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Toward Ecosystemic Business Models in the Context of Industrial Internet

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Abstract

Purpose: This study explores business models within a particular domain of Industrial Internet.

Design/Methodology/Approach: Building from theory, this study is conceptual in nature.

Findings: This paper presents a business model framework for understanding the dynamics of value co-creation and co-capture from lifecycle and ecosystem configuration point of view.

Research limitations/implications: This study stresses the need to understand how the integrated, co-dependent processes of value co-creation and co-capture influence on business models of individual firms in co-evolving business ecosystems.

Practical implications: To fully benefit from the mutually connected opportunities enabled by IoT, it is important for firms to position themselves within the ecosystem in terms of the stage of product or service life cycle as well as the scale and scope of ecosystem configuration.

Originality/value: The originality of this research thus relates to expanding the business model literature from ecosystemic perspective.

Keywords: Ecosystem, Industrial Internet, Internet of Things, value co-creation, value co-capture

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Introduction

The rapid development and increasing pervasiveness of digital technologies (Turber et al., 2015) has exposed modern companies to highly dynamic, interconnected business environment. A rising trend in today's economy is digital technology being increasingly intertwined with non-digital products (Turber and Smiela, 2014). This trend is often referred to as the "Internet of Things", coined by Kevin Ashton in 1999 (Atzori et al., 2010; Gubbi et al., 2013) or "Industrial Internet" (Kantola et al., 2015; Fitzgerald, 2015; Muhonen et al., 2015). The concept of Industrial Internet can be understood as an application or business domain under the Internet of Things (Dahlberg et al., 2015; Muhonen et al., 2015). Therefore we refer to these terms interchangeably. The Internet of Things (IoT) is considered as the common paradigm of modern information and communications technology (ICT) field (Atzori et al., 2010), following the chain of personal computers, World Wide Web and mobile phones. To human-computer interaction, IoT adds the third dimension of physical objects. The IoT can therefore be defined as the network of physical objects, consumer devices and enterprise assets containing technology to communicate and sense or interact with external environment (LeHong and Velosa, 2014).

Yet, successful IoT implementations are not just the result of technology innovation, but involve the intelligently coordinated innovation of products, services, and business models (Berthelsen, 2015). Business models at a large sense can be considered to determine how an organization creates and captures value (Zott and Amit, 2010; Shafer et al., 2005; Chesbrough, 2010). Although the business model concept has gained notable momentum in academic research over the last decade, they have remained understudied in the context of IoT (Priem et al., 2013; Turber et al., 2015). In the interconnected domain of IoT, alongside the traditional business networks, new actors arise and the role of existing ones is changing. IoT is seen to offer immense potential to virtually all sectors of the economy by enabling innovative applications and services to consumers, companies and public sector alike (Pang et al., 2012; Muhonen et al., 2015). It is particularly important to highlight that "industry" in this respect refers to all fields of business, not only that of manufacturing. Yet, the literature has not provided actionable, field-tested model theories for capturing, visualizing and analyzing firms' business models in digitally intensive business environments (Turber and Smiela, 2014). This is the first research gap this paper aims to contribute to. In a similar vein to Zott and Amit (2015, 1), we consider a business model to describe the system of interdependent activities that are performed by a focal firm and its partners and the mechanisms, which link these activities to each other. Hence, we view the business model as a boundary-spanning unit of analysis (Zott & Amit 2007).

Furthermore, organizations are also challenged with managing the complexity of business models around digitized products (Turber et al., 2015). To date, the environment for smart applications and their business models has been very complicated, with a lot of experimentation, and many failures (Schaffers et al., 2011). Technology may be there for many, but business application has remained an issue (Glova et al., 2014). Hence, firms fail to create (and capture) value beyond the physical product (Turber et al., 2015). Especially traditional product companies feel increasingly compelled to revise their existing business models in response to new competitive dynamics and to tap into IoT inspired opportunities (Turber et al., 2015; Chesbrough and Appleyard; 2007; Dahlander and Gann, 2010). Yet, the scarce studies on IoT and related business models have focused on technological platforms and single firm's business models (Mazhelis et al., 2013, Lindgren and Aagaard, 2014; Westerlund et al., 2014). These previous firm-centric business models conceptualizations and frameworks are not suitable for analyzing the interdependent nature of growth and success of companies evolving in such an interconnected context (Weiller and Neely, 2013; Westerlund et al., 2014). As a result, the exact relationship between external forces and the business model has remained limitedly explored area (de Reuver et al. 2009, Ahokangas & Myllykoski, 2014). IoT is considered to change the dynamics of value creation and value capture (Hui, 2014). Accordingly, there is a need to shift research focus from enabling technologies to business ecosystems thinking (Westerlund et al., 2014; Dahlberg et al., 2015), and particularly onto value co-creation and co-capture. In this study, these activities refer to joint efforts for synergistic value creation and capture between all stakeholders. This is the second research gap this paper seeks to address.

Thus, the purpose of this study is to provide a theoreti-

cally grounded framework for the analysis of IoT business models. The research question of paper calls

how the business model can be used to understand the dynamics of value co-creation and co-capture in IoT ecosystems?

The literature starts with discussing the background of business model concept, moving onto the impact of digitalization and Internet on business models, and further expanding to ecosystemic perspective on business models. Finally, we introduce our research approach and the conceptual business model framework and address its implications for research and practice. We also discuss the limitations of this research and propose future research directions.

Business Models and the Internet

The Origins of the Business Model Concept

The business model concept became hype with the rise of electronic commerce in the 1990s (Timmers, 1998; Onetti et al., 2012; Teece, 2010; Amit and Zott, 2001; Zott et al., 2011) to explain e-business firms' value creation logic and competitive advantage issues (Ahokangas et al., 2014; Wirtz et al., 2015). Internet-based start-ups in particular used the term to differentiate themselves from the incumbents. Since then, many forums and communities have been established around the topic, and numerous papers published within industrial and academic research during the past decades. Teece (2010, 174) claims that importance of business models is driven by factors such as "the emerging knowledge economy, the growth of the Internet and e-commerce, the outsourcing and offshoring of many business activities, and restructuring of the financial services industry around the world". Also, Veit et al., (2014, 45) emphasize that "the growth of the internet has undoubtedly created greater opportunities for digitized business transactions but this has been accompanied by an intensified competition and an accelerated pace of technological change" making formalized and conceptualized business modelling even more important. Indeed, technological innovation creates the need for business models for bringing discoveries to market and for the opportunity to satisfy unrequited customer needs (Teece, 2010; Glova et al., 2014; Chesbrough, 2010). A business model description is therefore an important starting point for business innovation and transformation (Wirtz et al., 2015), as it can serve as a tool to align technology development and economic value creation (Glova et al., 2014; Chesbrough and Rosenbloom, 2002).

