future in an immersion in the reality of today, with a focus on both gaining deep and novel insights into today's challenges and customer pain points and establishing alignment across critical stakeholders about key elements of the present situation (Gabrielli & Zoels, 2003; A. Wilkinson et al., 2014). This aims to accomplish two ends. The first is to facilitate reframing of the initial question, by challenging decision-makers to examine the assumptions they are bringing into the definition of the problem itself, opening up a wider array of choices. The second is to work towards aligning the views of key stakeholders around critical design criteria that describe the ideal future, ensuring coherence and commitment in a more inclusive conversation across a broader group of stakeholders. On the demand side, design tools like job-to-be-done (JTBD) and journey mapping offers methods that allow innovators to pursue deeper insights into current reality (Bucolo & Matthews, 2011), facilitated by the development of empathy for those to be served that first-hand ethnographic data collection encourages. On the supply side, capability mapping aids in the important work of accurately assessing the kinds of experiences that the organization is capable of producing. Taken together, this allows highlighting of the experience gap between the experience desired by the customer and that currently delivered by the organization. Identification of the experience gap is the step that facilitates the design of strategies that address future scenarios.

- *Case study example 1:* In a recent 2030 futures study involving a heterogeneous group of industry experts in the financial services sector (Buhring, 2017), the Delphi method was used as a basis for foresight. In the first Delphi survey round, the objective was to ignite a conversation around the prevailing innovation system, and probe deeper into what defines the current "status quo". Data analyzed at the end of this survey round provided important insights as to which products and services are considered as drivers of continues growth. Similarly, the data highlighted that the focus was placed on innovations addressing current customer needs. Due to the diversity of participants in both their backgrounds, perspectives, and experiences, a broad range of opinions were recorded as to what are the signs of change that would have impact on the organization. Hence, establishing what is going on today, and aligning the perspectives across relevant stakeholders in the innovation eco-system, befalls as an important factor in initiating and practicing futures thinking (see Curry & Hodgson, 2008; Morrison & Wilson, 1997).

2.2 Facilitating a Productive Design Conversation

An important goal of the design conversation is emergence: the development of previously unseen possibilities that emerge when a group of stakeholders with diverse perspectives are involved in a generative conversation, in contrast to an evaluative one (whose starting point is a set of existing identifiable options). In order to accomplish this, the conversation must achieve two things: (1) finding a blend of inquiry and advocacy and (2) leveraging the diversity within the conversation

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to produce higher order solutions rather than divisive debates. The two are closely related.

An essential aspect of successful design work is the engagement of critical players in the larger ecosystem, outside of the organization itself. It is through mutual learning and cooperation among these players that shaping behaviors, aimed at making preferred scenarios a reality in the future, is coordinated. But turning the theoretical diversity these players bring into the formulation of more creative, shared scenarios, requires changing the nature of the conversation itself to incorporate an increasing role for dialogue as well as debate, for inquiry as well as advocacy. Participants in such conversations must listen to understand rather than defend, and for possibilities rather than weaknesses. Design Thinking's tools for collaborative problem solving can assist the search for higher-order solutions, by offering a structured process in which that dialogue and inquiry occurs, and where divergent views are surfaced and explored, rather than relying solely on the skills of the leader of the conversation. These conversations must also occur at different levels: the ecosystem, the organization itself, and the functional and local levels within it. It is these nested and coordinated conversations that make possible the translation of abstract strategies into actionable new ways of thinking and behaving.

- *Case study example 2:* Resultant from the aforementioned 2030 futures study (Buhring, 2017), a series of futures scenario statements were produced as consensus toward the Delphi panels' combined vision of preferable or desirable futures. From this research, a subsequent study phase was initiated to expand on the stories and narratives contained in each scenario at a deeper level, thus moving the Design conversation from information gathering, to processing the inherent cues for specific potential new futures. A key observation in this study phase was noticed by Designers and interdisciplinary innovation practitioners who questioned the dominant business logic, which in context of the traditional financial services business and operating model, was considered in conflict between the embedded present and these imagined futures.

2.3 Specifying a Portfolio of Desirable Futures

Whereas scenario building might tend to focus on possible and plausible futures, Design brings a strong emphasis on specifying a set of preferred futures. In this way, its intent lies more with shaping the future than merely responding to it. Like scenario planning, the emphasis is on optionality – specifying a range of different future options. Design tools here assist decision-makers to construct that portfolio of alternatives with an eye towards timing, by surfacing assumptions around impact on the demand side relative to ease of implementation on the supply side, with capability development a critical factor.

Design also suggests that new futures, in order to become realities, must be experienced, rather than merely thought: more than cognitive, they must be vivid, personally meaningful, and compelling to the members of the organization who must adopt new behaviors in order to execute them. The idea of experiencing a new future in an emotional as well as cognitive way is grounded in an interpretive, socially constructed perspective, rather than an objectively rational one (Andrews, 2012). One core dilemma in moving an organization into a new future, then, is how to make new ideas tangible. Architects build models, Product Designers construct prototypes (Buhring & Koskinen, 2017) – but prototyping a new future is more challenging to envision. This is where Design's emphasis on visualization tools like storytelling and journey mapping contribute to Foresight work.

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- *Case study example 3:* An enterprise software firm used Design Thinking to explore and discuss potentially disruptive changes in their industry. The company melded Design Thinking's emphasis on visualization and storytelling with traditional approaches to Strategic Foresight in order to compose and communicate new strategies. Carefully constructed prototypes told the story of the strategic imperative they faced at varying levels of detail – from the high-level warning of the potential obsolescence of their core capabilities to the plight of a salesperson responding to a customer's pricing request. From executive dashboard to salesperson's inbox, the connections were illuminated. The prototypes not only engaged; they clarified, allowing people at different level to better understand the specifics of how the new futures impacted their roles and activities.

2.4 Active Experimentation to gather new Knowledge and Learning

Design's emphasis on learning in action offers a final and powerful contribution to enhancing the strategic planning process when used in conjunction with Foresight: assumptions underlying the future scenarios can be surfaced and tested through experiments in the present. In engaging ecosystem players, at different levels, in the design and execution of these experiments, learning becomes on-going and scenarios can be adjusted as real-world feedback informs the process.

- *Case study example 4:* From the analysis of data obtained at the completion of the 2030 Financial Services Delphi futures study (Buhring, 2017), a Design Foresight visioning approach provided further opportunities to apply data visualization and storytelling techniques. For example, utilizing storytelling narratives and imaginary creations, serves as an effective way to engage with the intended readership of a Design Foresight study in both entertaining, informing, and energizing ways. Stories can change or enhance readers' perceptions of futures, seeing themselves in different perspectives, and identifying their "self" by interpreting and completing the story in his or her head (Sametz & Maydoney, 2003). In this 2030 futures study, personas were created that embodied the essence of futures scenario statements in verbal and non-verbal communications intended to connect the reader on both analytical and emotional levels (Figure 3).

