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Business model innovations for the Internet of Things: a focus on the retail setting

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Abstract

The increasing popularity of the Internet of Things offers innumerable opportunities for an unlimited quantity of different actors in various sectors. In this context, companies require innovative business models, shifting from a firm-specific perspective to a collective one, ready to face the new dynamics of this environment. This dissertation addresses the essentiality of new business models to face the specifications of the IoT sector, focusing particularly on the smart retail setting of the IoT.

Firstly, an overview of the Internet of Things as an economic phenomenon is given, concentrating on the terminology and valuable business opportunities emerging in nine settings of the IoT environment. In the same chapter the advantages in the retail setting are further analyzed and the concept of smart retailing is introduced, highlighting the benefits relative to combining the IoT technology with retail, such as: fully automated checkout, optimization of store layout, fine-tune inventory management, condition based maintenance and smart customer relationship. The chapter ends with a brief overview of the research on business models in general, mentioning the Business Model Canvas as an example.

After clarifying the concept of business model in chapter one, in chapter two an extensive literature review was conducted on business models specifically applied to the IoT sector. Three main models were analyzed: the DNA model by Sun et al., the Ecosystem model by Westerlund et al. and Turber et al.'s Network centric approach.

In the third chapter elements of the aforementioned models were adapted and customized to the retail setting, emphasizing how the innovation of business models must be applied in smart retail. Finally, real-life examples of companies are investigated to further exemplify the study conducted.

At the end, a conclusion is provided to sum up the research and clarify the final view point: the essentiality of a collaborative approach to unlock the true potential value of the Internet of Things.

Abstract italiano

La crescente popolarità dell'Internet delle Cose offre innumerevoli opportunità per una grande quantità di attori in vari settori. In questo contesto, le aziende necessitano di modelli di business innovativi, spostandosi da una visione volta alla singola impresa verso una prospettiva più collettiva e pronta a cogliere le nuove dinamiche di questo ambiente. La seguente tesi enfatizza la necessità di modelli di business nuovi per affrontare le peculiarità del settore dell'Internet delle Cose, focalizzandosi principalmente sul settore dello smart retail.

In primo luogo viene fornito un resoconto dell'Internet delle Cose come fenomeno economico, analizzando la terminologia e le varie opportunità di impresa che emergono in nove scenari dell'ambiente IoT. Nello stesso capitolo vengono ulteriormente studiati i vantaggi nel settore retail, introducendo il concetto di "smart retail" e focalizzandosi sui benefici relativi all'unione fra la tecnologia IoT con il mondo del retail, fra cui: checkout completamente automatizzato, ottimizzazione del layout del punto vendita, ottimizzazione della gestione dell'inventario, manutenzione basata sulle condizioni e relazione col cliente smart. Il capitolo si conclude con una panoramica sulla ricerca del concetto di business model in generale, prendendo come esempio il Business Model Canvas, in modo da collegare i due concetti, come descritto nel capitolo successivo.

Nel secondo capitolo viene condotta un'ampia revisione della letteratura concernente i modelli di business applicati al settore dell'Internet delle Cose. Tre modelli principali sono stati analizzati: il modello DNA elaborato da Sun et al., il modello Ecosistemico elaborato da Westerlund et al. ed il modello basato su un Approccio di Rete di Turber et al..

Nel terzo e ultimo capitolo i modelli sopracitati vengono adattati ed adeguati al contesto del smart retail, evidenziando come l'innovazione dei business model debba considerare le specificità del contesto della vendita al dettaglio. In fine vengono citati dei casi empirici per confermare la ricerca condotta.

La conclusione ultima, una volta ricapitolata la ricerca, chiarifica il punto di vista finale: l'essenzialità di un approccio collaborativo per sbloccare il vero potenziale dell'Internet delle Cose.

1. Chapter one – The Internet of Things scenario and business models

1.1 Introduction

The definition of the Internet of Things can sometimes appear as blurry. For this reason, part of the next chapter is dedicated to clarifying the meaning of such term which is frequently described in many different ways. Referring to a variety of well-regarded authors in the field, their perspectives are reported and analyzed. As the IoT is a relatively new concept and considering the pace at which this phenomenon is growing, further elucidation was given to the settings identified by McKinsey and Co. (2015) in their paper "The Internet of Things: mapping the value beyond the hype". Particular attention is given to the business opportunities generated from the IoT when applied in these sectors.

After providing the general overview of the sector, the economic impact of the Internet of Things in the retail setting is discussed in more detail. This analysis gives an overview of the advantages gained by implementing the IoT in the retail setting, specifically highlighting the features of fully automated checkout, optimization of store layout, fine-tune inventory management, condition based maintenance and smart customer relationship. Challenges for smart retail are also discussed, introducing the following paragraph on business models.

As one of the biggest threats to the spreading of the IoT is the lack of appropriate business models, this notion is presented in this chapter. An outline of the concept of business model is given as in the following chapter the two main subjects of this dissertation will be put together: the Internet of Things and business models. Just like for the Internet of Things, Business models have also been defined in many ways over time and in this chapter a consideration of the various definitions is provided. A concise description of the Business Model Canvas by Osterwlader and Pigneur (2005) is also given as an illustrative example.

In the conclusion, there is a summing up of what has been stated and all the elements of the chapter are tied up in order to guarantee a clear direction of this dissertation. All the elements presented in this chapter are pre-requisites to progress to the academic papers which focus on business models applied to the Internet of Things reviewed in the second chapter.

1.2 The Internet of Things

Nowadays it is close to impossible to imagine a world without the internet, and in the near future the same will be true for a world without the Internet of Things. Nevertheless, the predictions of growth of this sector vary greatly due to the uncertainty that pervades the industry in terms of finding solutions to the many problems it is bound to encounter. McKinsey and Company suggest an over-all economic weight which varies between $3.9 trillion and $11.1 trillion per year in 2025. Among the multitude of threats to this growth, a major problem that could hinder the progression of the IoT is the lack of appropriate business models. This thesis aims at addressing the significance of innovative business models in order to contribute to unlock the true potential of the IoT, especially in the retail setting.

The Internet of Things (IoT) is a concept first mentioned by Kevin Ashton in 1999 while giving a presentation at Procter and Gamble, when he first theorized the linkage between radio frequency identification (RFID) and the internet. Nowadays this term has gained a lot of popularity and it refers to the network of items embedded with electronics which enables them to communicate among each other and exchange data. These "smart items" do not merely provide information, as they capable of elaborating and processing it. The communication of the IoT is generally regarded as M2M, which stands for Machine to Machine, Machine to Man, Man to Machine or Machine to Mobile (Morrish 2013).

Heer et al. (2011) affirm that the evolution of technology and the internet has led to the creation of a new paradigm: the internet of things. According to them, a gargantuan quantity of devices is linked to one another through the internet in order to share information, regardless of their location. Each of these items has an embedded intelligence, which they refer to as ambience intelligence, allowing the objects to adapt their exchange of information according to circumstances.

Borgia (2014) outlines how the IoT merges technology and innovations from different sources, most notably: ubiquitous computing, pervasive computing, internet protocols, sensing technologies, communication technologies and embedded devices. He regards intelligent items as the building blocks for the vision of the Internet of Things. By making ordinary objects such as microwaves, fridges or cars become intelligent, they can gather data from the environment and interact with the physical world.

Ultimately the IoT can be seen as a new technological revolution which can link everything with everyone within an integrated network (Rifkin 2014). Microchips and sensors can link every element of economic and social life to a common platform: the IoT platform. Although smart watches or self-driving cars have captured a lot of attention from the media, they represent only a drop in the ocean compared to what the IoT-enabled future could bring.

This dynamic and technology-rich digital environment of the IoT provides numerous possibilities to exploit the added value applications in many scenarios (Kyriazis 2013).

As stated in the introduction, the McKinsey Global Institute estimates the total potential impact of the IoT to vary between $3.9 trillion and $11.1 trillion per year in 2025. According to them, this value will be captured in main 9 settings as follows:

1. Human: this setting refers to devices connected to the human body, which may be both wearable or ingestible. Their main functions include monitoring and maintaining human health and increasing productivity. The foreseen value for this setting is predicted to be between $170 billion to almost $1.6 trillion globally in 2025. The major value source for this setting is the improvement in quality of life, extension of lifespan for chronically ill people and reduction in treatment costs. Secondly, value will be created thanks to progressions in wellness – using data created by fitness bands or other wearables to optimize fitness practices.

2. Home: this setting refers to smart objects embedded in homes, which allow an improved energy management, advanced security monitoring and automation of domestic chores. The economic impact in this setting is estimated to reach between $200 billion to 350$ billion annually by 2025. Most of this value will be created by the automation of chores: with smart objects such as self-guided vacuum cleaners or intelligent lawn mowers a lot of time can be saved and efficiency can be improved.

3. Retail environments: this setting refers to the physical places where consumers engage in commerce (both of goods and services). The economic impact for this setting is estimated between $410 billion to $1.2 trillion per year in 2025. The largest sources of value creation are automated checkout, real-time advertising and promotion, layout optimization and reduced inventory shrinkage.

4. Offices: this setting refers to the commercial space where knowledge workers carry out their work. The potential economic impact is estimated between $70 billion to $150

billion per year in 2025, most of which will be captured by improvements in human productivity, organizational redesign and intelligent energy management systems.

5. Factories: this setting refers to standardized production environments. The IoT has already had a critical role in factories, leading to the next phase of factory automation know as Industry 4.0, which indicates the full digitization of production processes. The impact of IoT in this setting could yield an economic value of $1.2 trillion to $3.7 trillion per year in 2025. Most of the worth will be seized by operational optimization (making each process in factories more efficient), for example by using sensors rather than human judgement to adjust machine performance. Additionally, the most esteemed applications of the IoT in factories are going to be predictive maintenance and inventory optimization.