Despite the importance of business models, no unified definitions exist. Researchers have proposed many definitions and concepts in order to describe the essence and purpose of business models (Wirtz et al., 2015). Business models have been depicted, for instance, as an architecture (Timmers, 1998; Osterwalder and Pigneur, 2002), a description (Applegate, 2000; Weill and Vitale, 2001), a narrative (Magretta, 2002), representation (Shafer et al., 2005; Morris et al., 2005), a structural template (Amit and Zott, 2001), a method (Afuah and Tucci, 2001), a recipe (Baden-Fuller and Morgan, 2010) a framework (Afuah, 2004), a pattern (Brousseau and Penard, 2006), a set (Seelos and Mair, 2007) and a model or conceptual tool (Chesbrough, 2003; Osterwalder, 2004; Osterwalder et al., 2005). For instance Osterwalder et al. (2005, 7) define a business model as "a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenues streams". Indeed, common with all different perspectives to business models is that they tend to portray the notion on how firms create and capture value (Zott and Amit, 2010; Shafer et al., 2005; Chesbrough, 2010).

Furthermore, Osterwalder and Pigneur (2002) considered a business model as a link between strategy, business processes, and information systems, where ICT lays the foundations for how business models are built. These main elements of the business model have been illustrated by Pateli (2003), shown in Figure 1.

Figure 1. Business model definition framework (adapted from Pateli, 2003)

Business models can create a shared and common understanding of the ICT domain and facilitate communication between people and heterogeneous and widely spread application systems (Osterwalder and Pigneur, 2002). Even if there is a common acknowledgement that effective and efficient business models are a huge valuable asset to business, most businesses find it hard and use tremendous resources to explain and understand their business better (Lindgren and Aagaard, 2014). One explanation for this is that many of modern business model conceptualizations and frameworks are still firm-centric, and thus less suited for analyzing the interdependent nature of the growth and success of companies that are evolving in the same innovation ecosystem (Weiller and Neely, 2013; Westerlund et al., 2014). Originally, the business model concept was considered to nest between network and firm to describe a firm's position within its value network (Amit and Zott, 2001; Hedman and Kalling, 2003; Turber et al., 2015). However, during the course, the focus moved to study business models from the focus of the firm (Magretta, 2002; Casadesus-Masanell and Ricart, 2010; McGrath, 2010).

Hence, this study argues that business model research needs to draw its attention back to a dynamic approach in order to consider various influences on business model viability, business model evolution and the place of business models in the product or service lifecycle (see also Demil and Lecocq, 2010; Ahokangas et al., 2014). Indeed, a shift is starting to take place from single-firm revenue generation towards multi-firm control and interface issues (Ballon, 2007), which we discuss further in the following parts of this study.

Business Models, Digitalization and the Industrial Internet

Early approaches to business modeling focused on the selection of the most appropriate virtual channels and revenue models within the e-business context (Ballon, 2007; Amit and Zott, 2001; Magretta, 2002). As the Internet boom of the start of the millennia subsided, the attention of business model literature shifted towards the integration of virtual activities into the real-world marketplace. Along with the rise of the mobile telecommunications industry, business models were increasingly connected with shifting firm boundaries, through vertical and horizontal integration within the industry as well as through the complex provision of new services (Ballon, 2007). This vertical and horizontal nature of the IoT is illustrated in the following Figure 2, where within IoT ecosystems, physical objects are seamlessly integrated into the information network through enabling ICT, where physical objects can become active participants in business processes (Haller et al., 2009, 15).

The vertical and horizontal integration within the digitally intensive industries means that business models were also designed to match the nature of integration (Ballon, 2007). Technical products are usually commercialized through vertical business models. Here, firms, e.g. infrastructure and technology providers, believe that competitive advantage rises from focusing on value creation within narrow segments (Ahokangas, 2015). These firms focus on offering a complete solution and thus, all technology and services are provided and controlled by the same company (Quinnell, 2013). Therefore, vertical models are slow to respond to market dynamics. (Quinnell, 2013).

Horizontal models enable fast growth and innovation in the industry, as they allow multiple providers to focus on their respective fields through a common framework (Quinnell, 2013). Horizontal business models aim to capture as much value as possible across different segments. Hence, cost awareness and short-term prof-