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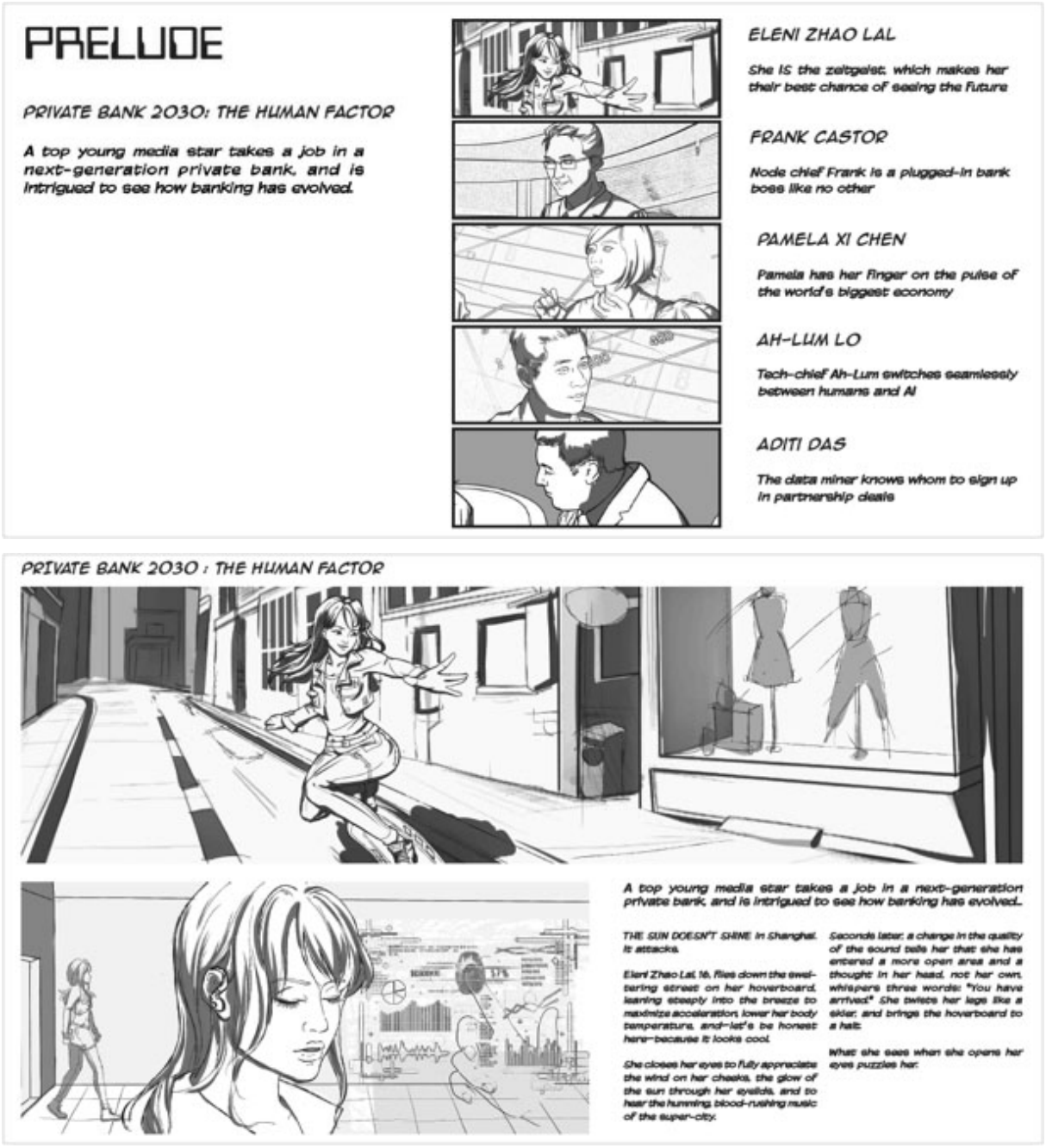

Fig. 3. Data visualization in form of storytelling persona and narratives (extract)

3 Conclusion

Practicing systematic futures thinking, enhanced by Design tools and approaches, can enhance Strategic Planning's ability to foster innovation by detecting early warning signs of change and

giving deeper insights into the phenomenon behind these signs. Thus, applying systematic futures thinking, through a process we refer to as "Foresight by Design," enhances concrete knowledge and processes for strategic innovation. However, as we have highlighted in this conceptual paper, there is to-date little real understanding into how designers and interdisciplinary innovation practitioners work in concert to navigate disruption, make sense of complexity, and deal with uncertainty in order to envisage the medium and longer-term futures (5-15 years). This represents a significant opportunity for both research and practice moving forward.

This conceptual approach may also offer important contributions for overcoming weaknesses in aligning Strategy, Innovation and Foresight functions. Consequently, we argue for acknowledgement of an ever-growing need for Innovation, Design, and Foresight stakeholders to work more closely together to make possible envisaging higher order, more innovative and sustainable solutions that will yield the greatest economic and social benefits (Buhring, 2017; Heskett, 2009; Hines & Zindato, 2016; Liedtka, 1998; Meroni, 2008; Slaughter, 2002).

To this end, we have advanced in this conceptual paper some hypotheses around a broader role for the strategic Design conversation to enhance systematic futures thinking and produce potentially transformational visions of desirable futures. While there are many methods in Design and Foresight disciplines relevant to opportunity identification, the value of systematic futures thinking is based on the strategic production of visions of desirable futures (scenarios), which can help inform decision-makers about the innovation challenges and opportunities that will emerge over the medium and longer-term time horizon (Buhring, 2017; Buhring & Koskinen, 2017; Kock et al., 2015). The desired futures thinking outcomes we hypothesize, however, are unlikely to be achieved through short-term, sporadic, or superficial Design Thinking approaches, as its processes need to be understandable and collaboratively used by all strategic innovation stakeholders. Further limitations are acknowledged in the organizational practice of Foresight in Design research, and its objective evaluation of performance and contribution over existing Strategic Planning approaches.

To this end, the review of the Strategic Planning, Design and Foresight literature, and knowledge gained from our own applied field research, have identified key conceptual Foresight factors that can help integrate systematic futures thinking at the front end of innovation. These include using Design tools and approaches to achieve deeper insight and alignment around current reality, to facilitate a more productive Design conversation, to aid in specifying a portfolio of desirable futures, and to engage ecosystem partners in active experimentation that generates new knowledge and learning.

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Opening up Corporate Foresight: What Can We Learn from Open and User Innovation?

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Abstract. Organizations find themselves in a fast-paced and increasingly complex and uncertain environment. Hence, they engage in foresight to understand weak signals and developments that may affect them in the medium to long run and build up "strategic preparedness". Literature on open and user innovation has described methods to tap into external knowledge sources and some have potential to enhance foresight results, but research has not yet fully benefitted from these insights. Thus, the aim of this article is to synthesize findings from both literatures and explain why users and user collectives are a valuable knowledge source for foresight. The contributions of the paper are twofold. First, the paper provides a typology of methods, which are suitable for drawing on user knowledge. Second, the identified methods are compared with one another in terms of advantages, disadvantages and boundary conditions.

Keywords. Open Foresight; Distributed Information Sources; Corporate Foresight; Innovation Management; User Innovation.