6. Worksites: this setting refers to custom production environments, for example oil and gas exploration, mining and construction. Typically, each site in this category presents ad hoc challenges with complex supply chains. The potential economic impact for the worksite setting is estimated between $160 billion and $930 billion per year in 2025, most of which would be generated by improvements in operation efficiency, enhanced business processes, automation and decrease in labor and energy costs. A large sum of the potential economic value would also be due to condition-based and predictive maintenance which allow dramatic cost reductions in routine maintenance practices, reduce breakdowns, increase productive uptime and extend the useful life of a machinery.

7. Vehicles: this setting refers to how the IoT will impact vehicles such as cars, trains, trucks, aircrafts etc., which will account for an estimated economic impact of $210 billion to $740 billion per year globally in 2025. Most of this value will be produced by improving safety, security and condition-based maintenance.

8. Cities: this setting refers to how the IoT will improve services, alleviate traffic congestion, develop water and energy conservation techniques and generally improve the quality of life in smart cities. The anticipated economic impact of the IoT in cities could reach values between $930 billion to $1.7 trillion globally in 2025, the largest effect being caused by improved health and safety and the value of time-saving.

9. Outside: this setting refers to how the IoT influences the outdoors between urban

environments and it could potentially account for an economic impact between $560 billion to $850 billion per year in 2025. This setting includes vehicular navigation, container shipping and package delivery, where improved logistic routines will create the most value.

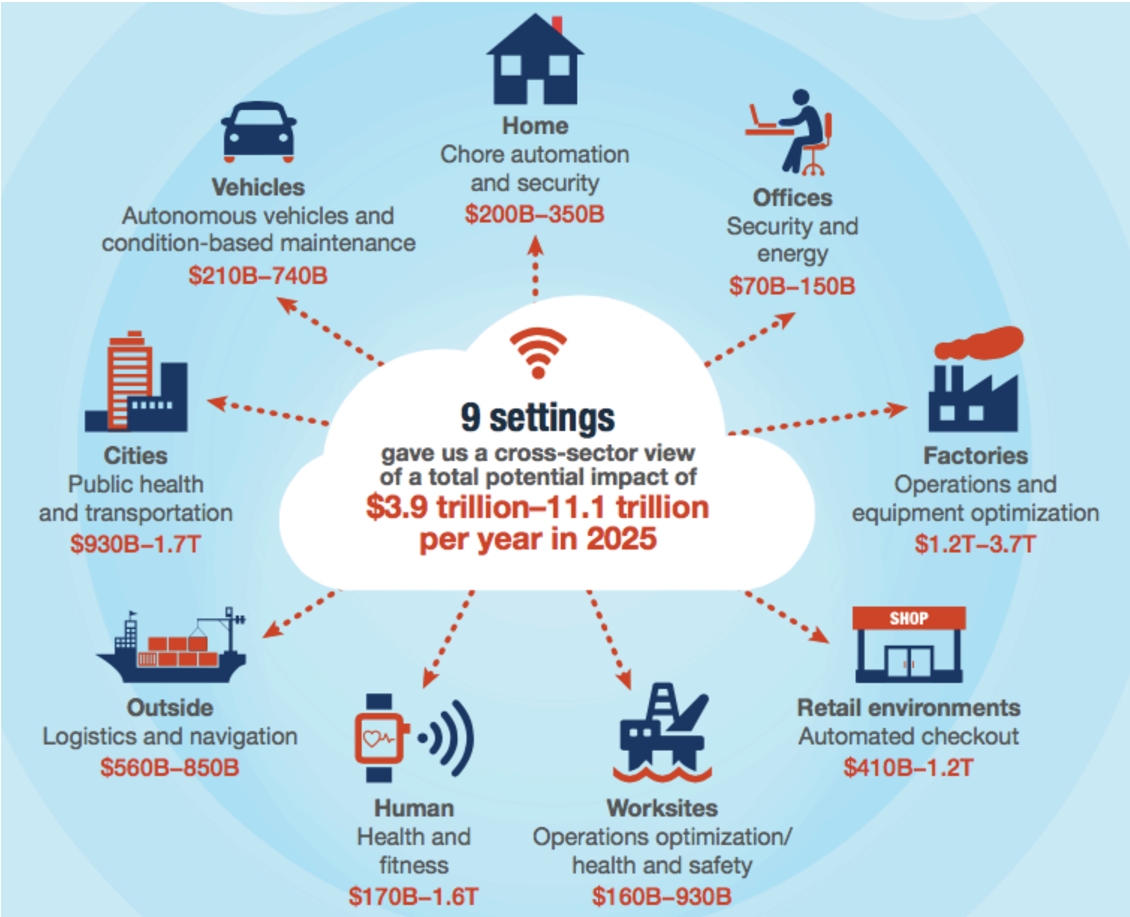

Figure 1 *– extract from McKinsey and Co- 2015, "The Internet of things: mapping the value beyond the hype"*

Although the aforementioned settings have huge potential value, challenges must be overcome and problems must be addressed to successfully obtain such economic impact (Borgia, 2014; Miorandi et al. 2012; Zorzi et al. 2010).

Security is a major concern as potential issues are not anymore restricted to privacy breaches but are extended to health and life threats. The hacking of smart fridges, baby monitors, drug infusion pumps, pacemakers or self-driving cars are security nightmares for firms investing in the IoT (Banafa 2016). Connectivity is also a potential issue as connecting so many devices will require the creation of IoT ecosystems, but joining billions of devices could result in a bottle neck effect. Furthermore the evolution of devices is not happening simultaneously and in the same way in every part of the world. This out of sync evolution will make some technologies become obsolete quicker than others creating compatibility issues (Banafa 2016).

The biggest issue after security, which many experts regard as the most threatening (McKinsey Global Institute 2015), is business model adaptation and innovation.

1.3 Economic impact of the IoT in the retail setting

This dissertation will focus particularly on an analysis of the impact of the IoT in the retail setting, and how business models should be innovated in such circumstances. The retail setting includes any sort of traditional store, but also showrooms (where consumers may view but not buy goods) and other physical places where customers can purchase goods such as theaters or sports arenas. All these settings have undergone relevant changes in the past two decades, most notably due to the arrival of online shopping. The IoT however can potentially create even greater disruption is such sectors (Manyika 2015). Thanks to the IoT, for example, a shopper can be guided to a product as he enters the store and receive a personalized coupon to purchase that good while in the store the same day. This practice is known as real-time in-store promotions, which over time can gather information on consumers and develop a profile including data on what they purchased and what they are willing to pay. Once these profiles are complete targeted advertisements can be made which can increase the spending per customer.

Other advantages gained by applying the IoT to the retail setting outlined by Manyika (2015) include:

1) Fully automatic checkout

Checking out of a shop is crucial point of shopping: on the side of the vendors it is the most labor-intensive process in retail, and under the consumer's point of view it is often source of frustration due to long waiting lines and complex transactions to make payments. The current self-checkout systems do not offer big advantages in comparison to the traditional cashier systems. With IoT devices, however, customers will be able to walk out the store without pausing. Their chosen products will be scanned automatically while placed in their shopping baskets, the prices of the items will be added up and ultimately the customer's mobile payment account will be charged.

2) Optimization of store layouts

By continuously gathering data on the movements and location of shoppers thanks to IoT devices, vendors will be able to boost the physical layout of stores in order to increase sales. It is estimated that this innovation will grant most benefits to early adopters providing them with a competitive advantage.

3) Fine – tune inventory management

Inventory operations will be dealt with automatically with the advent of the IoT, aiming at cutting the excess of stock on hand (which implies elevated carrying costs and the danger of being trapped with unsold products) but at the same time avoiding stock-outs caused by not having enough available products. This will be possible thanks to automated shelf replenishments and real-time inventory monitoring. Restocking products when necessary rather than using a rule-based method (e.g. twice a week) could help diminish inventory costs by up to 10%.

4) Condition-based maintenance

The introduction of IoT devices in the retail setting can also reduce costs associated with a lot of physical assets. In banks, for example, repairing ATMs in real-time based on their condition can reduce normal maintenance costs by 10-40%.

5) Smart CRM

Smart customer relationship is a step further than the current tracking of customers' interactions, allowing employees to acquire insights on how to interact with individual consumers. This is made possible thanks to the addition of sensor data and the enabling of real-time responses in the retail environment. Retailers could use in-store cameras with a facial recognition software to pinpoint individual customers as they walk in the store and sales staff could guide them to particular products based on their buying history.

The total economic impact estimated for the above improvements in the retail setting accounts for between $410 billion to $1.2 trillion per year in 2025. The gap between the aforementioned estimates is due to the challenges the IoT sector must face, in particular in relation to technological evolution and the development of new business processes.

All the above improvements have true potential to produce relevant economic impacts however there are barriers to overcome, for example the old-fashioned store formats. In India 90% of the stores are informal (Manyika 2015), without large and well-capitalized chains the technology adoptions and innovations are indeed going to be hindered. Additionally, consumers in these areas are also less prepared for IoT applications. Considering the retail industry in general the adoption of technology also remains uneven: larger chains often lead the way whereas smaller stores are likely to follow only when forced by competitive pressure.

More technical issues may also represent an obstacle to the deployment of IoT technology in the retail industry. Advances in data analytics are necessary to provide the aforementioned benefits related to custom offers and improved store layouts.

As the IoT becomes more pervasive in the retail environment changes are going to affect actors among the value chain, including both consumers and employees. Such advancements are likely to reduce the need of labor within stores, both at the selling floor and at checkouts. At the same time buyers are likely to purchase more thanks to customized offers and cross-channel selling, gaining more value through time saving, convenience and attractive promotions.

Although the opportunities are endless, a lot of retail companies are slow in adopting such technology due to fragmentation, restricted margins in the industry and absence of scale. Nevertheless, some improvements have been made by retail companies in advanced economies, especially regarding the adoption of payment, security and inventory control systems. In this manner companies can improve their economics in a number of ways, including reducing shrinkage, which refers to the losses caused by theft by employees and consumers, reducing inventory expenses, increasing productivity and ameliorating customer experience.