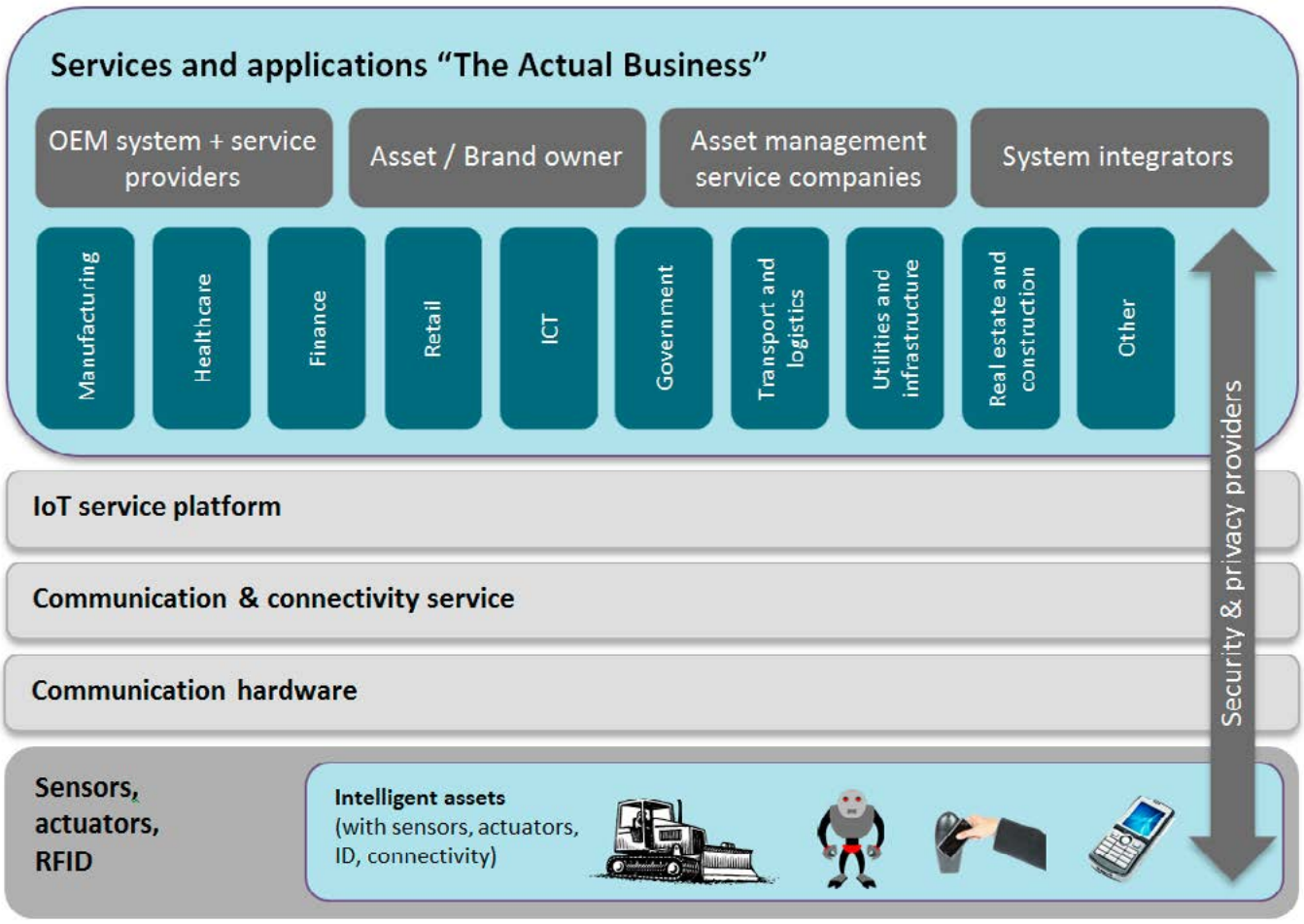

Figure 2. The IoT as a business ecosystem (adapted from Ailisto, 2015)

it potential often guide these firms (Ahokangas, 2015). However, even though horizontal models allow rapid scale-up of applications and businesses, considerable inputs from different parties are required before the system is able to run smoothly (Quinnell, 2013). Therefore, horizontal model is more heavily dependent on supporting infrastructure.

Yet, as digitalization and Industrial Internet progresses, traditional firm-centric business models are facing challenges, as product manufacturers are increasingly in the need of transforming their mode of operation to service providers. Previously independent actors are increasingly connected with each other through both technical and business ties. The introduction of new technologies such as Radiofrequency Identification (RFID), Bluetooth and smart computing has enabled many new application and business propositions in traditional industrial sectors, such as the energy sector, logistics and transport, manufacturing and production, industrial automation, environment, utilities, maintenance, health-care and services (Glova et al., 2014; Gubbi et al., 2013; Mazhelis et al., 2013). Connections and communications between physical items, such as sensors, mobile phones and other consumer devices, or even enterprise assets, to the Internet and to each other, make business modelling more challenging but also more valuable. Companies are recognizing the potential for faster decision making, real-time control, service time reduction, process optimization, new business models, enhanced operational efficiency, resource conservation, and the capability to do all of this location-independently, and moreover, globally (VTT Visions 3, 2013; Hui, 2014; Turber and Smiela, 2014; Mazhelis et al., 2013). The entire IoT domain is demanding for new service concepts and business models, as companies need to "fundamentally rethink their orthodoxies about value creation and value capture" (Hui, 2014). This kind of transformation requires a conversion from product to service mindset (Hui, 2014; Dahlberg et al., 2015), as illustrated in the following Table 1.

Table 1. Shifting from product to service mindset (adapted from Hui, 2014)

VALUE CREATION	Needs of customers	Existing needs and lifestyle are solved on reactive basis	Addressing real-time and emerging need in a predictive manner
	Offering	A stand alone product expiring over time	Over the air updates for products to enhance or correct features
	The role of data	Single point data will be used for future product requirements	The data is combined for creating user experience of existing products, at the same time enabling other services
VALUE CAPTURE	Path to profit	The next product or device will be sold	Allows recurring returns (for example monthly based billing)
	Control points	Intellectual Property Rights (e.g. patents) and brand	Personalization and context: network effects between products
	Development of capabilities	Leveraging the core competences as well as existing processes and resources	To understand how partners within ecosystem are making money

The literature shows that researchers and practitioners have yet not researched widely on how digitization and the IoT effect on business models (Turber et al., 2015). Furthermore, IoT research from the business ecosystem perspective has been practically nonexistent, because limited research has focused on technological platform perspective and single firms' business models (Mazhelis et al., 2013; Westerlund et al., 2014). However, alongside the traditional business network of buyers, suppliers and makers of product or services, new actors arise and the role of existing ones is changing, which requires new research approaches. Successful firms do not just add value but reinvent it (Normann and Ramirez, 1993, 65). Therefore, the focus needs to shift from enabling technologies to the value-creating system itself (Normann and Ramirez, 1993) through business ecosystems thinking (Westerlund et al., 2014; Dahlberg et al., 2015), and from linear value creation and capture to boundary-spanning value co-creation and co-capture.

The Ecosystemic Perspective on Business Models

A biological ecosystem can be defined as a community of interacting organisms and their physical environment (Oxford English Dictionary). Drawing from ecosystem analogy, a business ecosystem, as defined by Moore (1993), is an economic community that is supported by a foundation of interacting organizations and individuals – the organisms of the business world (Moore 1996: 15). Moore expanded previous supply chain network theories to include other organizations such as universities, industry associations and other (non-commercial) stakeholders, as well as the interactions between them (Rong et al., 2015). As biological ecosystems, also business ecosystems are characterized by high complexity, interdependence, co-

operation, competition and coevolution (Moore, 1996; Jansson et al., 2015; Lehto et al., 2013). The concept of business ecosystem emphasizes companies' joint utilization of complementary capabilities in pursuit of new innovations (Lehto et al., 2013; Chesbrough et al., 2014; Hirvonen-Kantola et al., 2015).