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1 Introduction

In a rapidly changing world, corporate foresight represents a promising approach for organizations to identify emerging changes in their environment early and act accordingly in a timely manner. As firms develop an understanding of weak signals, trends and developments that may affect their business in the medium-to-long run, they build up "strategic preparedness" and prevent discontinuities that may come to them as a dangerous surprise (Ansoff, 1975). In addition, foresight helps organizations to recognize and exploit emerging opportunities more quickly and, thus, foster the firm's innovation capacity. Ultimately, organizations that keep a good vision on what is happening at their periphery can gain tremendous advantage over rivals (Day & Schoemaker, 2005).

Corporate foresight has continuously evolved over time (Rohrbeck et al., 2015). Foresight was typically conducted by firm managers and internal employees, and sometimes external sources such as networks (Reger, 2001) as well as analysts and consultants (Rohrbeck et al., 2015). Other external sources such as (lead) users, user collectives (e.g. communities and crowds), suppliers, buyers, research institutions, partner firms or even competitors have so far rarely played a role. This is remarkable, given that advances in information and communication technologies, among other factors, have increased the potential and decreased the costs of conducting searches for external sources (West & Bogers, 2013). Research on open innovation (e.g. von Hippel, 1988, 2005; Chesbrough, 2003; Baldwin & von Hippel, 2011) described how different approaches to source knowledge from external sources can help firms to support their innovative activities. Some of them have significant application potential to enrich 'established' foresight, but research has not yet fully benefitted from these findings.

Thus, this paper picks up on this need for investigation of those methods, which can be used for foresight. However, since open and user innovation literature is an umbrella term, which encompasses many different methods and knowledge sources, trying to evaluate all of them would be clearly beyond the scope of one single article. Thus, the paper narrows its focus to methods that rely on knowledge of users and user collectives. Using a conceptual approach, the paper builds on a synthesis of previous findings from foresight as well as open and user innovation literature. In the context of the first research question, the paper seeks to identify: Which methods are suitable for sourcing user knowledge for foresight? However, no universal methodology or 'off-the-shelf' approach exists and the selection of suitable methods always depends on the firm's specific objectives (Slaughter, 2002; Magruk, 2011). Therefore, the paper seeks to answer the second research question: What are the advantages, disadvantages and boundary conditions of these methods?

The paper is structured as follows: In the next section, a literature review on foresight, which is currently developing towards a more open understanding, is presented. The third section highlights why users are highly qualified sources of knowledge and why opening up foresight to users holds potential to improve foresight practice. In the fourth section, a typology of open foresight methods that are suitable for drawing on knowledge of users and user collectives is provided. In the fifth section, these methods are compared with a view to their advantages, disadvantages and boundary conditions. This discussion is structured along the following key design dimensions:

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(1) number of users involved, (2) mode of interaction, (3) governance mechanisms, and (4) type of incentives. Finally, the sixth section concludes and suggests areas for further research.

2 Moving from Foresight to Open Foresight

In order to ensure their survival in today's highly dynamic world, companies need to be able to detect changes and react to these early (Nelson and Winter, 1982). Against this background, foresight implies a readiness to deal with long-term issues (Miles, 2010) by providing firms with a basis enabling them to adapt to unfolding environmental changes. Often vague information exists, which foreshadows the occurrence of later events and developments. Information progressively develops and improves over time, but the later a firm reacts, the more likely it will be too late in making important decisions. Ansoff (1975) points out that the time remaining before the impact on the firm passes a critical benchmark is crucial: "For a threat this benchmark may be the level of loss beyond which the firm's survival is threatened; for an opportunity the point beyond which the cost of "climbing the bandwagon" can no longer be recovered through profits" (p. 24). Thus, through an improved awareness of so-called weak signals, foresight allows firms to act in a timely manner and have their responses better planned and executed in order to seize opportunities and avert dangers.

Foresight is an approach to anticipate possible future developments. However, there is no unified or commonly accepted definition of foresight. Instead, a broad variety of different definitions or similar expressions exist, which often denote different activities in firms (Reger, 2001; Amsteus, 2008). Ehls et al. (2016) give an overview of definitions and point out that the concept has so far been referred to as a tool, a process, or an ability. Horton (1999) outlines that foresight involves gathering relevant information about possible future events and developments that may possibly affect the organization in the medium-to-long term. Thus, foresight typically takes a holistic view, i.e. it looks beyond the close and immediate market environment in order to consider political, economic, social, and technological ("PEST") factors. The resulting knowledge is then translated and interpreted in order to understand possible environmental changes and their implications. Finally, foresight involves a commitment to action, i.e. newly discovered insights lead to concrete action, which brings benefits to the organization (Horton, 1999). In that sense, foresight is perceived as an action-oriented approach that does not aim at predicting or forecasting the future, but supports individuals in thinking about different possible future states (Vecchiato, 2012).

Foresight activities can benefit companies in multiple ways. Voros (2003) points out that by opening up an expanded range of perceptions of available options, foresight can make strategy-making potentially wiser (Voros, 2003). Rohrbeck and Gemünden (2011) identified three roles through which foresight activities can enhance a firm's innovation capacity. First, foresight can play the initiator role, i.e. "foresight triggers innovation initiatives by identifying new customer needs, technologies, and product concepts of competitors" (p. 237). Second, foresight can play the strategist role, i.e. "foresight directs innovation activities by creating a vision, providing strategic guidance, consolidating opinions, assessing and repositioning innovation portfolios, and identifying the new business models of competitors" (p. 237). Third, foresight can play the opponent role, i.e. "foresight challenges the innovators to create better and more successful innovations by challenging basic assumptions, challenging the state-of-the-art of current R&D projects, and scanning for disruptions that could endanger current and future innovations" (p. 237). Rohrbeck and Kum (2018) conducted a longitudinal analysis and found strong empirical

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evidence that foresight leads to higher future preparedness and ultimately enables superior firm performance.

Experts agree that no universal methodology for conducting foresight exists (Magruk, 2011). There is no satisfactory 'off the shelf' solution and foresight will take different shapes and forms in different organizations to reflect firms' goals and specific needs (Slaughter, 2002). Numerous methods are available for exploring possible alternative futures and literature on traditional foresight often focused on scenario technique, roadmapping, and the Delphi method, amongst others. Methods differ in their fundamental attributes. On the one hand, Popper (2008) distinguishes between qualitative, quantitative and semi-quantitative methods and finds that the use of qualitative methods is most popular, "due to the fact that the study of the future is inevitably informed by opinions and judgements based on subjective and creative interpretations of the changes (or lack of changes) creating or shaping the future" (p. 70). On the other hand, building on Georghiou's (2001) typology, Popper (2008) distinguishes foresight methods regarding their capability to gather or process information based on evidence, creativity, expertise, or interaction. Foresight methods consist of these capabilities to different proportions. In many cases, foresight methods complement each other and, thus, a combination of methods is often selected. Hines and Bishop (2013) developed a framework as a meta-method, which helps carrying out foresight in a logical flow and allows substitution of methods in a modular fashion. Another foresight process framework, which outlines distinct phases, has been put forward by Voros (2003).