1.4 Review of the concept of Business Model

The meaning of the term “business model” has changed over the years and still today there is not a universally accepted definition. Osterwalder et al. (2005) carried out an extensive study on the subject and concluded that the term “business model” is relatively young, having appeared for the first time in an academic article by Bellman et al. in 1957. and being included in the title of a research paper for the first time in 1960 by Jones. Yet the expression “business model” gained popularity only in the 1990s, during the expansion of the Internet.

A commonly accepted explanation was formulated by Timmers in 1998, which described a business model as an integrated architecture combining the products, services and information exchanges, including the involved actors and their functions together with the potential value generated for the entire number of participants and the source of revenue.

Another description was given by Thomas (2001), who stated that a business model is a way to run a profitable business focusing on the global structures of processes, customers, suppliers, channels, resources and capabilities.

Royon et al. (2007) affirm that each business model must be associated with the industry in which it is applied, concentrating on customer demands (which are the principal driving force) and value (which is the leading offering). They continue to address the variety of ways the term "business model" may be intended, concluding that it is essentially a visual representation of the way an organization operates to fulfill its hierarchy of objectives. A universal aim for an organization is to generate, convey, capture and share value.

Casadesus-masanell and Ricart (2010) emphasize that a business model entails various managerial decisions and the effects they produce. Every decision has an after-effect, thus promoting dynamism. They also assert that in order for a business model to be durable, it must be aligned with the general values and objectives of the company.

Nevertheless it was also notice by Zott, Amit, and Massa (2011) that sometimes business models are studied without explicitly defining the concept. The same authors assert that there was a shift from focusing on "what business models are" to "what business models are for".

A lot of research has addressed the methods through which a business model could be depicted, both at a firm-level and industry level. The most popular based on a firm-level perspective is the Business Model Canvas by Osterwalder and Pigneur (2005). In their book "Business Model Generation" the authors review the previous research on the subject and distinguish the central building blocks for their business model framework. Their model became widespread as it is a straightforward way to obtain a visual approach of the concept. However the Business Model Canvas does not show an evident cause and effect connection and sometimes can result in a time-consuming and complex activity while developing multi-level business models.

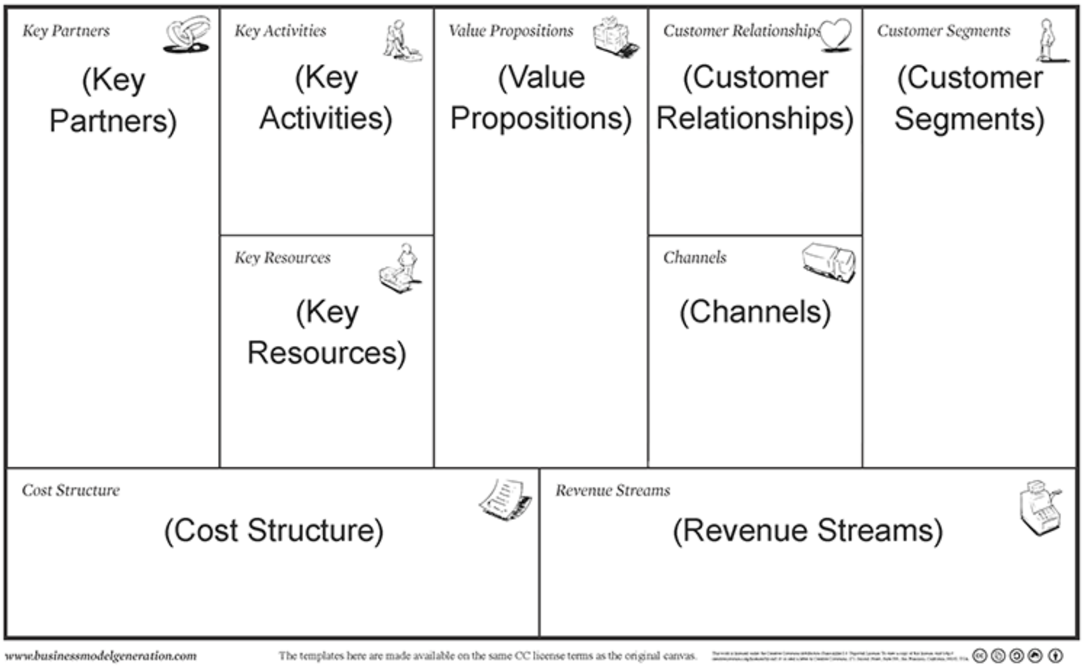

***Figure 2** – extract from Osterwalder & Pigneur (2005) "Business Model Generation"*

The above model features an exploded view of the elements of a business model, yet fails to clarify the dynamics between the components.

1.5 Conclusions

The elements in this chapter were essential to provide some relevant information for the three business models which will be discussed in the following one.

The main important piece of knowledge to gain from the above chapter is that it is indispensable to address business relevant factors in the IoT industry in order to unlock its true potential. This idea is mirrored even in other sectors, as claimed by the IBM Global service report in 2006, in fact, CEOs consider the innovation of business models as the most effective driver of business diversification, value creation and sustainable competitive advantage. Contrastingly product or service innovations are less defensible in the long term. In the same report, it is argued that an adequate innovation of business models can be five times more effective in terms of growth than product innovation. By innovating business models many benefits are gained, including cost reductions, increased strategic flexibility, exploitation of new markets and reduction in investment risk.

From the study on business models it is important to note that the term is still somewhat puzzling and even in the business models studied in the following chapter some parts are still undergoing changes.

From the focus on the retail setting it is clear that there is a true possibility to gain a number of advantages, yet there are still challenges to face. This perspective is very useful to start to comprehend the concepts of the second chapter, with every business model describing a high degree of flexibility and adaptability as an essential characteristic of success.

Chapter 2 –
Business models applied to the Internet of Things

2.1 Introduction

In relation to the IoT industry, there is a shortage of appropriate business models which address the peculiarities of the sector, despite business models being of fundamental importance to any organization (Magretta 2002). For this dissertation, the following three researches on business models for the IoT were analyzed:

- "A holistic approach to visualizing business models for the Internet of Things" Sun et al.
- "Designing business models for the Internet of Things" Westerlund et al.
- "Designing business models in the era of the Internet of Things" Turber et al.

Although differing from one another, all these business models are very important as they highlight fundamental information while relating the concept of business model to the IoT environment. They are also useful to gain a deeper understanding not only of the IoT scenario, but also of the items that compose such environment.

2.2 "A holistic approach to visualizing business models for the Internet of Things" Sun et al.

Yunchuan Sun et al. focus their preliminary study on the three layers of the IoT:
-Firstly, they analyzed the *Sensing layer.* The major costs in this level are deployment costs and in order to encourage the acquisition of colossal volumes of data they ought to be reduced.
-Secondly the *Network layer* is examined, which aims at spreading huge amounts of real-time data. The aim is for customers to find items at the best quality but lowest cost and for businesses to obtain customer behavioral data and inventory control. In this layer information is not exchanged merely by people, but it is extended also to things.
-In third place the *Application layer* is scrutinized, in which the most important features are being smart and intelligent, especially in relation to data processing.

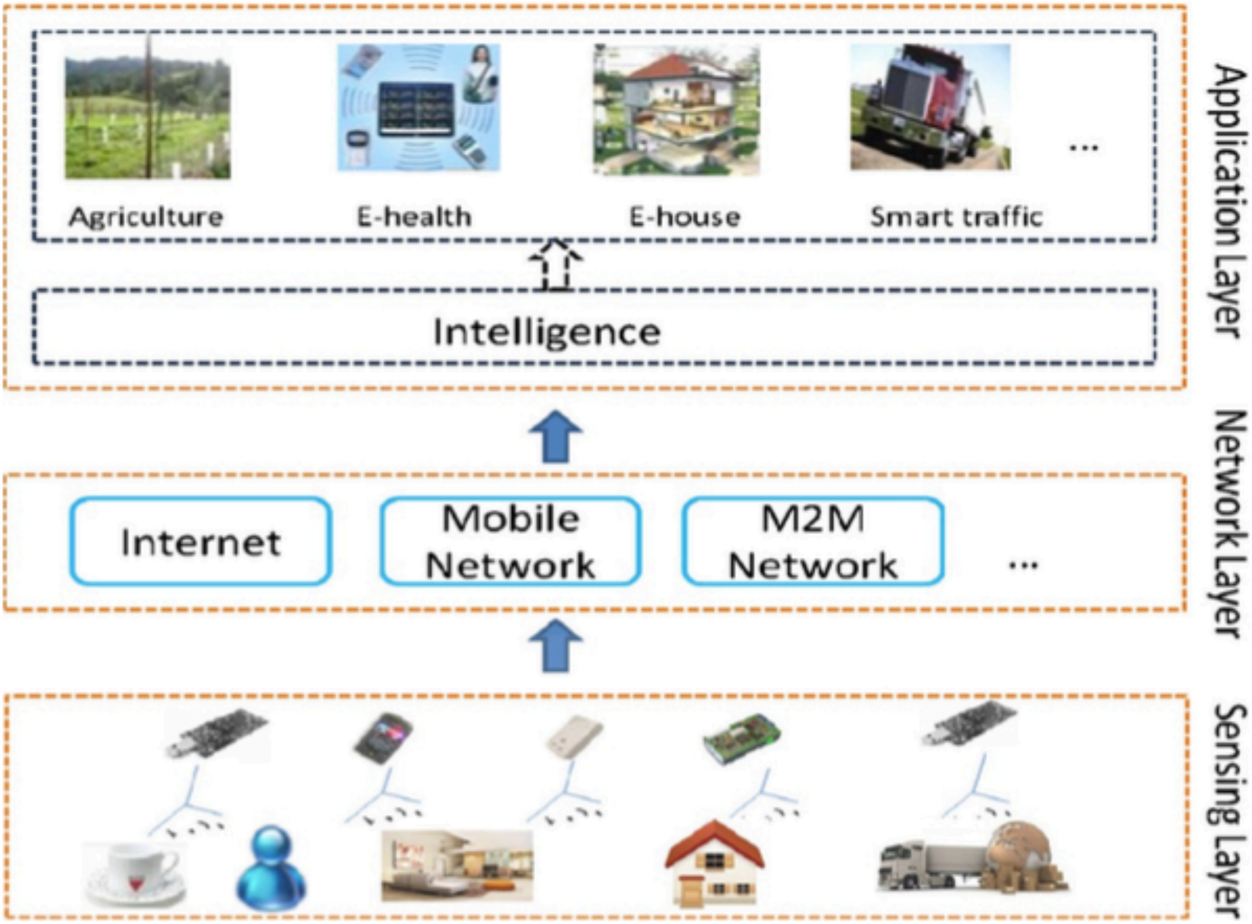

Figure 3 *– extract from "A holistic approach to visualizing business models for the Internet of Things" Sun et al.*

The absence of business models addressing these layers stimulated the authors to formulate the DNA model, which focuses on Design, Needs and Aspirations. Fundamental questions are stressed in particular ones referring to value proposal, cost benefit relationship and ways to profit from IoT technologies. In their study, many definitions of business models are given, specifically converging attention to the integrated architecture of products, services and information flows. Consideration is also given to the roles of actors and how participants in general can create value. Ultimately business models are regarded as representations where the main driving force is customer demands and the main offering is value creation (Royon 2007).