Successful IoT implementations are not just about technological solutions, but involve also the intelligently coordinated innovation of products, services, and business models (Berthelsen, 2015). In this kind of context, the business model can be viewed as a boundary-spanning unit of analysis (Zott and Amit, 2007, Ahokangas et al. 2014), as the business model shifts the focus of research on how the firm connects with its external environment. The boundary-spanning nature of business models has been acknowledged by some scholars in business model research, as discussed by Zott and Amit (2010). Zott et al., (2011), in their extensive review of the business model literature, state that even though business models are centered on a focal firm, their boundaries are wider, and business models emphasize a system-level activity approach, with also the focal firm's partners playing a role. This refers to the need to consider the activities that are performed for the focal firm but outside its boundaries by partners, suppliers or customers (Zott and Amit, 2010). Hence, the focal firm is able to rely on the resources and capabilities of third parties, and utilize the external ideas and sources of innovation through the open business model concept (see also Chesbrough, Vanhaverbeke and West, 2014).

Messerschmitt and Szyperski (2003) discussed ecosystems in ICT and presented a layered model of the ecosystem stakeholder roles. In the traditional approach, an ecosystem is based on technical infrastructure, a platform, to which other players of the ecosystem integrate (Messerschmitt and Szyperski, 2003). Products, systems and services, as well as user applications are built on this technological foundation. Wirtz et al. (2010) discussed four business models for the Web 2.0 in order to classify Internet-based business models. Each of these business models, illustrated in the following Figure 3, can be offered standalone or bundled. Yrjölä et al. (2015a) organized these models into a layered, ecosystemic model. In this perspective, it can be interpreted that the lower level business models serve as enablers and value levers for the higher layers (Yrjölä et al. 2015a). In an ecosystem, the members evolve symbiotically through simultaneous collaboration and competition (Moore, 1993; Lehto et al., 2013; Jansson et al., 2014; Rong et al., 2015, Ritala et al., 2014). Hence, this model can be used to highlight the dependencies between the ecosystem layers (Yrjölä et al., 2015a).

Onetti et al., (2012) also state that the business model needs to accommodate the spatial dimensions and organizational boundaries, as well as the role of partners. The firm's choices "can make the difference in terms of company's ability to access resources, develop competences, create a network, benefit from knowledge spill-overs and therefore excel, innovate and implement its strategy" (Onetti et al., 2012, 359). Therefore, we argue that as networks and partnerships can have a great influence on how value is (co)created and (co)

Figure 3. The 4C business model typology (Adapted from Yrjölä et al., 2015a)

captured, they need to be considered as a part of the business model itself (Wirtz et al., 2015; Chesbrough et al., 2014).

Ahokangas et al. (2014) propose a dynamic, processual framework for business models, consisting of the elements what the firm does, how the activities are organized, why do they think it can be done profitably and where the activities take place, internal or external to the firm. According to Ahokangas et al. (2014, 22) all elements of the business model can be externalized. Amit and Zott (2015, 1) also state that a "business model describes the system of interdependent activities performed by a focal firm and its partners and the mechanisms that link these activities to each other". The authors stress that the content, structure and governance of business models are important but the antecedents of business model design need to be acknowledged as well. These antecedents are the goals for creating and capturing value, the templates used by other organizations, collaboration and the activities of stakeholders, and internal and external constrains (Amit and Zott, 2015). Their business model describes how a focal firm may tap into its ecosystem to perform the activities that are necessary to fulfill perceived customer needs, as it focuses on the activities performed by the subset of actors within the focal firm's ecosystem. Thus, their conceptual framework alerts to the "possibilities for leveraging resources that exist within the business ecosystem (Amit and Zott, 2015, 16).

Therefore, in the development of IoT related offerings, it is essential early on to consider the underlying business opportunities that are attractive and feasible for all the key stakeholders, which emphasizes value co-creation and co-capture (Jansson et al., 2014). In the ecosystemic perspective, the logic is enabling value creation for all stakeholders, not only how it is captured by the focal firm (Zott et al., 2011, Upward and Jones, 2015). The identification of interconnections and dependencies within the ecosystem and business model synergy are particularly relevant, as in complex, interconnected ecosystems, value co-creation for the focal firm may in fact result in value co-destruction for another (Upward and Jones, 2015). This emphasizes the role of synergic business models, as it is business model synergy that enables simultaneous value co-creation and co-capture within that ecosystem (Ahokangas, 2015) among "any and all actors in the organization's value constellation (Upward and Jones, 2015, 10). These previous discussions build the theoretical foundations of our IoT business model framework, which we elaborate in the following chapter.

Ecosystemic business model framework for IoT

Building from the literature, we propose a conceptual business model framework for understanding the dynamics of value co-creation and co-capture in the context of Industrial Internet. In deriving our framework, we extend the work by Messerschmitt and Szyperski (2003). From business perspective, this technical approach is too limited. It does not consider the integration of multiple businesses operating in a collaborative environment (Glova et al., 2014). Hence, we apply an OSI model (Open Systems Interconnection), which is a conceptual framework for understanding relationships (Rouse, 2014). Our framework is presented in the following Figure 4.

In order to answer the research question in relation to understanding the dynamics of value co-creation and value co-capture in IoT ecosystems, both the ecosystem configuration in terms of scope and scale, as well as the life cycle perspective in terms of stage need to be taken into account. The IoT ecosystem can be considered to function as an open innovation platform where joint development of innovations is highlighted (Saebi and Foss 2015; Chesbrough et al., 2014). Industrial Internet as a business ecosystem (Figure 2) sets the dimensions of scale and scope of value co-creation and co-capture. The infrastructure and hardware are needed for running IoT services. The important role of platforms and data is highlighted by the example of Google; without the platform it is not possible to collect and utilize data in value creation or capture. The actual devices and equipment, e.g. sensors that gather data, create the next layer. This is typically the layer where IoT companies start their business, only to realize that they need a platform and connectivity for efficient data acquisition and analysis. The furthest layer includes applications and user interface, aimed for end users. This would include, for instance, a web-based personal health monitoring service. In this perspective, scale and scope follow the previously presented 4C business model typology. The role of the business model in co-evolving IoT business ecosystems (Rong et