Research on foresight has over time continuously advanced in both theory and methodology (Reger, 2001; Rohrbeck et al., 2015). Previously, foresight was typically conducted within the firm's organizational boundaries and involved mostly internal managers and employees and only some additional experts and consultants. However, internal actors often have difficulty to perceive possibly impactful information, as they are focused on day-to-day business or are locked in prevailing mindsets and power structures of the organization; in addition, the value of expert judgment in foreseeing change is disputed (Rau et al., 2014).

In the meantime, advances in and a growing availability of information and communications technologies have facilitated approaches to integrate externals into innovative activities (Dodgson et al., 2006). Likewise, information and communication technologies are likely to revolutionize the foresight practice (von der Gracht et al., 2015). It appears that foresight practice increasingly evolves into a more open direction, thereby increasingly utilizing new methods to source future-related knowledge from external knowledge sources. In consequence of this development, foresight research takes up many insights, which have previously been elaborated in the literature on open innovation (for a review see e.g. Dahlander & Gann, 2010; Huizingh, 2011; West & Bogers, 2013). At the heart of this stream of research lies the idea that companies should become more open to external knowledge and ideas (Chesbrough, 2003). The meaning of openness relates to a broader debate on the boundaries of the firm and is expressed through various forms of relationships with external actors (Dahlander & Gann, 2010). For instance, the literature has documented involvement of (lead) users (Gassmann et al., 2006; Grimpke & Sofka, 2009), communities, crowds, suppliers (Li & Vanhaverbeke, 2009; Schiele, 2010), buyers, research institutions (Fabrizio, 2009; Cassiman et al., 2010; Harryson et al., 2008), partner firms or even competitors (Lim et al., 2010). Advances in information and communication technologies (particularly the Internet and social media) facilitated access to distributed knowledge and enabled novel approaches to source knowledge from, or collaborate with, external sources. Among the most important open innovation approaches are, for instance, crowdsourcing (Afuah & Tucci, 2013; Bayus, 2013; Boudreau & Lakhani, 2013; Piezunka & Dahlander, 2015), co-creation (Sawhney & Prandelli, 2000; Prahalad

& Ramaswamy, 2004; Füller et al., 2009), and online communities (Janzik & Raasch, 2011; Kim, 2000).

Some of the methods described in the open and user innovation literature can also be used to explore alternative futures and hold potential for enhancing current foresight practice. Thus, the concept of "Open Foresight" as first coined by Daheim and Uerz (2008) refers to "the next phase of corporate foresight", which is "based on the assumption that businesses can shape future contexts and markets by anticipating through an open dialogue the dynamic interaction between social, technological and economic forces" (Daheim & Uerz 2008, p. 332). Mietzner (2009) differentiates between closed and open foresight, with open foresight referring to the opening of the process to utilize the firm's outside world. Miemis et al. (2012) refers to open foresight as a "process for analyzing complex issues in an open and collaborative way" (p. 92). Ehls et al. (2016) identify three defining elements, which include (1) the systematic use of distributed information sources in order to anticipate the future corporate business environment, (2) which is institutionalized within the organization and often conducted with outside actors, and (3) draws especially on insights and methods from the open and user innovation research. Wiener et al. (2018) and Wiener (2018) focus on the necessary organizational context and culture, which is are an important precondition for a company's openness towards external sources. In addition, the concept has appeared in few practice-oriented articles (Rau et al., 2014; Gattringer & Strehl, 2014a, 2014b; Rudzinski & Uerz, 2014). A related term that also emerged together with the rise of the 'open' paragdigm is "networked foresight", which refers to foresight conducted in innovation networks (van der Duin et al., 2014; Heger & Boman, 2015). Overall, little research on open foresight has been conducted so far. In particular, research has not caught up on new possibilities that enable the sourcing of user knowledge.

3 Benefits from Integrating Users and User Collectives as Knowledge Sources

In order to explore alternative futures, firms can get valuable input from individual (lead) users or tap the rich source of knowledge available in various different user collectives, such as (online) communities or crowds. The definition of users underlying this article covers not only the firm's own users, but also users from analogous markets, who face trends similar to that of the target market (Franke et al., 2013), as well as some nonusers, who are very knowledgeable about relevant future-related topics. Prior to the discussion of possible open foresight methods, an understanding of users' competences and knowledge is needed and of how their integration can potentially enhance foresight results.

Boundedly rational actors tend to conduct local searches, i.e. they look for solutions in the surroundings of their current position (Cyert & March, 1963; Nelson & Winter, 1982; Stuart & Podolny, 1996; Katila, 2002; Katila & Ahuja, 2002). However, when firms draw only on previous experiences, established views, already existing knowledge and familiar routines, they will only take into consideration a narrow solution space. Regarding foresight, this implies a high probability of blind spots remaining, and of potential harmful developments being ignored or promising opportunities being missed.

Diversity is a critical component of innovative capabilities (Cohen & Levinthal, 1990) in general. This also applies to foresight, where the "attempt to accommodate diverse perspectives on the future is central to the methods for the scanning of weak signals" (Könnölä et al., 2007, p. 611). Through the involvement of actors with diverse perspectives, the potential solution space can

be significantly broadened. In this way, "Opening up the foresight activities to externals is a promising way to detect blind spots" (Rau et al., 2014, p. 31). A study by Jeppesen and Lakhani (2008) confirms the importance of involving people with alternative knowledge. In the context of a "broadcast search" problem, when information is disclosed widely and everyone is invited to participate, they examined which external solvers are able to provide successful solutions. They found that individuals, who come from a field of expertise that is far from the focal field of the problem, are more likely to come up with successful solutions than actors in the source problem field. As they are not bound to current thinking in the field of the focal problem, marginal persons can offer perspectives and heuristics that are novel and therefore useful for generating solutions to these problems.

Besides adding a novel perspective to foresight, users possess specific knowledge, which is very valuable to firms. Users can be considered as experts regarding need-related information, as they know their needs best and have the fullest information about how they want to use a certain product. In contrast, manufacturers possess information about solution possibilities as well as the production process itself. This means that users and manufacturers tend to draw on different local information when they innovate. However, bridging need and solution information between users and manufacturers is often very difficult, because information is sticky, i.e. it is costly to transfer a given piece of information to a specific location in a form useable by a knowledge seeker (von Hippel, 1998). In order to minimize costs incurred in connection with understanding user needs, it is therefore advantageous to source information from its origin and integrate user knowledge as closely as possible into the foresight process.

However, not all users are equally helpful. A crucial distinction between typical and lead users dates back from seminal work by von Hippel (1986). He had observed that typical users of a firm's existing products are not well positioned to assess new product needs and potential solutions. Typical users have a limited ability to conceive novel attributes and uses because they are too familiar with existing product attributes and constrained by their present real-world experience. In contrast, lead users "are familiar with conditions which lie in the future for most - and so are in the position to provide accurate data on needs related to such future conditions" (von Hippel, 1986, p. 796). Lead users have needs that foreshadow the general demand in the marketplace, but face such needs months or years before the bulk of that marketplace encounters them. This ability makes lead users an important knowledge source for foresight. By utilizing knowledge from lead users, a firm is better equipped to perceive changing habits and preferences of users and socio-cultural trends.