Business models can be considered as a system of elements, linkages between these elements and the dynamics behind these connections (Tucci 2000). According to them, advantages of innovative business models in the IoT sector include: gaining first mover advantage, accelerating the eventual strategic re-alignment process and better seizing opportunities. Essentially having an innovative business model ameliorates the dynamic capabilities of a company, which are the ability of a company to interpret, build and reconfigure internal and external skills in order to face the ever-changing environment (Trott 2016).

Sun's model focuses on six elements which require attention while elaborating business models for the Internet of Things:
-Customers: Who are our main customers?
-Markets: How is the market changing? Is a new positioning strategy required?
-Channels: Through which channels should the product or service be offered?
-Infrastructures: Who are the key partners? What are the key activities and resources?
-Value: What is the value offering proposed?
-Revenue & costs: What is their current relationship?

The DNA model:

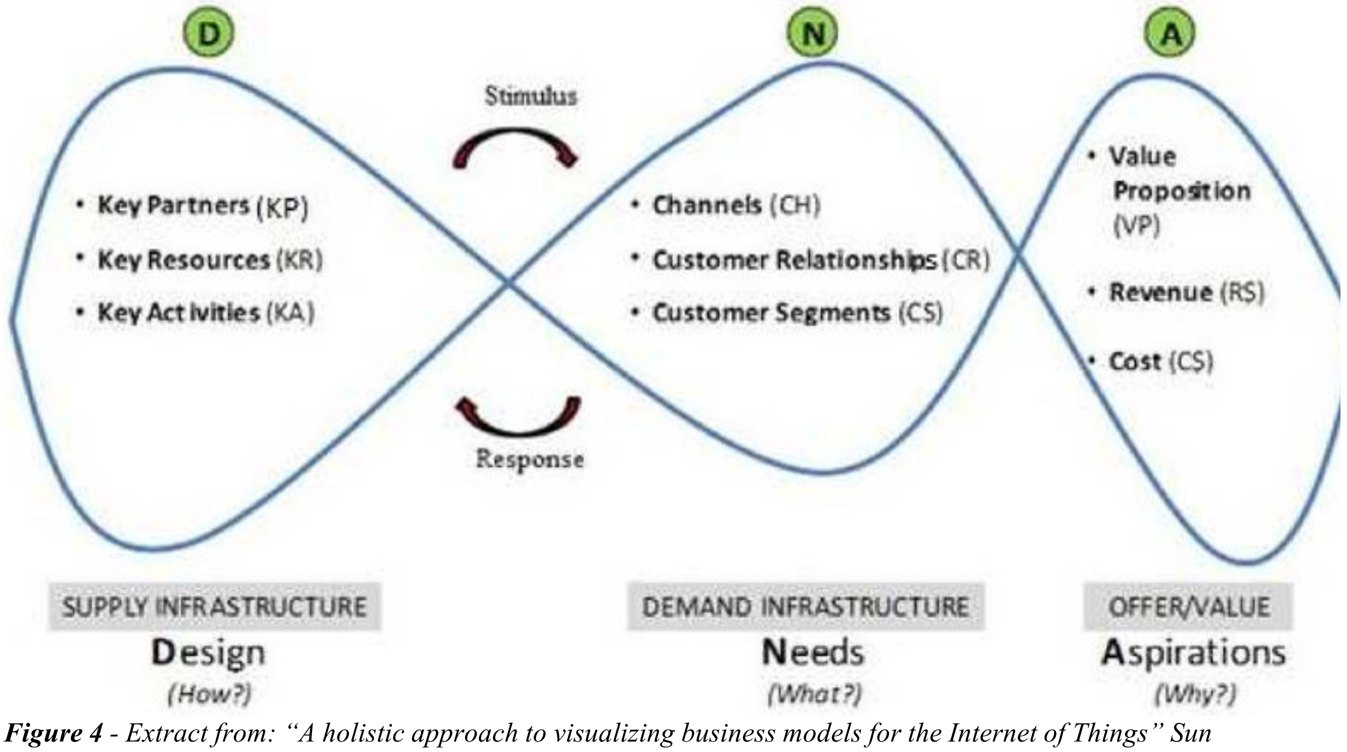

Figure 4 *- Extract from: "A holistic approach to visualizing business models for the Internet of Things" Sun et al.*

The DNA model is divided into 3 main parts:

D – Design, which answers the questions "How?" and focuses on the supply infrastructure composed by key partners, key resources and key activities.

N – Needs, which answers the questions "What?" and focuses on the demand infrastructure composed by channels, customer relationships and customer segments

A – Aspirations, which answers the questions "Why?" and focuses on the value offering, composed by the value proposition, the revenue and costs.
The first two blocks (D+N) represent the means to achieve the final outcome (A).

The study of Yunchuan Sun et al. indeed highlights how a business operating in the IoT industry must be particularly receptive to environmental changes, by creating their value offering based on the stimuli coming from the internal supply infrastructure and the external demand infrastructure.

2.3 "Designing business models for the Internet of Things" Westerlund et al.

Westerlund et al. identify two main trends when relating the IoT and the elaboration of business models:
1)The IoT is not viewed merely as a technology platform but as a business ecosystem
2)There is a shift from focusing on firm-specific business models towards ecosystem business models

An ecosystem business model is a business model made out of value pillars affixed in the ecosystem. In this case both the pillars and all the other parts of the ecosystem can create and capture value. Despite the trend of technologies becoming more and more ubiquitous allowing things to become smarter, more reliable and more independent, research on the IoT as a business ecosystem has been close to none. According to Leminen (2010) this is due to the fact that scholars have focused more on technological platforms and firm-specific business models. Möller et. al. (2005) argue that the upcoming of diverging activities and the consequent increase in complexity stresses the importance of elaborating new kinds of value systems. The interdependency in the IoT field created by the connection of a multitude of actors needs to be addressed not only under a technical point of view but also with a business perspective.

Muegge (2011) clarifies the idea of business ecosystem defining it as a group of economic players whose different business activities are anchored around a common platform, where both organizations and individuals self-identify.

According to the authors, there are three main challenges when creating successful business models in the IoT sector:

-*Diversity of objects:* it is difficult to design a universal business model for the IoT as there is a variety of differing kinds of connected objects combined with uncertain standardized interfaces. Current estimates assert that presently there are about 10 billion connected devices and by 2020 this number will reach 50 billion, more than 99% of physical items that are not connected today will join the IoT network (Evans, 2011).

-*Immaturity of innovation*: there are a lot of technologies and innovations which many times are not yet products or services and this can lead to confusion for firms. The authors refer to Moore's technology adoption lifecycle, which distinguishes 5 categories of innovation adopters: innovators – early adopters – early majority – late majority and laggards. The main task in this challenge is to shift from the early adopters to early majority, but in order to do so, the business model must allow a scaling up of businesses. In addition, early adopters are normally tolerant about the immaturity of innovation whereas the early majority usually wants not only finished products, but also ancillary products and related devices.

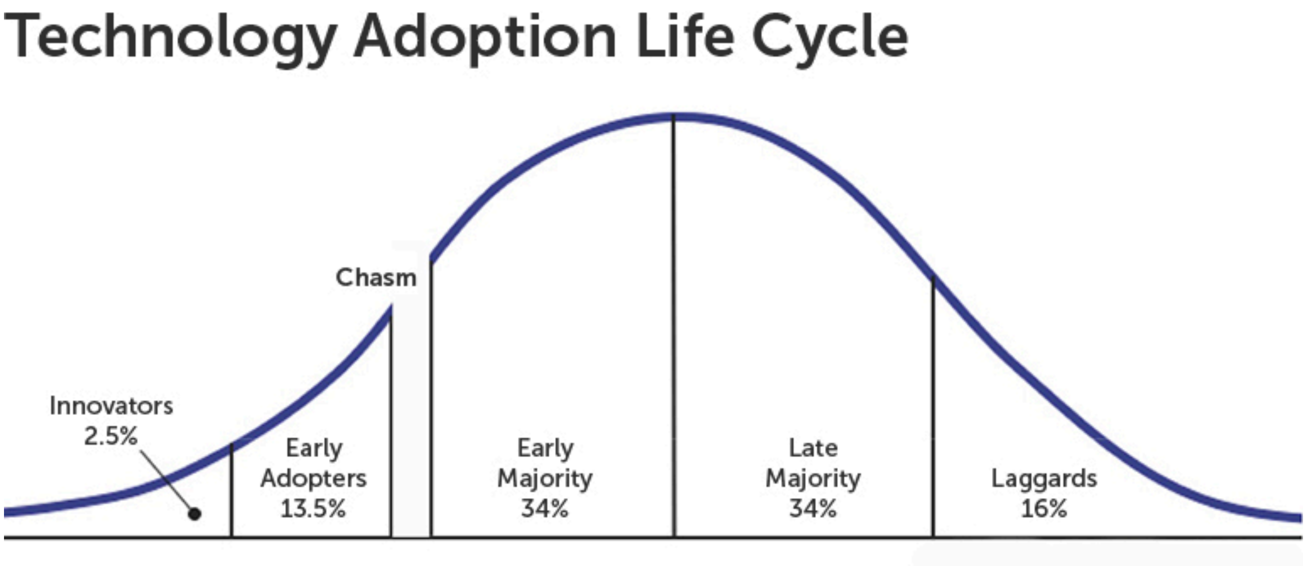

Figure 5 *– extract from "Crossing the chasm" G. Moore*

Appropriate business models are necessary to allow the IoT industry to cross the chasm (Moore 2014). Furthermore, modularized objects are fundamental in order to target wider markets, including "plug and play" kinds of components.