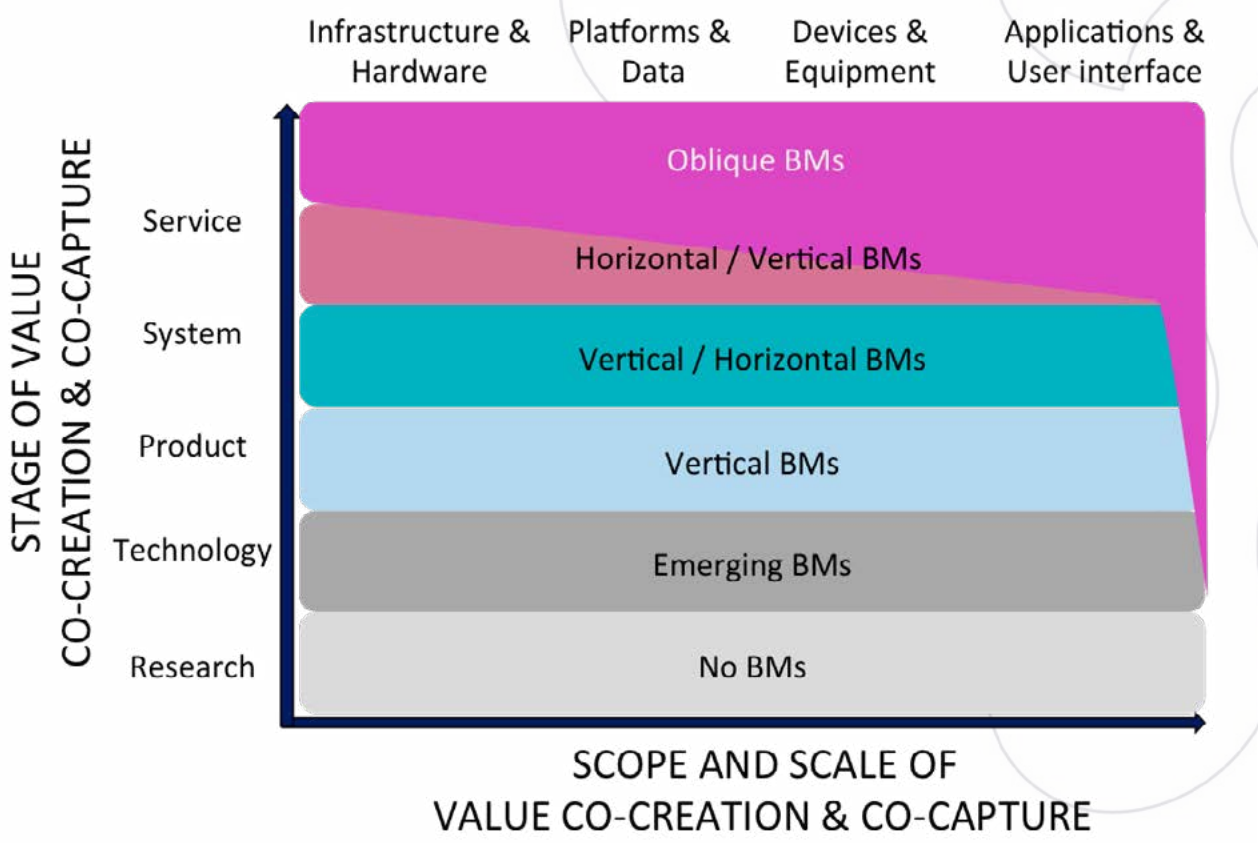

Figure 4. The IoT Business Model Framework

al., 2015) is hence to connect the firm with its external environment, customers, competitors and larger society (Teece, 2010; Ahokangas et al., 2015).

Indeed, cooperation demonstrates the linkage between the constructive elements and the ecosystem configuration, but this process of cooperation varies along the lifecycle of the business ecosystem (Rong et al., 2015). Hence, we extend the work by Messerschmitt and Szyperski (2003) to include research to life cycle stages. The stages of value co-creation and co-capture therefore include research, technology, products, systems and service. This life cycle perspective highlights that value co-creation and co-capture processes start already before any actual business models exist. Ecosystem players need to be sensitive to the goals and motives of other ecosystem stakeholders and how these impact the synergy of the ecosystem already before any actual business. This means that already research activities, either carried out by firms or specific research institutions, add value to the ecosystem through the exploration of different business opportunities. In the technology development stage, actual business models start to emerge, as at this stage, the commercialization aspects need to be considered as well. At the earlier stages, vertical, product-focused business models appear more common, and at the later stages, as services start to emerge, horizontal models prevail.

We claim, that simultaneous value co-creation and co-capture within IoT ecosystems rises through "oblique" business models. In the context of IoT, the relationship among partners is no longer based on customer-supplier–relationship but organizations are now dependent on each other, interact in order to achieve common strategic objectives and eventually share a common fate (Iansiti and Levien, 2004; Moore, 1996; Rong et al., 2015). Therefore, organizations cannot build their business models in silos, but a synergic view requires them to consider the stage of life cycle of clients and partners as well, as the stage determines how firms should build their own business models. Whereas previous ICT-based business models have considered only one layer of the ecosystem configuration, either through horizontal or vertical business models, the oblique IoT business model views the ecosystem as a whole (Ahokangas et al. 2015; Lehto et al., 2013). An oblique business model with an evolving and loosely coupled structure (Saebi and Foss, 2015; Amit and Zott, 2015),

Table 2. Oblique business model case illustration

	Apple	Uber	Airbnb
Stage			
Service	On-demand music experience	On-demand transportation	On-demand travel accommodation
System	Platform-based: Apple gets a share per tune played	Platform-based: Uber gets a share per ride	Platform-based: Airbnb gets a share per rental
Product	Music player	Smartphone app	Website
Technology	Disrupting traditional music industry through mp3 technology	Disrupting traditional taxi industry through mobile application	Disrupting traditional travel industry through online service
Research	Based on two-sided value co-creation and co-capture for artists and listeners	Based on two-sided value co-creation and co-capture for passengers and drivers	Based on two-sided value co-creation and co-capture for guests and hosts
Scale and Scope			
	iPod as hardware, iTunes as platform, iPhone as device, uniform interface, service based on bundled content.	A user application that utilizes equipment of others with own technological infrastructure and platform to provide a taxi service.	An online platform that utilizes the property of others to offer accommodation for travellers.

follows the rationales of open innovation (Chesbrough et al., 2006; Chesbrough et al., 2014). Through oblique business models, fast-growing and service-oriented companies are able to utilize external resources outside firm boundaries (Ahokangas, 2015; Bogers and West, 2012; Chesbrough et al., 2014). We extend our elaboration through the following case illustration.