Lead users have a second important characteristic: As they are dissatisfied with the current market offering, they benefit significantly by obtaining a solution that caters to their needs (von Hippel, 1986). As they expect an innovation-related benefit, lead users are motivated to provide - and often freely reveal at no cost - information and contribute to the development of new products and services (von Hippel, 1986; von Hippel, 1988; Urban & von Hippel, 1988; Morrison et al., 2000; Morrison et al, 2004; Franke & Shah, 2003). Some lead users even develop their own innovations and their ideas were found to be more commercially successful as compared to ideas generated by traditional marketing research methods (Lilien et al., 2002). Even though foresight does not immediately aim at generating new ideas and new innovative products, it can be assumed that the incentive associated with obtaining a solution to lead users' needs still plays a role and motivates them to contribute to foresight.

Further research investigated the nature of lead users as well as the consequences of lead userness. Schreier and Prügl (2008) found that lead users are often characterized as having innovative personalities, breaking with accepted modes of thought and action and discovering both problems

and avenues of solution. In addition, they found that lead users tend to adopt new products faster and more heavily than ordinary users. Being an early adopter implies that lead users can act as opinion leaders, i.e. they can, combined with their importance as communication sources, play an important role in the diffusion process of newly launched products (Morrison et al., 2004). In that sense, lead users may influence (and perhaps even set) trends, which makes them an even more valuable source for foresight.

4 Methods for Drawing on User Knowledge

A growing body of literature on open innovation documents how companies reach beyond their organizational boundaries to search for knowledge from external actors. Many of these methods are also suitable for foresight and allow firms to utilize user knowledge for exploring possible alternative futures. In the following, the paper describes how firms can conduct foresight with lead users as well as community-based and crowdsourcing approaches. The methods partly complement each other and can be combined in many ways. In addition, some well-established methods from more "traditional" foresight exist, which can now be conducted in a significantly more open way or incorporate elements from open innovation.

4.1 Open Foresight with Lead Users

The characteristics of lead users laid the basis for the development of the lead user method (von Hippel, 1986). The method aims to incorporate lead users in the fuzzy front end of the innovation process in order to learn more about emerging needs and, thus, help firms generate ideas and concepts for new products and services. The methodology involves four steps and starts with a definition of the search field and of the goals and requirements directed towards the outcome of the process (Lüthje & Herstatt, 2004). In the next two steps, relevant trends as well as lead users, who lead these trends, have to be identified. In order to identify lead users, firms can use the pyramiding approach, which is a variant of snowball sampling that involves asking individuals with a given attribute (in this case: lead user characteristics) to identify one or more others who they think has higher levels of the sought-after attribute (von Hippel et al., 2009). At the end of the process, identified lead users are invited to workshops, where they discuss and collaboratively develop new product concepts together with company employees.

Trend analysis and identification are important functions of foresight; thus, it can be stated that foresight is already part of the lead user method. Previous research has clearly pointed out that, since lead users are familiar with future conditions, they are well-equipped to "serve as a need-forecasting laboratory" (von Hippel, 1986, p. 791) and "can be harnessed for forecasting purposes (Morrison et al., 2004, p. 361). Thus, while the lead user method relies on interviews with experts as well as secondary information sources such as academic publications, data banks and the internet for trend forecasting (Lühtje & Herstatt, 2004), one can argue that, in general, lead users themselves can contribute valuable input to the discovery of trends and open foresight. In order to conduct foresight with lead users, the lead user method needs to be adjusted as follows: At first, the search space has to be defined. In a second step, lead users, who are particularly knowledgeable in the specified search field, have to be identified. Finally, lead users are to be involved in the exploration of possible futures and trends. Rau et al. (2014) focus on foresight workshops as appropriate means of opening up foresight processes and enabling collaborative action. In the workshops, more "traditional" foresight methods can be employed. For instance,

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lead users can provide valuable input for creativity methods (such as brainstorming) or support the elaboration of scenarios.

Apart from the possibility to conduct physical foresight workshops, identified lead users can be interrogated as experts on future needs. To this end, interviews or surveys can be conducted. Of particular importance for foresight is the Delphi method, which relies on an anonymous group of experts, who will be asked to assess possible future states (Cuhls, 2012). Such a group may consist of lead users serving as experts. The Delphi method consists of at least two rounds; in the second round, participants will receive feedback on the other experts' opinions from the first round. In order to achieve consensus, the experts have the possibility to revise their initial assessment. The Delphi method can be modified by including additional open innovation elements ("Open Delphi"), such as an Internet-based research community (Stockinger, 2015).

Another method to obtain trend-related information from lead users is through informal networking with lead users. Once identified, lead users can be directly approached at conferences or events or be contacted online via email or social networking sites such as LinkedIn, Facebook or Google+. In addition, some lead users may be active in Twitter or maintain blogs, whereas firms can follow their tweets and postings. For instance, Hanke and Möhrle (2013) have analyzed blogs as a source of information for trend identification.

4.2 Open Foresight Methods Involving User Communities and Social Networks

Communities are voluntary associations where members interact with each other to acquire and exchange information about a topic of common interest. While various types of communities exist, open innovation literature has focused on those involved in creating innovation outside the boundaries of the firm (West & Lakhani, 2008). Much information discussed and exchanged in communities is usable, accessible and even valuable for companies (Füller et al., 2006). For instance, as users articulate their general satisfaction and complaints, report bugs and problems or share ideas for improvement and novel products and features, communities can be a rich source of information for innovation and new product development. Likewise, in some communities users discuss future-related issues, which provides relevant and valuable input for open foresight. Some communities, such as professional futurist associations or informal groups (e.g. organized via meetup.com) gather offline. However, as the Internet enables communication and collaboration between members from all over the world, most communities have an online presence.

One possibility for firms, which intend to utilize online communities as a source of information for foresight, is to rely on existing third-party communities and observe the dialogue and interactions of members taking place. This approach is referred to as netnography and was pioneered by Kozinets (1998). Initial steps of the method (Kozinets, 2002) involve formulating research questions, identifying relevant communities that are appropriate for answering this question and familiarizing with the community. Subsequent data collection includes retrieving copies of the publicly available online dialogue as well as taking field notes on observations. The data needs to be filtered in order to include only informational and on-topic information (here, future-related information is particularly relevant), and the data collection continues until a point of saturation is reached. Finally, the content retrieved from the community dialogue is analyzed and interpreted to understand the needs of community members and identify relevant trends. Zeng (2018) applies a netnographic approach to the case of an online community in the field of renewable energy. He finds that fruitful discussions take place in the community and that it is possible to derive trends and use the members' input for foresight issues.

Unobtrusively observing communities relates to the broader phenomenon of social media monitoring. In different social networks such as Facebook, Google+, LinkedIn or Twitter, online user interactions are recorded and stored in archives, which represent an under-exploited resource for foresight (Cachia et al., 2007). This massive amount of data from social networks, often combined with data from additional sources, is usually termed "big data" and can be analyzed to detect trends and developments with high predictive value. As Drexler et al. (2014) point out, "Big Data isn't just a description of huge amounts of data; it is about identifying and understanding the relations and correlations among pieces of information, and it's about predictions" (p. 304). Through aggregation and extrapolation of data, patterns can be recognized and, thus, changing habits und trends in social behavior be identified. For instance, Asur and Huberman (2010) demonstrated Twitter's predictive power. While the available amount of data is increasing at fast speed, many sophisticated tools for data mining, social media monitoring and analytics are now available to help make sense of the data.

