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A BUSINESS MODEL FRAMEWORK FOR INTERNET OF THINGS

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ABSTRACT

The Internet of Things (IoT) generates new business opportunities by connecting physical objects with a multitude of sensors. IoT research mainly focused on technology and business models are relatively unexplored, although developing IoT business models is important for successful IoT service. This study aims to investigate what are the elements to be taken in order to create a business model for IoT. To address this issue, we review the literature on the creation of business model for IoT and propose a generic business model framework for IoT business through the literature analysis. The IoT allows existing business models to change and new business to emerge. This research acts as a starting point for designing or developing business models for IoT services.

***Keywords*:** IoT, business model, framework

1.0 INTRODUCTION

The technologies of the Internet of Things (IoT) are increasingly embedded in previously nondigital products of everyday life, which impacts the nature of goods and services and in consequence, on overarching business models (Yoo et al., 2012, Turber & Smiela, 2014). The separation between physical and digital industries is now consigned to the past because the IoT makes possible hybrid solutions that merge physical products and digital services (Fleisch et al., 2014).

The concept of IoT surpasses several areas of knowledge and can be considered as potentially relevant in any supply chain, creating unprecedented opportunities in the public and private sectors to develop new products and services, increase productivity and process efficiency, improve decision making, solve critical social problems and develop new user experiences (Borgia, 2014; Barrett et al., 2015, Yoo et al., 2012). Perera et al. (2015) present a broad view and concrete examples of IoT applications in several domains of private and public sectors.

IoT-based products/services allow for a radical change in existing business models (Porter & Heppelmann, 2014). However, a mediocre technology used in a great business model can be better than a great technology explored in a poor business model (Chesbrough, 2010); therefore, we must understand how to generate proper business models for IoT-based products and services (Dijkman et al., 2015; Turber & Smiela, 2014).

The IoT brings numerous opportunities for products and services innovations and, at the same time, it brings a set of uncertainties, for example, it can increase the complexity and the level of competition in most manufacturing systems (Ehret & Wirtz, 2017). It is key to understand what can be gained by connecting current products to the IoT and not simply doing it because the IoT is a hype (Saarikko, Westergren, & Blomquist, 2017).

2.0 LITERATURE REVIEW

The Internet Of Things (IoT) refers to an emerging paradigm consisting of a continuum of uniquely addressable things communicating to one another to form a worldwide dynamic network (Koreshoff et al., 2013; Borgia, 2014). According to Mattern and Floerkemeier (2010), the IoT is not the result of a single technology, but it is the combination of several complementary development technologies that provide capabilities, which help to bridge the gap between the virtual and the physical world. These capabilities include (Mattern & Floerkemeier, 2010; Porter & Helpperman, 2014):

Communication and cooperation – in the IoT, the objects have the ability to network with Internet resources and with each other, to make use of data and services and update their state; they use several wireless technologies for it, such as 4G, Wi-Fi, Bluetooth, ZigBee, Wireless Personal Area Networks (WPANs), among others.

Addressability - the objects are located on the Internet of Things and can be remotely configured and addressed via discovery, look-up or name services; they can be remotely interrogated or configured.

Identification - the objects are uniquely identified, using technologies such as RFID (Radio Frequency Identification) and NFC (Near Field Communication). Identification enables objects to be linked to specific information associated with them.

Context-aware sensing – in the IoT the objects collect data about their surrounding environment with the use of sensors, they record and forward data and react according to the context

Monitoring – sensors enable the monitoring of a product's condition, the product's operation, and usage; it also enables alerts and notifications of changes.

Actuation - the objects contain actuators that can be used to remotely control real-world processes in the environment via the Internet (for example, converting electrical signals into mechanical movements)

Embedded information processing - microcontrollers or processors, and resources can be used, for instance, the smart objects have storage capacity. These to process and interpret sensor's information, or to give products a ""memory"" of how they are used.

Localization - the smart objects know their physical location and can be located via the use of GPS, mobile phone networks, ultrasound time measurements, UWB (Ultra-Wide Band), radio beacons and optical technologies.