-*Unstructured ecosystems:* it is currently too soon to identify the participants and which role they will assume. Möller et al. assert that the intricacy of an ecosystem is related to the number of its participants, and given the mentioned predictions in the first chapter of this dissertation, the IoT is designated to be a very complicated ecosystem. This will be even more true in its initial stage, where the ecosystems are chaotic and unstructured. As the sector is rapidly evolving different structures outline the necessity of different types of activities in the ecosystem, and this increasing complexity requests new types of value systems (cf. Möller et al., 2005).

Different authors have contributed to define the concept of business ecosystems:

- Muegge (2013) develops a system of systems perspective, known as “architecture”. In line with this view he defines a platform as an organization of things, such as technology or complementary assets, a community as an organization of people and a business ecosystem as an organization of economic actors.

- Moore (1996) refers to a business ecosystem as an economic community sustained by a foundation of interacting individuals and organizations, in which all stakeholder take part. He argues that the leaders in ecosystems are those who have a convincing stimulus in the co-evolutionary process.

- Peltoniemi (2005) argues that “a system is more than the sum of its parts” and to study a system it is essential to consider it as a whole rather than studying its detached elements. She also adds that when dealing with socio-economic systems such as business ones, it is fundamental to adapt promptly to environmental changes with a co-evolution process.

The existing literature on business ecosystems requires additional research (Carbone, 2009; Muegge 2013) as traditional business models are inadequate in understanding the interconnections and interdependency of evolving business ecosystems, specially in the IoT sector.

The study of Westerlund et al. argues that entrepreneurs should adopt an ecosystem approach due to the nature of the sector. They should focus on value design when elaborating business models with an ecosystem view. There should be a shift in elaborating business models for firms to business models for ecosystems, focusing on understanding integrated value drivers such as shared overall value rather than fragmented value related to individuals’ work.

Some authors in particular have contributed to this mindset:

- Weill and Vitale (2001) present a set of straightforward plans aimed at providing simple tools for new e-business initiatives. They divide the plans into three groups of business model schematics: participants (designated firm, customers, suppliers and allies), relationships and flows (information, services and money).
- Tapscott, Lowy and Ticoll (2000) created a value map to demonstrate how a business web works, including partners, customers and suppliers and the value exchanges among them.
- Muegge (2011) asserts that the driving force of innovation within an ecosystem is a resource cycle starting from the platform moving to the business ecosystem, passing to the developer community and then returning to the platform. The locus of the value creation and innovation is the developer community and the business ecosystem is the locus of value capture.
- Allee (2000) maps value exchanges among companies, suppliers, partners, communities and users as a series of flow diagrams illustrating goods, services and revenue streams. In this "value network" dynamics play a fundamental role.

According to the aforementioned authors, individuals should focus on different *value drivers* in ecosystems in order to create a non-biased win-win situation. Examples of these value drivers for the IoT sector include sustainability, improved customer experience and cybersecurity. Value drivers are linked by *value nodes*, which in the IoT sector can be identified as sensors or programmed machines. These value nodes exchange value in a variety of ways, which describe how the actions in the business ecosystem take place in order to capture value. This is essential because it counterbalances the down point of the business model canvas, as it intends to prove how the exchanges actually take place, not merely a static perspective.

As not all the value created is meaningful in the ecosystem, it is important to extract the relevant value which can be monetized. Managers should be able to "zoom in" or "zoom out" of the different elements in the ecosystems in order to locate what is and what is not valuable. This process is defined as *value extract* by Westerlund et al.

The *value exchanges* mentioned by the authors refer to the variety of means through which resources, information and knowledge are traded. These value flows are very important as they explain the manner in which revenues are exchanged and distributed across the ecosystem.

Ultimately the idea of *value design* exemplifies how value is intentionally created and captured in ecosystems, encompassing the overall architecture that illustrates the foundational structure of the ecosystem business model. The concept of value design is pretty similar to the one of business model, however the latter is typically associated with a specific firm whereas the first is applied on an ecosystem scale.

Below is the representation of the value design process by Westerlund et al.

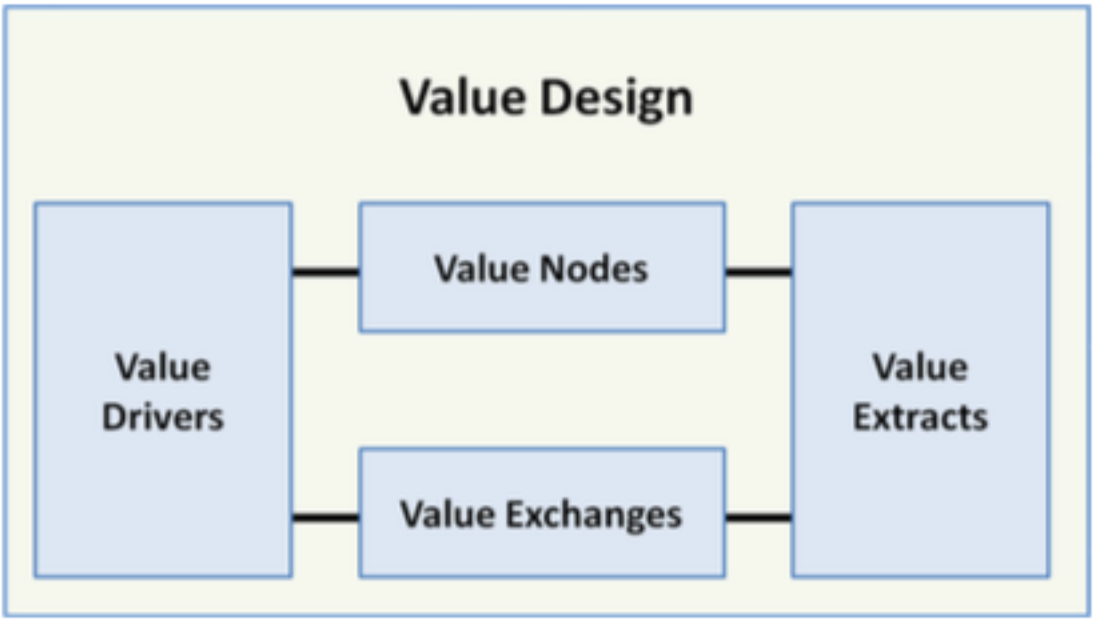

Figure 6 – extract from "Designing business models for the Internet of Things" Westerlund et al.

2.4 "Designing business models in the era of the Internet of Things" Turber et al.

According to Turber et al. the approach must shift from a firm-specific perspective to IoT driven environments. This is similar to Westerlund's view as seen above. Companies must reevaluate their firm-centered lenses to obtain a competitive advantage in IoT driven environments. The newly developed frameworks must include the value of the network of collaborating partners (who), the sources of value creation (where) and the benefits from collaborating (why). Turber asserts that the IoT requires new business models which frequently involve multiple partners and thereby cross-industry ecosystems.

Their research is conducted under a design point of view aiming at finding an approach able to visualize, envision and analyze the complexity of the business models in the IoT industry. They refer to the IoT environment as a universe of products and services enabled by digital technology and communication mechanisms. They avail of Yoo at al.'s studies which state that digitalized objects have an architecture composed of four different layers:

1) Device layer: compromises the hardware components, including any kind of device and operating system to control it
2) Network layer: includes both the logical transmission and the physical transport
3) Service layer: refers to the direct interaction with users through application programs
4) Contents layer: hosts the data (texts, images, geo-location etc.)

Each one of these layers can potentially be a source of value creation by multiple ecosystem partners.

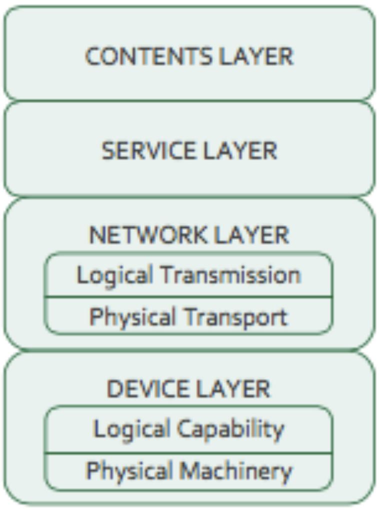

***Figure** 7 - extract from "Designing business models in the era of the Internet of Things" Turber et al.*

A relevant observation to this division of a technological item is the fact that the four modular layers can be de-coupled. This "de-couplebility" would allow multiple stakeholders to contribute to the value across the layers, provided interoperability of components.

From his research Turber individuates the necessity of providing a network-centric view reflecting the collaboration required from various partners, focusing on the role of customers which can take an active role in the value network (co-producing). He also emphasizes the worth of both monetary and non-monetary incentives to participate, focusing on different sources of value creation from Yoo et al.'s layers and viewing the ecosystem as an operant resource.

According to Turber no extant business model suffices the peculiarities of the IoT sector, however the approach by El Sawy et al. is able to grasp an evolutionary dimension. The model addresses the following essential questions: Who (defines target users), What (refers to value proposition) and How (addresses the value chain required to convey the value proposition) and Why finally illustrates the motivating economic model to capture value.