Apart from the possibility of monitoring communities and social networks, firms can become more directly involved by taking on a privileged position through sponsorship of existing communities, or through creation of their own communities (West & Lakhani, 2008). Against this background, corporate employees join interactions with community members to brainstorm and stimulate dialog on future-related issues or elaborate shared visions about how users imagine the future will look like. Hence, communities and social networks "could operate as a large-scale method for online brainstorming, a text-bed for future concepts, ideas, assumptions or scenarios" (Cachia et al. 2007, p. 1196).

4.3 Crowdsourcing Methods for Open Foresight

Another way of sourcing user knowledge for open foresight is through 'crowdsourcing'. The underlying idea is that a task, which was traditionally performed by a designated agent (usually an employee), is outsourced to an undefined, generally large group of people by way of an open call (Howe, 2006). After the problem has been broadcast, typically via a web-based platform, members of the crowd self-select to solve the problem and submit their ideas, suggestions for improvement or concrete solutions. Different approaches of crowdsourcing exist, which are also applicable to open foresight.

One type of crowdsourcing is collaboration-based, where many heterogeneous individuals work together towards a shared solution. This is common in many projects in open source software development (Lakhani & von Hippel, 2003; von Krogh et al., 2003; Belonzon & Schankermann, 2012). Another well-known example is Wikipedia, where thousands of volunteers collaborate, interact and assist each other to build the world's largest online encyclopedia (e.g. Tapscott & Williams, 2006). Similarly, wikis and databases that are elaborated in collaboration can be used to collect knowledge for foresight. Schatzmann et al. (2013) mentions "wildcard databases, prediction databases, trend databases, databases that are used for horizon scanning and databases that are used for mapping strategic Foresight" (p. 6). One concrete example the so-called "TrendWiki", which was set up as a crowdsourcing tool for reporting weak signals of change (e.g. an interesting blog post about new innovation, an interesting aspect heard at a conference, or even just the fact that someone noticed a change in how traffic patterns are shifting) (Hiltunen, 2011). The results are shared, commented upon, refined or expanded and then the organization's foresight team meets twice a year to cluster signals into patterns and phenomena. Although the TrendWiki is designed for employees from all over the world to report weak signals, the approach can also be conducted with users.

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Another type of crowdsourcing is tournament-based, where many heterogeneous individuals work on a task or problem and compete for the best solution, which then wins a price. For instance, companies set up their own platforms to let a large crowd of users brainstorm for ideas, as highlighted by the case of Dell Idea Storm (Bayus, 2013). In other cases, when facing specific technical challenges, companies use the service of intermediaries for broadcast search among experts (e.g. Innocentive case in Jeppesen & Lakhani, 2008). Similarly, principles of tournament-crowdsourcing can be applied to collect information about weak signals and future information. This can be achieved for instance, through idea-spotting networks such as springwise.com and trend-hunter.com, where idea spotters can register and report their observations about ideas, innovations and startups (Hiltunen, 2011). The best ideas will be published and spotters will receive rewards for good spottings.

Prediction markets offer another crowdsourcing approach, which can be applied to diverse areas, such as forecasting future political (e.g. election results), economic (e.g. interest rates; sales), social (e.g. population development), and technological (e.g. market success of technologies) developments. Prediction markets are web-based applications that work like traditional stock markets: Users buy shares if they expect a future event will occur, or sell shares if they expect a future event will not occur. In real time, demand and supply determine a price, which reflects the likelihood that a certain event or development will occur. The price increases as more participants believe an event or development is likely to occur and, thus, bet (real or virtual) money on it. Thereby, prediction markets collect and aggregate judgments of all participants, who feed on all available sources of information such as historical data, forecasts from other approaches, news, individual expectations (Graefe et al., 2010).

Finally, an emerging approach are collaborative forecasting games, which invite a crowd, often several thousands of players, to imagine how certain futures would look like (Schatzmann et al. 2013; Rau et al., 2014). The Institute for the Future (IFTF) has developed the "Foresight Engine" platform to set up games, which simulate different future realities: e.g. a future threatened by "superthreats" (such as in the game "Superstruct"), a future of energy (game "SmartGrid 2025") or a future of health care provision systems (game "Future of hospitals"). Players immerse themselves in these scenarios through e.g. YouTube videos and information made available through Facebook, blogs and wikis. In the tradition of brainstorming, players are encouraged to submit their ideas about the future, and, when others build on these ideas to form chains of discussion, they earn points, awards, and achievements for winning ideas . By aggregating numerous micro-forecasts, a big picture emerges of how the future will possibly look like.

5 Comparing Open Foresight Methods

The previous section has provided an overview of possible approaches for implementing open foresight with users and user collectives. On this basis, the present section describes corresponding advantages, disadvantages as well as boundary conditions. The discussion is structured along four key design dimensions according to which methods differ. First, available methods differ regarding the number of involved users, i.e. they use knowledge from individuals or from a collective. Second, methods vary regarding the mode of interaction, as they rely either on active cooperation, unilateral sourcing of knowledge or passive observation. Third, methods (except passive methods) differ with regard to the degree of control they leave a company to influence activities and can also be subdivided into self-organized or more directed forms of governance. Fourth, methods (except passive methods) rely on different incentives to motivate users to con-

tribute to foresight, with both intrinsic and extrinsic motivations existing. Table 1 offers an overview of the four design dimensions and the corresponding methods.

5.1 Individuals' Knowledge vs. the "Wisdom of the Crowd"

First, available foresight methods can be distinguished from one another as to the number of involved users, i.e. methods rely either on the sourcing of knowledge from individuals or the knowledge from a collective, i.e. a group or crowd of users.

When a firm decides to tap the rich source of user knowledge, one possible approach is to involve individual users. While typical users are constrained by their present real-world experience, lead users encounter needs significantly earlier than the mainstream. Thus, lead users are particularly qualified to act as experts in open foresight. Just as the lead user method relies on the integration of selected individuals, a limited number of previously identified lead users can be invited for participation in open foresight workshops (Rau et al., 2014). In this context, traditional foresight methods can be applied, i.e. the firm is not required to make significant adjustments to its current foresight practice. However, preparing a workshop and bringing together all participants in one place is time-consuming and requires a significant investment of human and financial resources (Lüthje & Herstatt, 2004). As alternative to having lead users participate in workshops, firms can source their future-related information through interviewing, networking or using social networks to connect and follow. But still, the number of users with whom the firm establishes contact should not get too big, as "maintaining too many relationships is costly and may lead to a diversion of managerial attention" (Dahlander & Gann, 2010, p. 706). At some point, when the number of experts gets too large, the benefits of integrating external sources may be offset (Wallin & von Krogh, 2010). In addition, the identification of lead users (von Hippel et al., 2009), who are both knowledgeable and motivated to join foresight activities, is not trivial and remains a challenge. There is also a risk of a selection bias existing, if a firm tends to select lead users, who share their views and, thus, hinders the detection of blind spots.