Apple's iPod was among the first ones to create an oblique business model by basically combining memory stick (product) to content (service) distributed to masses: cheap hardware with very versatile content, bypassing completely the more old-fashioned music distribution logic employed by the music industry. Uber Technologies' mobile application for fulfilling a physical need resulted in the collapse of a traditional value chain in on-demand transportation. The fast rise of companies providing local services through similar business models has even resulted in a term "uberification" (Schlafman, 2014). Airbnb developed a website for list, find and rent accommodation, without owning any real estate. Through their platform-based business model, their ability to scale up occurs basically with zero marginal cost (Moazed, 2014). These cases further ground oblique business models on sharing economy –based thinking, where business opportunities can be seen as

two-sided, i.e., simultaneous provisioning and utilization of resources (Yrjölä et al., 2015b). Thus, in addition to value co-creation and co-capture through open innovation, oblique business models also consider the possibilities for value sharing. Stephany (2015), has recently defined Sharing Economy as "the value in taking the underutilized assets and making them accessible online to a community, leading to a reduced need for ownership of those assets." Hence, sharing economy thinking has become popular especially in peer-to-peer communities that are the source of Uber's and Airbnb's business opportunity.

Conclusion

Eventually the layers in the IoT ecosystem are becoming blurred or fuzzy at the firm level, as companies seek bundled or hybrid business models that combine or aggregate services from different layers. During the ecosystem's evolution, also the specific roles of actors can change. In this kind of dynamic context, the oblique business model is the binding factor between the stage, scale and scope of value co-creation and co-capture, as it brings the focus onto the ecosystemic business opportunity itself. In this way, the business model provides synergy for mutually connected opportunities within the ecosystem. Business opportunities in the field of IoT may rise at any stage of the product or service development. The benefit of the oblique business model thus is that it does not separate the sources of value creation, capture, and sharing as they are embedded within the whole ecosystem. The famous cases of Apple, Uber and Airbnb show that the number of oblique business models is growing rapidly, winning market share and jeopardizing the established or incumbent firm's horizontal and vertical business models (Ahokangas, 2015). Oblique business models have the power to disrupt whole industries.

The academic contribution of this paper lies within the business model literature, firstly by discussing the role of external environment within business models and secondly, by discussing the emerging ICT-based business models in the field of Internet of Things. This study stresses the need to understand the nature of integrated, co-dependent processes of value co-creation, co-capture and sharing and their impact on the business models of individual firms in co-evolving business ecosystems. We extend the research from value creation and capture at the firm level onto how value can be co-created and co-captured at the ecosystem level. The originality of this research thus relates to expanding the business model literature from ecosystemic perspective.

The practical implications of this paper relate to the alternative business opportunities in the context of IoT. This study highlights the configuration of the IoT business ecosystems and the need to for firms to position themselves within the ecosystem in terms of the stage, scope and scale of value co-creation and co-capture. In this way, the opportunities offered by Industrial Internet and digitization can truly be exploited to build for competitive advantage especially for firms previously focused on serving the physical, product-based value chain.

The limitations of this research relate to the need to empirically test the issues we have pointed in relation to the stage, scope and scale of ecosystemic value creation and capture. Both qualitative and quantitative research is needed to build further propositions and hypotheses to validate our framework. Thus, these limitations also relate to potential future research directions and questions that arise from our research. Digitization and the Internet of Things are spreading to various new business fields and industries, ranging from private SMEs into large public organizations. Does firm size matter in this context? Are ecosystemic business models similarly applicable to large and small firms? Are the dynamics of ecosystemic business models different in different industries characterized by high levels of digitization? How do the roles of ecosystem members change and evolve within the ecosystem over time? For instance these issues we hope future research to address.

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References

Adner, R. & Kapoor, R (2010) Value Creation In Innovation Ecosystems: How the Structure of Technological Interdependence affects Firm Performance in New Technology Generations. Strategic Management Journal, Vol. 31, pp. 306-333.

Afuah , A. (2004) Business Models – a Strategic Management Approach, McGraw Hill Irwin, New York.

Afuah, A., & Tucci, C. L. (2001) Internet business models and strategies: Text and cases. McGraw-Hill, New York.

Ahokangas, P. (2015, January 29) Vertical, horizontal and oblique business models (blog) Available at: http://techbusstratintfutures.blogspot.fi/

Ahokangas,P., Alila, H., Helaakoski, H., Kyllönen, V., Lehtimäki, T., Peltomaa, I., Seppänen, V. & Tanner, H. (2015) Collaborative Business Networks of the Future. VTT Value Network 2.0. VTT Technical Research Centre of Finland. Grano, Kuopio.

Ahokangas, P., Juntunen, M. & Myllykoski, J. (2014) Cloud Computing and Transformation of International E-Business Models. Research in Competence-Based Management, Vol. 7, pp. 3-28.

Ailisto, H. (2015) Industrial Internet – opportunity for Finland. Keynote Presentation at Automaatio XXI Conference, 17-18 March, Helsinki

Amit, R., & Zott, C. (2001). Value creation in e-business. Strategic Management Journal, Vol. 22, No. 6-7, pp. 493-520.

Amit, R & Zott, C. (2015) Crafting Business Architecture: The Antecedents of Business Model Design. Strategic Entrepreneurship Journal. pp. 1-20. Available at: http://wileyonlinelibrary.com DOI: 10.1002/sej.1200

Applegate, L. M. 2000. E-business models: Making sense of the internet business landscape. In G. Dickson & G. DeSanctis (Eds.), Information technology and the future enterprise: New models for managers, pp. 49-101. Englewood Cliffs, NJ: Prentice-Hall.

Atzori, L., Iera, A. & Morabito, G. (2010) The Internet of Things: a survey. Computer Networks, Vol. 54, pp. 2787–2805.

Baden-Fuller, C., & Morgan, M. S. (2010). Business models as models. Long Range Planning, Vol. 43, No. 2-3, pp. 156-171.

Ballon, P. (2007) Business modelling revisited: the configuration of control and value, info, Vol. 9, No. 5, pp. 6 – 19.

Berthelsen, E. (2015) A new agenda item for enterprise executives: Enterprise IoT. Machina Research. (white paper).

Bogers, M. & West, J. (2012) Managing Distributed Innovation: Strategic Utilization of Open and User Innovation. Creativity and Innovation Management, Vol. 21. No. 1, pp. 61-75.

Brousseau, E., & Penard, T. 2006. The economics of digital business models: A framework for analyzing the economics of platforms. Review of Network Economics, Vol. 6, No. 2, pp. 81-110.

Casadesus-Masanell, R., & Ricart, J. E. (2010). Competitiveness: A business model reconfiguration for innovation and internationalization. Management Research, Vol. 8, No. 2, pp. 123-149.