User interface - the objects can communicate with people by means such as flexible displays, image or gesture recognition. Innovative interaction forms are relevant because the IoT must provide natural interfaces with users.

All these capabilities that result from the integration of the IoT technologies generate a wide range of possibilities to create innovative products and services with aggregate value, connecting the physical and the digital worlds (Borgia, 2014). The introduction of new technologies brings opportunities for existing companies to change their business model and for new companies to start a new business.

The business model literature has its origins in the late 1990's (Timmers, 1998). Since then, there has been an increasing interest in this topic in practice and various research areas (Osterwalder & Pigneur, 2009). For Zott, Amit and Massa (2011), business models have been used to address or explain the e-business phenomenon and the use of IT in organizations, as well as the management of technology and innovation. Companies must understand how to unlock value from technology, which has stimulated research on this concept (Timmers, 1998; Ehret & Wirtz, 2017).

Zott, Amit and Massa (2011) claim, after an extensive literature review, that a business model has different definitions: it can be referred as a statement, a description, a representation, an architecture, a tool or a conceptual model, a structural template, a method, a framework, a pattern, or a set of elements. A business model can be defined as a bundle of specific activities conducted to satisfy the perceived needs of the market, along with the specification of which parties (a company and its partners) perform the activities, and how these activities are linked to each other (Amit & Zott, 2012).

According to Turber and Smiela (2014), a business model is a holistic representation of a business formed by the combination of internal and external factors. There is no consensus on the elements that compose a business model. Timmers (1998:4) claims that a business model has to indicate (1) an architecture for the product, service and information flows (2) a description of the various business actors and their roles; (3) the potential benefits for the business actors; and (4) the sources of revenues. Dmitriev et al. (2014) reviewed the literature, indicating that the most frequently identified elements in business models are: value proposition, target market, revenue model, partner network, internal infrastructure, and processes.

There are various business model frameworks, at the enterprise level and at the industry level (Sun et al., 2012; Leminen et al. 2012). At the enterprise level, the most used frameworks are: the Value Chain, the Strategy Map, the Four-Box

Business Model, and the Business Model Canvas (BMC). At the industry level, one can consider: the Five Forces, the Value Net, Supply Chain models, and the Business Model Environment. Among these models, the Value Chain and the BMC are the most widely used (Sun et al., 2012).

In the following section would analyze and classify on some of the present approaches from 2015 until 2017 on business models for IoT.

Table 1: Business Models for IoT

Author(s)	Year	Goal	Method	Theory/Literature
Bilgeri and Wortmann	2017	Investigate specific barriers to technology-driven IoT business model innovation	Interviews	Innovation stages
Diaz et al	2017	Business model of public services provided with the IoT and other technologies in smart cities	Case studies	Business Model Canvas
Ehret and Wirtz	2017	Explores the conditions for designing non-ownership business models for the emerging IoT	Theoretical paper	Entrepreneurship and Transaction Cost Theories
Ghanbari et al	2017	Discuss the relevance of vertical cooperation in the IoT and highlight the need to develop new value networks that leverage this cooperation	Theoretical paper	Value Chain
Saarikko et al	2017	Discuss value creation with IoT and the need to form partnerships to develop intricate solutions	Case study	Value creation/value chain
Gerpott and May	2016	Provides a foundation for firms trying to evaluate the suitability of IoT-enhanced offering against the background of their current portfolio.	Theoretical paper	Product portlio
Jue et al	2016	Develop a generic business model framework for IoT, based on Business Model Canvas, through literature analysis and interviews.	Interviews, case studies	Business Model Canvas
Novales et al	2016	Provides an overview of different terms and identifies five conceptual elements that form the building blocks of digitized products	Systematic literature review	Literature on digitized products
Tesch	2016	Discusses scenario planning as a means for evaluating business models in the IoT context	Design research	Business Model Canvas and Scenario
Wan et al	2016	Discusses business model and IoT, identifying 10 core elements with Analytic Network Process (ANP)	Delphi	Value Net Model, ANP