In contrast, firms can tap the vast pool of knowledge available within a user collective, such as a community or crowd. The Internet and modern information and communication technologies enabled the participation of a large number of people independent of their physical location. As a result, the potential of searching for input from external sources increased and the costs decreased (West & Bogers, 2014). Through community and social network-based and crowdsourcing approaches or by conducting Delphi with lead users as experts, these technological advances are utilized to source knowledge from a huge number of people. They thus harness the "wisdom of the crowd", which implies that the group or crowd makes more accurate decisions - or, in this context, better predictions - than an isolated individual, no matter how smart or well-informed he or she is. Surowiecki (2004) examined the requirements that are necessary to facilitate the wisdom of the crowd and found that diversity is central, as each person has different pieces of information. Given that all individuals in the diverse and large enough crowd are decentral and decide independently, individual pieces of information can be aggregated such that the resulting crowd opinion is more than the sum of its parts. Since these methods do not require the identification of knowledgeable users, but let the participants self-select, selection bias is avoided. Moreover, utilizing information and communication technologies, these methods tend to be of high value but low cost. Despite these advantages, sourcing knowledge from a group or crowd of users is not the means appropriate for problem solving in any circumstance (Afuah & Tucci, 2013). For instance, crowdsourcing is appropriate if problems are new, complex, and ill-defined (because underlying information or interrelations are difficult to access) and require a

substantial amount of creativity or transfer of analogous knowledge. In contrast, crowdsourcing is a less appropriate mechanism when a "problem is too tacit to be delineated and broadcast or requires a considerable amount of interaction between the seeker and the solver" (Afuah, 2014, p. 75).

Table 1. Overview of methods

Design Dimension	**Methods**		
Number of involved users	*Methods for sourcing knowledge from individuals* - Workshops with lead users - Interviewing lead users - Networking with lead users	*Methods for sourcing knowledge from a user collective* - Open Delphi - Crowdsourcing methods - Community- and social network-based methods	
Mode of interaction	*Interactive methods* - Face-to-face workshops - Active collaboration in online communities	*Unilateral sourcing methods* - Tournament-based crowdsourcing - Prediction markets - Interviewing users	*Passive observation methods* - Netnography in online communities - Big data analysis
Degree of control	*Methods relying on self-organization of users* - Collaboration-based crowdsourcing - Community and social network-based methods	*Methods leaving control to direct activities* - Community-based approaches (when platform owned by organization) - Workshops with lead users	
Incentives for contribution	*Methods relying on purely intrinsic motivations* - Collaboration-based crowdsourcing - Community and social network-based methods - Forecasting games	*Methods relying on mix of intrinsic and extrinisic motivations* - Tournament-based crowdsourcing- Prediction markets - Workshops with lead users	

5.2 Active Participation vs. Passive Observation

Second, open foresight methods vary significantly as to how the organization interacts with the environment. Methods rely on active cooperation, unilateral sourcing of knowledge, or passive observation.

Interactive methods directly integrate the holder of information, i.e. the user, into the foresight process to collaboratively explore possible alternative futures. In this context, interaction between the organization and users is characterized by direct communication and reciprocal exchange. Often, such interaction takes place in face-to-face workshops where participants are given the opportunity to express their thoughts and discuss them with each other. Workshop

participants give and receive immediate feedback and build on each other's insights and arguments, so that interaction leads to a self-reinforcing effect of cooperation among actors with different knowledge, skills, and experiences (Franke & Shah, 2003). Moreover, workshops allow for efficient communication between the organization and users, because the immediate interaction provides room to clarify comments and avoid, or at least reduce, misunderstandings and misinterpretations (Rau et al., 2014). Collective creativity flourishes when individuals actively interchange thoughts and expressions, but, originally, such creative environment was only found in a close physical environment (Cachia et al., 2007). Today, favorable conditions for interaction can also be found in online communities where members communicate and exchange their arguments in real-time. A possible disadvantage of interactive methods is, however, that "the personal integration might support psychological group effects such as groupthink, leading to a conformity of opinions" (Rau et al., 2014, p. 30).

A second type of methods relies on the unilateral sourcing of user knowledge. The organization thereby integrates solely the information artifact, but not the person holding the information (Diener, 2014). As neither mutual exchange nor deeper interaction are intended, the role of the user is limited to giving input. Typically, organizations first specify what kind of future-related information they need. Then, the organizations turn to the users, often using one-to-many and automated communication. For instance, organizations specify their problem, or what kind of information they look for, and invite users through an open call to participate in crowdsourcing tournaments. Users then self-select and submit their solutions and ideas. Afterwards, the input provided by users will be assessed internally and used for in-house foresight purposes. Moreover, organizations can interrogate users by means of interviews or surveys, or use prediction markets to let users bet on the likelihood of possible future events.

Moreover, some methods are available that allow organizations to passively obtain future-knowledge from users. The role of the user is confined to being an observee, as there is no exchange, communication or interaction at all. Instead, these methods rely solely on observation of online user dialogue and postings, which are generally available publicly in communities and social media. For instance, firms can screen tweets and blog entries of lead users or analyze data retrieved from social networks or online communities to systematically identify future-related information. One advantage of these methods is that increasing amounts of such data are publicly available and can often be accessed at no cost. Kozinets (2002) has pointed out that the strength of netnography lies in its unobtrusive nature, which provides a source of unbiased customer opinions. This argument can be generalized to all mentioned passive open foresight methods. On the other hand, the unobtrusiveness gives rise to ethical concerns about monitoring people's behavior without their consent (Kozinets, 2002). Moreover, while information can be retrieved at low cost, a high effort and investment may be required for protecting the privacy and confidentiality of users.

5.3 High Level of Control vs. Self-Organization

Third, interactive and unilateral sourcing methods differ as to the degree of control they leave a company to manage and maintain control over the direction of activities taking place. Thus, one may differentiate between self-organized or more directed forms of governance. This classification does not apply to passive methods: Online dialogue and expressions are observed, but are not influenced so that no governance of user behavior takes place.

When firms involve external sources into their innovative activities and invite volunteer users to contribute their knowledge, they cannot apply traditional organizational hierarchy or leadership authority to directing, incentivizing, or monitoring volunteers' efforts (Wallin & von Krogh,

2010). Many open innovation methods, which can also be applied to foresight, rely on the self-organization of users. This particularly applies to community and social network-based approaches or collaboration-based crowdsourcing, which are essentially characterized by broad participation and self-determined collaboration of users. Using the example of Wikipedia, Cachia et al. (2007) point out that, when contributors act within a well-structured framework, they can gain control of objectives with minimal infrastructure and monitoring and are able to cope with diversity, controversy, and inconsistency. A disadvantage from the firm's perspective is, however, that communities tend to take up problems of interest to them, giving firms only limited leeway to select, propose and effectively broadcast specific problems (Felin & Zenger, 2014). In contrast, in tournament-based crowdsourcing, firms can clearly specify their problem and the types of input they seek. The organization defines the terms (e.g. duration of call, evaluation criteria), then the users self-select to participate and submit solutions, suggestions and ideas. After the tournament deadline, the organization assesses the submissions and offers a reward to the user with the best contribution. However, while self-selection is assumed to attract suitable participants, the seeking firm has no direct control over the selection of participants (Afuah, 2014).