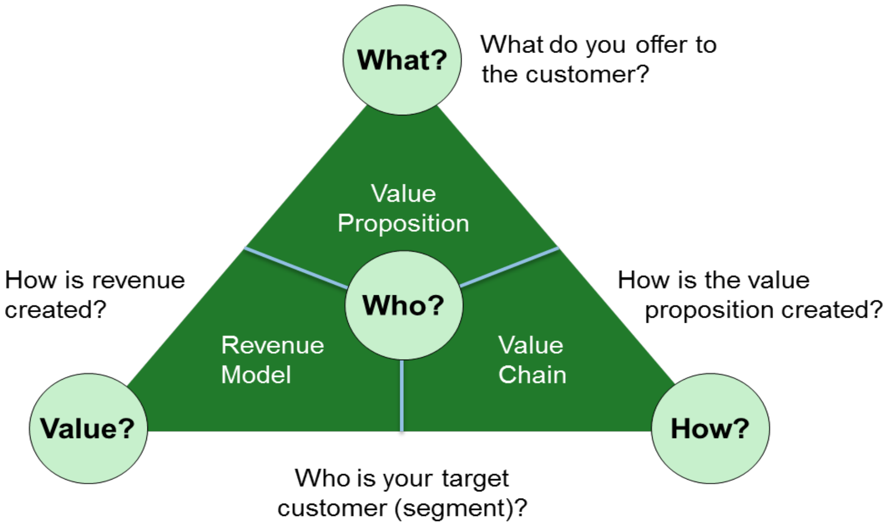

Figure 8 *- extract from "Designing business models in the era of the Internet of Things" Turber et al.*

Turber et al. finally elaborate their own artifact as a business model framework for IoT environments which has the characteristics of being network-centric and three dimensional as follows:

1) WHO are the partners that contribute to create the value network?

In this part all partners and stakeholders are included, referred to as collaborators. Each collaborator can co-create value with other external ones.

2) WHERE are the sources of value co-creation rooted in the layer model?

This section refers to the study of Yoo et al. on the four-layer device items. Each layer is a distinct source of opportunities and value creation.

3) WHY should partners collaborate within the network? (what are their benefits?)

This portion exemplifies the reasons collaborators have to participate in the network.

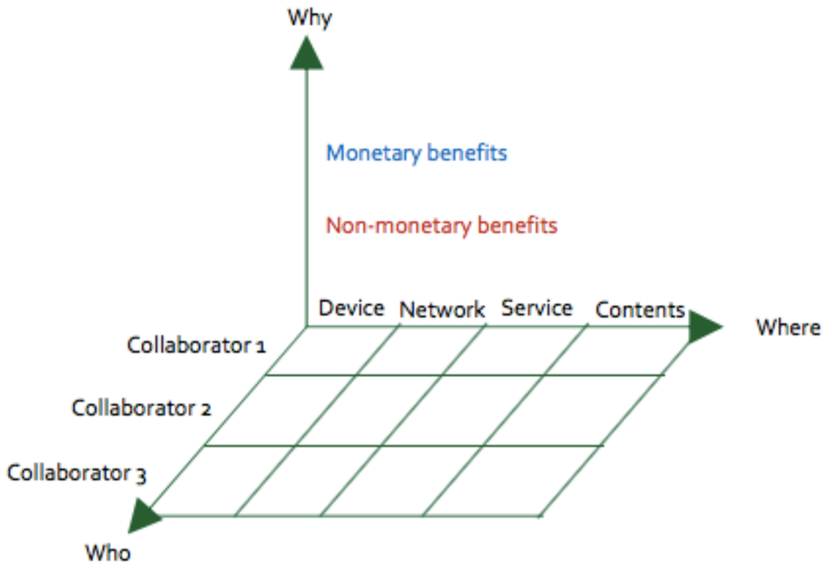

Figure 9 *- extract from "Designing business models in the era of the Internet of Things" Turber et al.*

2.4 Conclusions

In the above chapter the most prominent business models applied to the Internet of things' environment were discussed and analyzed. Although differing quite a bit one from another they also present common traits. The DNA model was inspired by the three layers of the IoT environment (application/network/sensing). The main piece of knowledge that emerges from such business model is that companies must be reactive to the turbulent environment and alter their value proposition based on the stimuli coming from both the inside and the outside. This is a common attribute in all the studied models as what stands outside of a firm's activity in the IoT environment is relevant also in Westerlund's model (ecosystem concept) and in Turber's model (network model).

Furthermore the distinction made by Sun et al. regarding the layers of the IoT environment are mirrored in the model built by Westerlund. The application layer can be linked to the value nodes and the network layer the value exchange.

In every model the word "why" appears. In the DNA model it refers to the aspirations and the value offering. In the ecosystem model it is linked to the value drivers, which show the general objectives companies should aim for. Lastly in the network-centric model it aims at uncovering the reasons why collaborators should participate in the bigger picture.

The next chapter will be aimed at connecting the elements seen in the first chapter on the retail setting to the business models analyzed in the second chapter. Real-life examples will also be studied in order to obtain an empirical verification of what mentioned above.

Chapter 3 – Business model innovations in the retail setting of the IoT

3.1 Introduction

The following chapter is divided in two main paragraphs. In the first paragraph, some elements of the previous business models related to the Internet of Things will be linked to the retail setting. As some components of the business models remain the same for both the IoT in general and the retail setting of the IoT, not all of them will be further analyzed. For Sun et Al.'s DNA model the focus will be on the Needs, as from the research conducted this feature is the most applicable when linking the model to the retail setting. The model elaborated by Westerlund et Al., instead, fits the whole retail setting thus it will be discussed in its entirety, focusing also on two relevant challenges identified by the authors: the immaturity of innovation and the unstructured ecosystems. Lastly the most pertinent components of the artifact elaborated by Turber et al. will be also interconnected with the retail setting parts seen in the first chapter.

The second paragraph is dedicated to real-life applications of the theory discussed in this whole dissertation. An example of Amazon Go, the new concept of grocery shop by Amazon.com, Inc. is discussed, especially how their study on computer vision can be seen as a value driver by Westerlund. Moreover, an overview of Levi Strauss's approach to the IoT is reported, highlighting in particular the new server they developed collaborating with Intel. This can be related to the artifact of Turber et al. and their network centric approach with status of collaborators.

3.2 Business models applied to smart retail

The "N" in the DNA model stands for "Needs" and refers to the demand infrastructure, which includes *customer segments, customers relationships* and *channels*. According to Nicasio (2018), the customers in the retail setting can be grouped into different *segments*:

- The well-informed shopper refers to customers who conduct research before making a purchase decision: they compare prices, analyze descriptions and examine reviews.
- The showroomers are customers who try on and evaluate items in person but eventually make their purchase online if they find a more competitive price.

- The wanderers are shoppers who enter stores without real intention of buying anything, just to kill time or to look around.
- The shoppers on a mission are those customers who know exactly what they want: their intention is to make their purchase as quickly as possible and exit the shop.
- The confused shoppers are unsure whether to buy an item or not and sometimes unable to decide what to do. Their uncertainty can be due both to lack of information or being overwhelmed.
- The bargain-hunters are shoppers whose main influencing factor is the pricing of the products. They look for the lowest price and are willing to spend a lot of time to find it.
- The regular customer is a shopper who returns to the store at a certain frequency.

The variety of intentions and behaviors of customers exemplifies the usefulness of the advantages brought by the IoT in the retail setting discussed in the third paragraph of the first chapter. Thanks to the fully automated check-out the shoppers on a mission will be able to exit the store even quicker as they will not have to wait at the cash desk. Their shopping experience will become frictionless, avoiding the frustration caused by waiting lines. This kind of shoppers could also benefit from the fine-tune inventory created with IoT technology as they would have nearly always what they are looking for thanks to real-time inventory monitoring. With the optimization of store layout sales are predicted to increase. This advantage could address mostly the regular customers but also other categories such as the wanderers or the confused shoppers, who could be more inclined to buy with an optimized layout.

The *customer relationship* becomes smart with the Internet of Things. According to Kestenbaum (2017), the retail environment is undergoing many changes, the main trend being a focus on the store experience. Retailers must attract customers to walk into their shops by offering something better than in the past. Many tech companies are leading the way in this change and their main goal is to integrate the physical world with the digital one. The principal objective is to collect in store data about customers which is already collected when shopping online. Nowadays when a customer shops online, the retailer can see what they click on, if they buy or move on, what they delete from their shopping cart and how long they stay looking at a picture. With the advancements of the Internet of Things this kind of data will be able to be collected even in store: retailers will know what item shoppers are looking at in a store, if they pick it up or not, if they put it down or keep it, where they walk and where they spend the most time standing if something catches their attention. Once marketing was aimed at segmenting consumers, today each consumer is a segment on their own, benefitting of an always more precise tailoring (micromarketing).

Finally, the channels through which customers are reached become endless. Thanks to the IoT retailers can use an omni-channel approach, which Ternstrand (2015) defines as a modern method of commerce which aims at creating a cohesive user experience for customers at every touchpoint and on any channel. There is a fusion between offline (brick-and mortar stores) and online ones making them "click-and-mortar". According to the author retail channels evolved gradually to become an omni-channel experience, as seen below:

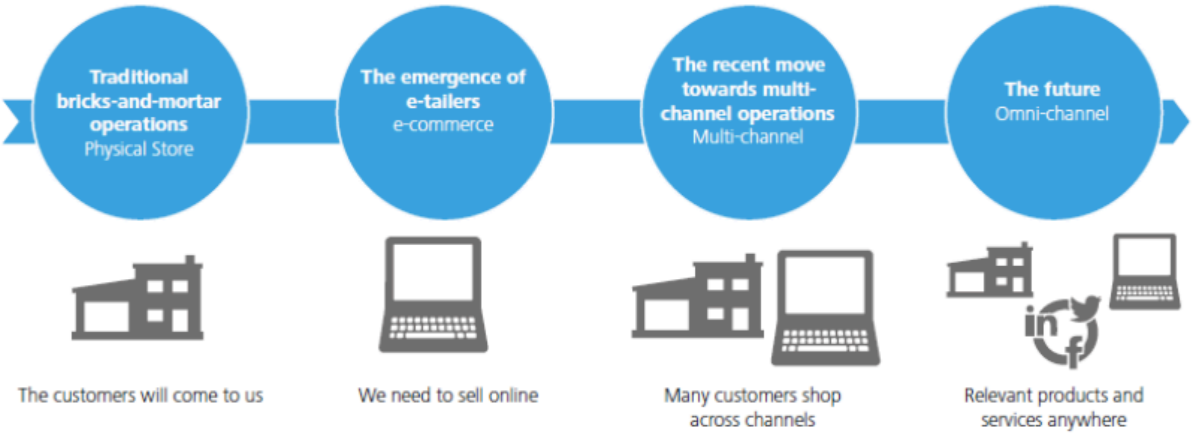

Figure 10 *– extract from "Omni-channel retail. A Deloitte Point of View" (Ternstrand 2015)*

Below is an adaptation of the DNA model by Sun et al. focusing on the Needs of the retail setting.