Chesbrough, H. (2003). Open Innovation: The New Imperative for Creating and Profiting from Technology. Boston: Harvard Business School Press.

Chesbrough, H. (2010) Business Model Innovation: Opportunities and Barriers. Long Range Planning, Vol. 43, No. 2-3, pp. 354-363.

Chesbrough, H. & Appleyard, M. (2007) Open innovation and strategy. California Management Review, Vol. 50, No. 1, pp. 57-74.

Chesbrough H, & Rosenbloom R. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. Industrial and Corporate Change, Vol. 11, pp. 529–555.

Chesbrough, H., Vanhaverbeke, W. & West, J. (2014) New Frontiers in Open Innovation. Oxford University Press, Oxford.

Chesbrough, H., Vanhaverbeke, W. and West, J. (2006) Open Innovation: Researching a New Paradigm, Oxford University Press, Oxford.

Dahlander, L. & Gann, D. (2010). How open is innovation? Research Policy, Vol. 39, No. 6, pp. 699– 709.

Dahlberg, H., Öberg, J., Glaumann, M., Gjelstrup, A. & Berntsson, G.L.(2015) Connected Things. Arthur DeLittle Telia-Sonera

Demil, B. &Lecocq, X. (2010) Business Model Evolution: In Search of Dynamic Consistency. Long Range Planning, Vol. 43, pp. 227-246.

De Reuver, M., Bouwman, H. & MacInnes, I. (2009) Business model dynamics: a case survey. Journal of Theoretical and Applied Electronic Commerce Research, Vol. 4, No. 1, pp. 1-11.

Fitzgerald, M. (2015, January 27) Gone Fishing – For Data. MIT Sloan Management Review. Available at: http://sloanreview.mit.edu/article/gone-fishing-for-data/

Frankenberger, K., Weiblen, T. & Gassmann, O. (2014) The antecedents of open business models: an exploratory study of incumbent firms. R&D Management, Vol. 44, No. 2, pp. 173-188.

Glova, J., Sabol, T. & Vajda, V. (2014) Business Models for the Internet of Things Environment. Procedia Economics and Finance, vol. 15, pp. 1122-1129.

Gubbi, J., Buyya, R., Marusic, S. & Palaniswami, M. (2013) Internet of Things (IoT): A vision, architectural elements, and future directions. Future Generation Computer Systems, Vol. 29, pp. 1645-1660.

Haller, S., Karnouskos, S., Schroth, C. (2009), The Internet of Things in an Enterprise Context, in J. Domingue, D. Fensel und P. Traverso (Eds.), First Future Internet Symposium - FIS 2008, LNCS 5468, Springer Verlag 2009, pp. 14-28.

Hedman, J. and T. Kalling (2003). "The business model concept: Theoretical underpinnings and empicical illustrations." European Journal of Information Systems, Vol. 12, No. 1, pp. 49-59.

Hirvonen-Kantola, S., Ahokangas, P., Iivari, M., Heikkilä, M. & Hentilä, H. (2015) Urban development practices as anticipatory action learning: case Arctic Smart City Living Laboratory. Procedia Economics and Finance, Vol. 21, pp. 337-345.

Hui, G. (2014, July 29) How the Internet of Things Changes Business Models. Harvard Business Review. Available at: https://hbr.org/2014/07/how-the-internet-of-things-changes-business-models

Iansiti, M., and Levien, R. (2004), The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability, Harvard Business Press.

Jansson, N., Ahokangas, P., Iivari, M., Perälä-Heape, M. & Salo, S. (2014) The Competitive Advantage of an Ecosystemic Business Model: The Case of OuluHealth. Interdisciplinary Studies Journal, 3 (4), 282-294.

Kantola, R., Llorente Santos, J. & Beijar, N. (2015) Policy-based communications for 5G mobile with customer edge switching. Security and Communication Networks, available at http://wileyonlinelibrary.com

LeHong, H. & Velosa, A. (2014, July 21) Hype Cycle for the Internet of Things. Gartner Inc. Available at: https://www.gartner.com/doc/2804217/hype-cycle-internet-things-

Lehto, I., Hermes, J., Ahokangas, P. & Myllykoski, J. (2013) Collaboration in Cloud Businesses – Value Networks and Ecosystems. Communications of the Cloud Software. (discussion paper) Available at: http://urn.fi/URN:NBN:fife201303062240

Lindgren, P. and Aagaard, A. (2014). The Sensing Business Model. Wireless personal communications, Vol. 76, No. 2, pp. 291-309.

Magretta, J. (2002). Why business models matter. Harvard Business Review, Vol. 80, No. 5, pp. 86-92.

Mazhelis, O., Warma, H., Leminen, S., Ahokangas, P., Pussinen, P., Rajahonka, M., Siuruainen, R., Okkonen, H., Shveykovskiy, A. & Myllykoski, J. (2013) Internet-of-Things Market, Value Networks, and Business Models: State of the Art Report. Jyväskylä University Printing House, Jyväskylä.

McGrath, R. G. (2010). Business models: A discovery driven approach. Long Range Planning, Vol. 43, No. 2-3, pp. 247-261.

Messerschmitt, D.G. & Szyperski, C. (2003) Software Ecosystem: Understanding an Indispensable Technology and Industry. The MIT Press.

Moazed, A. (2014, January 23) What is a Platform? Available at: http://www.applicoinc.com/blog/what-is-a-platform-business-model/

Moore, J. (1993) Predators and prey: a new ecology of competition. Harvard Business Review, Vol. 71, pp. 75–86.

Moore, J. (1996) The death of competition. Fortune, Vol. 133, No. 7, pp. 142-144.

Morris, M., Schindehutte, M., & Allen, J. (2005). The entrepreneur's business model: Toward a unified perspective. Journal of Business Research, Vol. 58, No. 6, pp. 726-735.

Muhonen, T., Ailisto, H. & Kess, P. (2015) Standardization in Industrial internet (IoT) and Condition-Based Maintenance. Proceedings at the Automaatio XXI Conference, 17-18 March, Helsinki

Normann, R. & Ramirez, R. (1993) From Value Chain to Value Constellation: Designing Interactive Strategy. Harvard Business Review, Vol. 71 pp. 65-77.

Onetti, A., Zucchella, A., Jones, M., & McDougall-Covin, P. (2012). Internationalization, innovation and entrepreneurship: Business models for new technology-based firms. Journal of Management and Governance, Vol. 16, No. 3, pp. 337-368.