Author (s)	Year	Goal	Method	Theory/Literature
Weinberger et al	2016	Introduces the concept of high-resolution management (HRM) in IoT	Theoretical paper	St. Gallen Business model Navigator, HRM
Chan	2015	Proposes a business model for IoT that consist of three dimensions: "Who, Where, and Why"	Case studies	Previous business models for IoT
Dijkman et al	2015	Present a business model framework specific for IoT applications	Survey	Business Model Canvas
Hognelid and Kalling	2015	Analyses the impact of IoT on business models and sources of value creation by applying a proposed framework to empirical illustrations	Theoretical paper	Value creation for e-business
Keskin and Kennedy	2015	Addresses the need for e-commerce service models in an IoT-enabled industry by defining players and predicting possible states in which a firm can choose to do business	Theoretical paper	Multi-sided markets and platforms
Leminen et al	2015	Investigates ecosystem business model or value designs in the IoT field	Delphi and Interviews	Value design, ecosystems
Niyato et al	2015	Proposes a new pricing scheme for IoT service providers	Theoretical paper	Business model literature
Qin and Yu	2015	Studies the value net model and the elements of the business model for IoT for telecom operators	Theoretical paper	Value Net Model
Rong et al	2015	Investigates how IoT could lead to a co-evolving business ecosystem rather than a supply chain	Case study	Business ecosystems

3.0 BUSINESS MODEL FRAMEWORK

The business model framework is constructed based on literature review in Section 2 and this framework as shown in Fig. 1.

<table>
<tr><td rowspan="2">Key partners
-Software developer
-University
-Data analytics company
-Device manufacturer
-Cloud computing service provider</td><td rowspan="2">Key activities
-Product development
-Partner management
-Platform integration
-Product distribution in points of sales or online
Software maintenance</td><td colspan="2">Value proposition
-Convenience
-Performance
-Customization</td></tr>
<tr><td colspan="2">IT Infrastructure
-3G/4G networkd
-Wifi connection
-Android and IoS Platform
-Cloud</td></tr>
<tr><td>Customer relationship
-Product website/blog/chat
-Social network
-Product apps</td><td>Customer segments
-General customer segment
-Vertical market
-Global market</td><td>Key resources
-Sensors
-Cloud services
-IoT dedicated network</td><td>Channel
-Internet
-Mobile
-Marketplaces
-Partners’ channels</td></tr>
<tr><td colspan="2">Cost structure
-Cloud services
-IT cost
Advertising
-Maintenance</td><td colspan="2">Revenue Streams
-Profit sharing
-Subscription fee
-Product sales</td></tr>
</table>

Figure 1 The business model framework for IoT

Figure 1 shows a generic business model framework, which consists of ten building blocks and elements in each block. The blocks consist the component of key partners, key activities, value proposition, customer relationships, customer segments, IT infrastructure, key resources, channels, cost structure and revenue streams. For the key partners component would be university for generating the business model and for research and development. For the value proposition, it focus on delivering superior performance and meeting the needs of consumers for convenience and customized services. In the cost structure block, maintenance is added because numerous networked sensors and devices cause increased maintenance expenditures. For the channels, it is important to offer the product

in major online marketplace. Besides, it would be interesting to use network of partners to distribute the product.

4.0 CONCLUSION

IoT allows companies to collect and exchange data and to accomplish tasks that were previously impossible, thus requiring new business models for a highly connected world. This paper presented a generic business model specifically for IoT services. Through literature analysis, we can identified the essential elements that are relevant to IoT business models and established the building blocks of an IoT business model based on the business model canvas. This framework can serve as a starting point when practitioners design and develop their business model in the IoT environment. It is important for companies to identify critical elements of their business model to create value in IoT services, enabling them to provide better value proposition to their customers. In a future work, the study can be extended to various industries to develop an adjusted business model framework, as IoT services vary enormously and are still expanding.

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