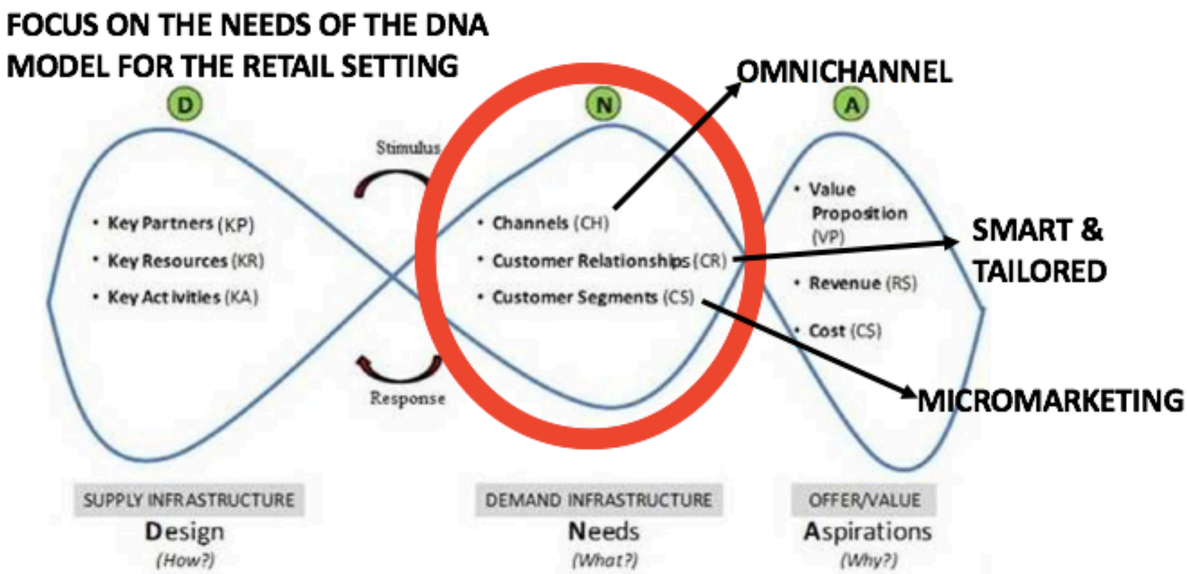

Figure 10 – Adapted Extract by Antonio Piron *from: "A holistic approach to visualizing business models for the Internet of Things" Sun et al.*

The other elements of the model such as the supply infrastructure (Design) and the offer and value (Aspirations) remain fairly similar in the retail setting to the other settings of the IoT. For example, the key partners for a company operating in the retail setting of the IoT or in the vehicle setting of the IoT could be IT specialist in the software field, regardless of the setting.

When applying Westerlund et al.'s business model to the retail setting of the IoT it is important to consider in particular one of the problems they mention in their study: the immaturity of innovation. In the case of the retail setting, under many aspects innovation is still behind. How can the layout of stores be optimized if they are like those found in 90% of India? The lack of technological advancements in many areas of the world is a barrier not only in the IoT in general but even more so in the IoT retail setting.

By applying Westerlund et al.'s research to the retail setting, it is clear that retailers should not merely focus on their own specific firm but they should extend their efforts to contribute to the retail ecosystem as a whole, in order to obtain a win-win situation. For example, if only one or a few stores introduce the automated check-out by using a smartphone and IoT sensors the advantages will be far smaller than if the whole retail sector would do. The advantages would be gained both by costumers and companies. The authors stress the fact the when operating in the IoT field companies should not compete against each other, at least for the moment, in a velocity race but more so in a relay race, contributing to the shared value together.

A value driver for retailers in the IoT environment could be to promulgate the use of IoT devices in order to gain more advantages thanks to network externalities. This value driver must be linked by value nodes, which in the retail setting could refer to more easily available and cheaper sensors for data collection (hardware components). Through the process of value extraction retailers should then identify where the most relevant value is created and subsequently communicate and eventually modify the value drivers through these value exchanges. This whole circular process in described as value design. In the above scenario, for example, retailers could find out that promulgating the use of the IoT is not an efficient value driver, or better, it is not specific enough. Retailers should in fact not only encourage the adoption of IoT devices but they should make sure they respect the principle of interoperability. Once this value is extracted, the information is exchanged and the value drivers are adjusted, completing the process of Value (re)-design till the next exchange produces another appropriate alteration.

Below is a visual representation of the above example, adapting Westerlund et al.'s model of value design.

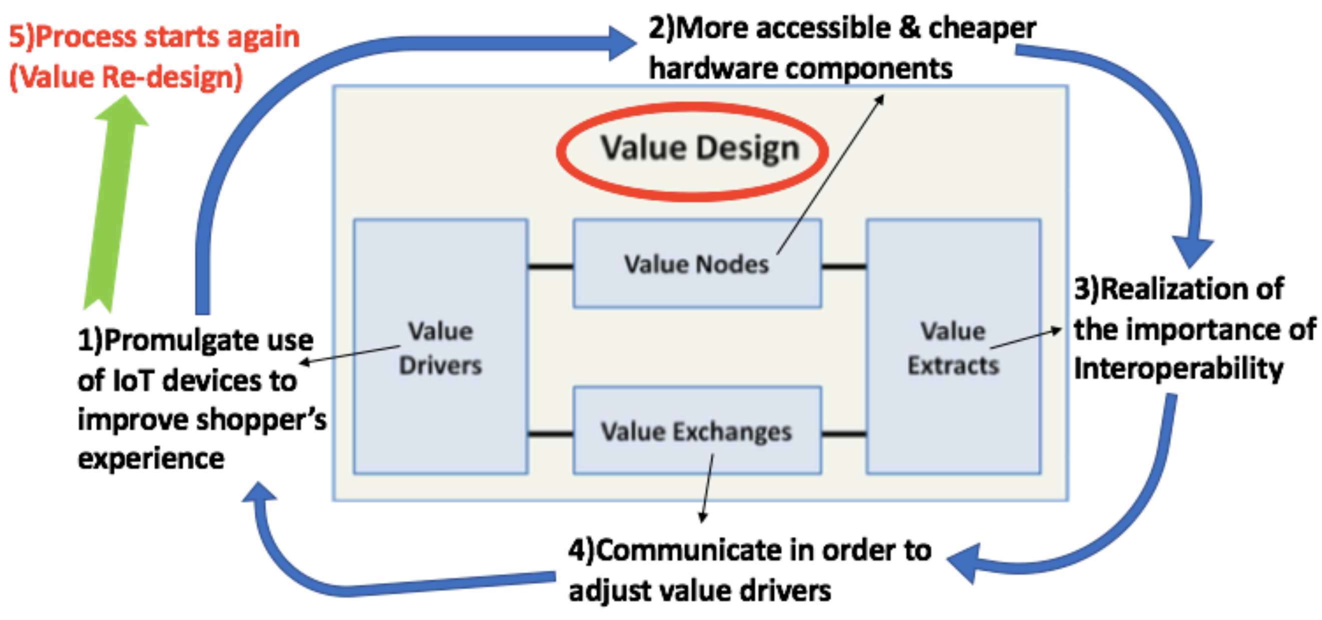

***Figure 11** – **Adapted extract by Antonio Piron** from "Designing business models for the Internet of Things" Westerlund et al.*

The alertness of inputs coming from the outside is also an essential value driver. In the IoT retail setting businesses must be fluid, flexible and willing to adapt to the complexity of the new customer behavior. Retailers must re-design the customers' experience based on their behavior. According to Drinkwater (2016), this re-design must happen in a number of channels, including:

- Physical stores: brick and mortar stores are not seen merely as a place to shop anymore but as a space of entertainment.
- Online stores: The e-commerce platforms are developing towards increasingly customized experiences by leveraging data analytics tools.
- Social media: These kinds of platforms are of key importance when it comes to engaging brands with shoppers, building brand awareness and fostering customer loyalty. There is a trend now where social media platforms are becoming also online selling platforms.
- Public spaces: many community areas are slowly being pervaded by means to engage with customers, through kiosks in shopping centers, ready to scan QR codes and NFC readers at bus stops.

Considering Turber et al.'s artifact applied to the retail setting of the IoT and especially the WHO arrow, various collaborators emerge, most notably other actors in the industry (other retailers), actors outside the industry such as tech companies and customers themselves. All these players contribute to the value creation, in line with the network centric view. The value is created through a number of different sources (WHERE arrow), mirroring the study of Yoo et al. on the four-layer device. Taking into account the device itself, an important source of value creation within the retail setting is the reduction in price and consequent easier availability of Radio Frequency Identification (RFID) technology for better in-store inventory tracking. According Yu et al. (2014), despite RFID not being new, its price has decreased from $1.00 per tag in 2005 to about 0.15$ in 2015 as shown in the graph below, becoming cheap enough to be added to every item in store.