In communities, the degree of control depends largely on the firm's role. A higher level of control to guide the activities of users towards achieving firm-level objectives can be exerted if the organization assumes a privileged role (West & Lakhani, 2008). As long as a firm uses a platform owned or maintained by third parties, it never has the same amount of control as in case of a proprietary platform (Dubiel et al., 2014). If the firm creates its own platform, it has more power to control membership and circumvent risks. On the other hand, if a firm exerts too much control, users may withdraw from the community, which will destroy the productive setting. While a firm may be tempted to control the work of voluntary contributors by demanding higher productivity, this may weaken people's motivation to contribute out of fun, learning, or recognition (Wallin & von Krogh, 2010). The governance structure influences the level of contributions, and it has been found that the more open a project is, the more emphasis needs to be put on a 'fair" governance structure (Shah, 2006). Further methods involving more directed forms of governance include workshops with lead users.

5.4 Intrinsic vs. Extrinsic Incentives for Participation

Fourth, methods rely on different incentives to motivate users to contribute to foresight and freely reveal their knowledge. Both intrinsic and extrinsic motivations may come into play. Again, this classification is irrelevant for passive methods, where users are typically unaware of being observed.

A general issue in open innovation is the circumstance that knowledgeable individuals work outside the company and that less powerful incentives are available to motivate them (Wallin & von Krogh, 2010). A particular challenge, which also affects foresight, is therefore to incentivize participation of users and keep up their interest. Previous research (Füller, 2007; Rohrbeck et al., 2010) identified different motivation sources of users, who virtually participate in innovation processes. According to their findings, methods for customer/user integration build on (1) the enjoyment of the interaction itself, which satisfies the user's need for entertainment and curiosity; (2) the enjoyment of being part of a group and the need for social recognition; (3) the personal need and product usage as users expect to benefit from being able to use a new or enhanced product later on; and (4) monetary incentives. Among these motivations, entertainment and curiosity were found to be the strongest drivers for participation (Rohrbeck et al., 2010). Thus,

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if the interaction meets the users' expectations and their contributions are taken seriously they will be willing to participate (Füller & Matzler, 2007).

Most described methods for sourcing future-related knowledge from users rely predominantly on the intrinsic motivation of users. For instance, users, who are active in communities and social networks or contribute to collaboration-based crowdsourcing, are strongly motivated by the interest in certain topics and enjoy social exchange and discussion with peers about their topic of interest. In order to preserve the contributors' motivation, Hiltunen (2011) highlighted (in the case of Finpro's crowdsourced TrendWiki) the importance of giving feedback to contributors. Another intrinsic motivation is fun, which plays an important role in collaborative forecasting games that incentivize users to participate by entertaining them (Schatzmann et al., 2013). Gamification holds potential to particularly get those individuals involved, who have not yet dealt with foresight or are not interested in future-related issues (Watkins & Neef, 2016).

In methods, which involve lead users, the potential use of a novel solution that caters to their needs provides a strong incentive for revealing information and contributing to innovative activities. Although foresight does not aim at the development of new products and services in the short run and the innovation-related benefit may be weaker, it is still relevant to motivate lead users to share their future-related knowledge. Lead users might feel honored to participate or simply enjoy the creative task (Lühtje & Herstatt, 2004). However, if intrinsic motivation does not suffice, additional monetary incentives can be used to extrinsicially motivate them to cooperate with the firm in foresight workshops and compensate for their efforts. Further methods, which rely on a mix of intrinsic and extrinsic motivations, include tournament-based crowdsourcing: While non-monetary factors continue to play a role, a price is announced to reward the winning solution or idea and, thereby, incentivize users to participate. A strong financial incentive is at work in prediction markets, where users are incentivized to participate and reveal information as they expect to win money for successful forecasting and trading performance. Graefe et al. (2010) highlight that prediction markets trick participants to continuously challenge the group opinion and look for superior information, as participation is only beneficial if one does not agree with, and is able to improve, the current forecast.

In addition to intrinsic and extrinsic motivations, Franke et al. (2013) found that, apart from potential participants calculating whether participation will pay off, there is also a subjective evaluation of fairness. Accordingly, the individual's propensity to submit a contribution increases when they get a fair share and have a voice in decisions.

6 Conclusion

Advances in information and communication technologies have facilitated new methods to source knowledge beyond organizational boundaries. Many of these methods known from open innovation can also be applied to foresight to source knowledge from external sources. This article focuses on users as one particular external knowledge source. The contributions of this paper are threefold. First, the paper reviewed literature on open and user innovation and identified arguments why users can be a valuable source of insight into future demands, preferences and behavior. Accordingly, users, and particularly lead users, have superior knowledge as they know their needs best and integrating their diverse perspectives may help broaden the search space and minimize the risk of overlooking harmful developments or missing promising opportunities. Second, the paper identifies and typologises methods that are suitable for drawing on user knowledge. It includes methods from open and user innovation as well as methods known from

traditional foresight that can now be conducted in significantly more open ways. Third, the paper analyses and juxtaposes these methods in regards to their advantages, disadvantages and boundary conditions. Thus, this section is particularly relevant for practitioners, who seek to integrate user knowledge into their foresight process and need guidance on selecting the right method, which is most appropriate for their goals.

Open innovation has induced a paradigm shift (Baldwin & von Hippel, 2011), which is now also affecting foresight practice. Similarly, foresight methods will increasingly rely on knowledge of external actors and thereby develop into a more open direction. It appears that the expertise of a limited number of individuals, such as experts, loses influence in favor of collective intelligence. Cachia et al. (2007) highlight a change in trust patterns: "While, some years ago people would only trust reputable encyclopedias written by experts acknowledged in their respective fields, now people are also confident in the collaborative work of anonymous contributors" (p. 1190f.). Moreover, increasing amounts of user dialogue available online are being analyzed for foresight, which will lead foresight to become more data-driven.

The methods discussed in this article have different strengths and weaknesses and the selection of a suitable method depends on the firm's specific objectives. In addition, these methods often supplement each other and can be combined. For instance, an online community can be used to post an open call for participation in crowdsourcing tournaments or prediction markets. Another example refers to the identification of lead users in social networks and communities (Belz & Baumbach, 2010; Brem & Bilgram, 2015) or prediction markets (Spann et al., 2009), which are then invited to discuss possible alternative futures with internal employees face-to-face in foresight workshops.

Little research on open foresight has been conducted yet. More research is needed to investigate under which conditions methods work best. Moreover, in the context of open innovation, West and Bogers (2014) pointed out that the identification and acquisition of innovations is only one part and that, in order to benefit from external sources, the innovations must be fully integrated into the firm's R&D activities. A similar issue applies to foresight, as foresight is not just about developing visions about possible alternative futures, but also using the knowledge to take the right action.

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