Osterwalder, A. (2004). The business model ontology – a proposition in a design science approach. Ph.D. Thesis, University of Lausanne.

Osterwalder, A. & Pigneur, Y. (2002). An e-business model ontology for modeling e-business.
Proceedings at the 15th Bled Electronic Commerce Conference, 17-19 June, Bled.

Osterwalder, A., Pigneur, Y., and Tucci, C.L. (2005) Clarifying business models: origins, present, and future of the concept. Communications of the Association for Information Systems, Vol. 16, No. 1, pp. 1–25.

Pang, Z., Chen, Q., Han, W. & Zheng, L. (2012) Value-centric design of the internet-of-things solution for food supply chain: Value creation, sensor portfolio and information fusion. Information Systems Frontiers, Vol. 17, No. 2, pp. 289-319.

Pateli, A. (2003). A framework for Understanding and Analysing eBusiness Models. Proceedings at the 16th Bled eCommerce Conference, 9-11 June, Bled.

Priem RL, Butler JE, Li S. 2013. Toward reimagining strategy research: retrospection and prospection on the 2011 AMR decade award article. Academy of Management Review Vol. 38, pp. 471–489.

Quinnell, R. (2013, October 2) Vertical vs. horizontal: Which IoT model will thrive? Available at: http://www.embedded.com/electronics-blogs/other/4422131/Vertical-vs--horizontal--Which-IoT-model-will-thrive-

Ritala, P., Golnam, A. & Wegmann, A. (2014) Coopetition-based business models: The case of Amazon.com. Industrial Marketing Management, Vol. 43, pp. 236-249.

Rong, K., Hu, G., Lin, Y., Shi, Y. & Guo, L. (2015) Understanding business ecosystem using a 6C framework in Internet-of-Things based sectors. International Journal of Production Economics, Vol. 159, pp. 41-55.

Rouse, M (2014, August) OSI reference model (Open Systems Interconnection) Available at: http://searchnetworking.techtarget.com/definition/OSI

Saebi, T. and Foss, N.J. (2015) Business Models for Open Innovation: Matching Heterogenous Open Innovation Strategies with Business Model Dimensions. European Management Journal, Vol. 33, No. 3, pp. 201-213.

Schaffers, H., Komninos, N., Pallot, M., Trousse, B., Nilsson, M. & Oliveira, A. (2011) Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation. In: J Dominique et al. (Eds): Future Internet Assembly, LNCS 6656, pp. 431-446.

Seelos C, Mair J. (2007). Profitable business models and market creation in the context of deep poverty: a strategic view. Academy of Management Perspectives Vol. 21, pp. 49–63.

Shafer, S. M., Smith, H. J., & Linder, J. C. (2005). The power of business models. Business
Horizons, Vol. 48, No. 3, pp. 199-205.

Schlafman, S. (2014, April 4) Uberification of the US Service Economy. Available at: http://schlaf.me/post/81679927670

Stephany, A. (2015) The Business of Sharing: Making it in the New Sharing Economy. Pagrave MacMillan. Available at: http://www.palgraveconnect.com/pc/doifinder/10.1057/9781137376183.0001.

Teece, D. J. (2010). Business models, business strategy and innovation. Long Range Planning, Vol. 43, No. 2-3, pp. 172-194.

Timmers, P. (1998). Business models for electronic markets. Electronic Markets, Vol. 8, No. 2, pp. 3-8.

Turber, S. & Smiela, C. (2014) A Business Model Type for the Internet of Things. Twenty Second European Conference on Information Systems, 9-11 June, Tel Aviv.

Turber, S., vom Brocke, J. & Gassmann, O. (2015) Designing Business Models in the age of Pervasive Digitization. Proceedings at the Academy of Management Annual Meeting, 7-11 August, Vancouver.

Upward A., & Jones, P.H. (2015) An Ontology for Strongly Sustainable Business Models: Defining an Enterprise Framework Compatible with Natural and Social Science. Organization & Environment, pp. 1-27. doi:10.1177/1086026615592933

Veit, D., Clemons, E., Benlian, A., Buxmann, P., Hess, T., Kundisch, D., Leimeister, J., Loos, P., Spann, M., (2014) Business Models: An Information Systems Research Agenda. Business & Information Systems Engineering, Vol. 6, No. 1, pp. Available at: http://aisel.aisnet.org/bise/vol6/iss1/8/

VTT Visions 3, (2013). Productivity leap with ioT. Visions of the Internet of Things with a special focus on Global Asset Management and Smart Lighting, VTT, Espoo. Available at: http://www2.vtt.fi/inf/pdf/visions/2013/V3.pdf

Weill, P. , & Vitale, M. R. (2001) Place to Space: Migrating to e-Business Models. Harvard Business School Press, Cambridge.

Weiller, C., & Neely, A. (2013). Business Model Design in an Ecosystem Context. University of Cambridge Working Papers. Cambridge Service Alliance, Cambridge.

Westerlund, M., Leminen, S., & Rajahonka, M. (2014) Designing Business Models for the Internet of Things. Technology Innovation Management Review. Available at: http://timreview.ca/article/807

Wirtz, B.W., Pistoia, A., Ullrich, S. & Göttel, V. (2015) Business Models: Origin, Development and Future Research Perspectives. Long Range Planning, pp. 1-19 (article in press)

Wirtz, B.W., Schilke, O. & Ullrich, S. (2010) Strategic Development of Business Models: Implications of the Web 2.0 for Creating Value on the Internet. Long Range Planning, Vol. 43, No. 2-3, pp. 216-226.

Zott, C., & Amit, R. (2010). Business model design: An activity system perspective. Long Range Planning, Vol. 43, No. 2-3, pp. 216-226.

Zott, C., Amit, R., & Massa, L. (2011). The business model: Recent developments and future research. Journal of Management, Vol. 37, No. 4, pp. 1019-1042.

Yrjölä, S., Ahokangas, P. & Matinmikko, M (2015a) Evaluation of recent spectrum sharing concepts from business model scalability point of view. Proceedings at the IEEE DySPAN 2015 – Dynamic Spectrum Access Networks, 29 September – 2 October, Stockholm.

Yrjölä, S., Matinmikko, M., Ahokangas, P., & Mustonen, M. (2015b). Licensed Shared Access to spectrum. In: Hu, F. (ed): Spectrum Sharing in Wireless Networks: Fairness, Efficiency, and Security. Taylor & Francis LLC, CRC Press. (forthcoming)

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