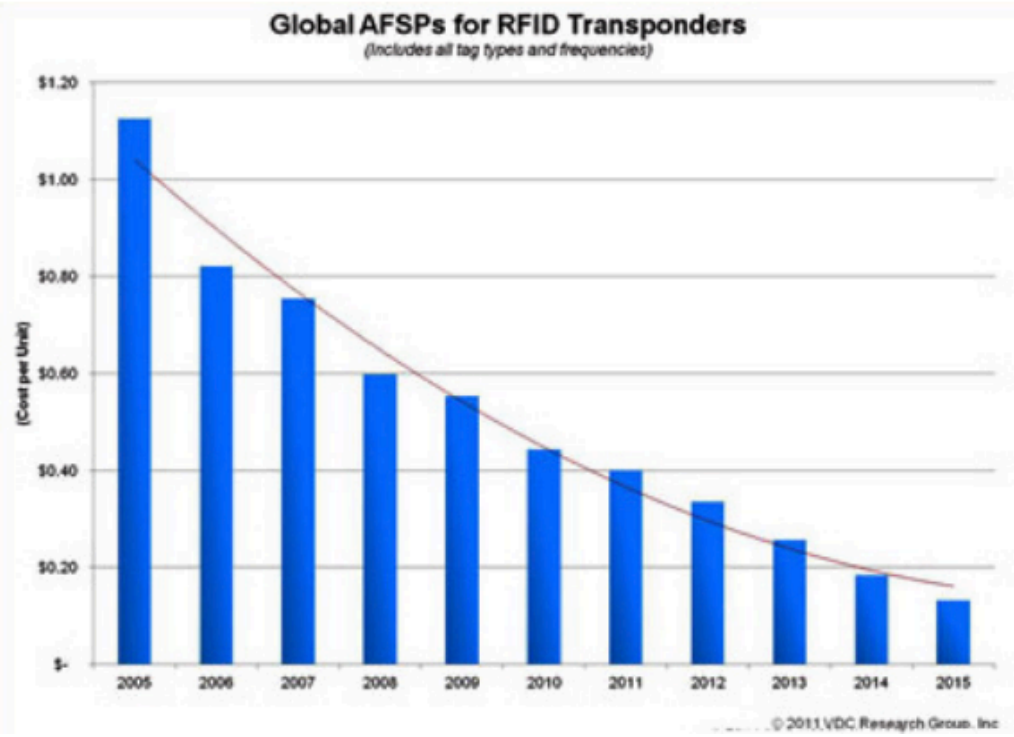

Figure 12 *– extract from "We do have that in stock: Levi Strauss brings the IoT to stores" S. Yu et at.*

Sources of value related to the network in the retail setting include internet access, speedy Wi-Fi and most importantly efficient curriers, as many goods require delivery, thus managing the provision of items to consumers and efficiently mastering new supply chain methods becomes essential. The service layer creates value by monitoring the interactions between the user and application programs, in the retail setting an example of way to enhance the value in this context is the omnipresence of social media. In this case even other IoT applications are of crucial importance, as retailers combine online and in-store experience for shoppers, turning the store into a place of entertainment by using Virtual Reality, Augmented Reality and data analytics tools. Lastly the Contents layer which creates value by hosting the data in the retail setting gives valuable insights on who customers are, how products are performing and new ways to engage with customers.

Finally Turber's study also focuses on WHY, considering both monetary and non-monetary benefits. As stated in chapter one the most prominent benefits of the retail setting of the IoT are smart CRM, fine-tune inventory, predictive maintenance, optimization of store layout and fully automated checkout. All these benefits are aimed at increasing sales by ameliorating shoppers' experiences.

A visual representation of Turber et al.'s artifact applied to the retail setting of the IoT can be seen below.

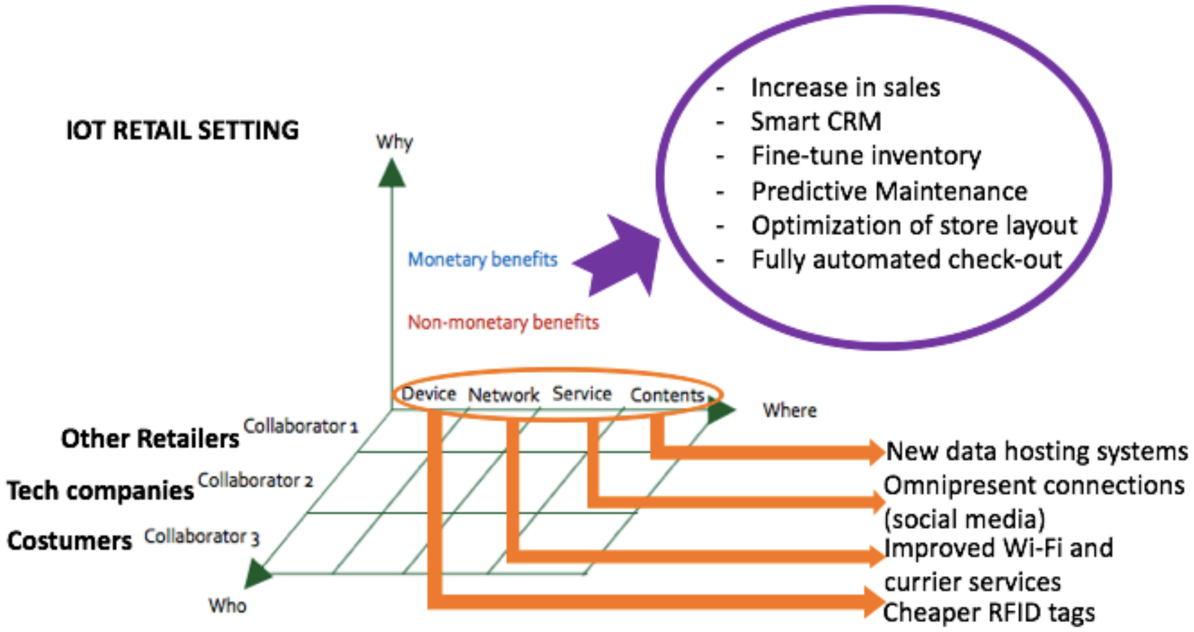

Figure 13 - Adapted extract by Antonio Piron *from "Designing business models in the era of the Internet of Things" Turber et al.*

It is also important to note that, in line with the network perspective by Turber et al. according to which all collaborators gain advantages, also customers benefit from this cooperation. Thanks to the IoT in retail customers become more aware: they have at their disposal a large quantity of information which they can use to personalize their shopping experience and stand out from the crowd. Customers are empowered by digital technology.

Focusing the study of the previous models of the general IoT specifically to the retail setting is essential to face the upcoming challenges in this area. More and more companies rely on the figure of the CEO – Chief Experience Officer, to administer the design of the retail experience and consequently deal with its trials, estimating which set of technologies to use will guarantee the best experience to shoppers. These challenges include:

- Shifting from a generalized approach to a personalized interaction with shoppers
- Managing new ways of engaging with customers and finding appropriate manners to retain them
- Keeping up to date with the continuously increasing number of connected devices in the market, such as wearables and smart homes, in order to evolve Omni channel strategies.
- Keeping a close eye on the changes in CRM as many variables come into place, such as new modes of living or increasingly smart forms of urbanization
- Considering the new potential security threats (cybercrime) and adapting to new regulations on data privacy

3.3 Real-life examples of smart retail: Amazon Go and Levi Strauss

With the advent of IoT technology retailers are struggling to preserve their position considering the consistent innovation requirements and the multiplying of new competitors. As customers become more demanding retailers must offer retail experiences to maintain their market share. There are few pioneers in this context, one of them being Amazon.com, Inc., the largest Internet retailer in the world. The company developed Amazon Go, a new grocery store in Seattle, Washington, where shoppers can grab their products off the shelves and simply walk out. The store uses sensors and cameras to identify which items are taken away and charges the customers accordingly on their Amazon Go app. Thanks to their implementation of the IoT they eliminated the need for long and frustrating checkout lines.

The “just walk out” motto of Amazon Go is based on a number of technologies, including computer vision, which refers to the mechanisms for obtaining, processing and reviewing digital images into numerical information. This technology is crucial for the new store concept and took years to develop. It was first studied by other actors in the IoT environment in the self-driving car sector. This is an example of how the IoT environment must collaborate in order to unlock its true potential value. Referring to Westerlund’s model, it epitomizes the concept of an ecosystem view rather than focusing on firm-specific business models. The study of common value drivers such as developments in computer vision is much more esteemed for the whole IoT environment than partial studies related to single industries.

According to Drinkwater (2016) Levi Strauss has also been a pioneer in the IoT retail setting. In 2015 Levi Strauss began a collaboration with Intel to create real-time inventory monitoring in one of their store in San Francisco. Through the use of RFID tags attached to all items an innovative system was developed which allows to locate and account for every item in the shop at any time. The system is able to communicate when stock must be replenished when running low and gain invaluable inventory information. Once again, this system is the result of a collaboration and compromises various sub-parts created by different actors, including cloud-based solutions, algorithms and advanced data analytics. Thanks to this system the store reduced inventory costs and improved their knowledge on customer behavior, as it can detect not only when an item is bought, but also when it is touched or tried on. Ultimately the information gained allows retailers to offer a better customer experience. Levi Strauss also used IoT technology in other formats, such as smart mirrors and augmented reality, through which shoppers can virtually try on clothes. The company also launched a "smart jacket" in collaboration with Google in 2017, weaving touch-sensitive fabric into every day clothing. The left cuff of the jacket, in particular, is able to translate touch inputs into controls for the owner's smartphone, such as music playback, navigation on Google maps and other tricks.

3.4 Conclusions

There is no doubt that the IoT is going to disrupt the whole world, from industries to people's everyday life, and in a similar manner it will unsettle the way we perceive and do business. Business models require transformations and this dissertation is proof of how important it is to address the matter and focus on a collaborative approach rather than firm-specific. Many studies confirmed the pivotal importance of cooperating and being aware of the surroundings of the sector, not only paying attention to a single company's activity. Traditional business thinking urges for innovation in order to accommodate the increasingly digitalized world and the IoT peculiarities, especially considering smart retail.

Is it fair to say as a general summing up that developing appropriate business models in the smart retail environment is still a work in progress, and taking into account the dynamism of the sector it is likely for it to remain in this manner for some time.

Word count: 11.093

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