

Innovating the Retail Industry; an IoT approach

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Globally the retail environment is radically changing, due to the growth of the Internet. Retailers are developing new ways to interact with customers and customer channels. It is predicted that in the next decade the Internet will play an even more vital role to everyday life. We will soon live in a world where physical objects are interconnected with computing capabilities, creating so-called ‘smart objects’. This smart component across a wide range of technologies and services is known as the Internet of Things. Literature indicates that retailers are often more adaptors of innovation, rather than innovators themselves. They are focused on creating new products, rather than innovating their services. The nature of service-based innovation is a rather under-searched area. This paper focuses on how the Internet of Things allows retailers to innovate their services in new ways by looking at the key drivers of innovation in the retail industry. Based on a critical literature review and an expert questionnaire it can be concluded that the Internet of Things is a successful tool to enhance innovation in the service-based retail industry. It provides several tools that enhance the overall shopping experience, by making it more easy, fun, interactive and personal. Furthermore the Internet of Things is better than other existing tools in predicting and analyzing the consumer market, as it allows retailers to gather not only information about existing processes, but also processes that were previously unconnected. This new data allows retailers to analyze needs per individual, resulting in micro-segmentation. On top of that it enables real-time analytics, which creates a new level of flexibility and better chances to adequately adapt to the ever-changing consumer market. The biggest restriction to the wide-spread acceptability of the IoT is the consumer its concern about security and privacy.

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Keywords

Retail Industry, Internet of Things, Big Data, Service Innovation, Technology Acceptance

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1. INTRODUCTION

Globally retailing is facing severe changes. The growth of the Internet has caused radical change in the retail landscape. Today most large retailers translated into multichannel firms, where the customer visits the retailer via different channels for different purposes. Focus has expanded from selling products to engaging and empowering customers in order to create a rewarding customer experience. Retailers try to reach consumers in new ways, by cultivating their possibilities. (Sorescu et al., 2011). Information technology is increasingly considered as an enabler of business competitive advantage in addition to its contribution to satisfy customers' demand of innovative and qualitative products and services. Due to a large deal of research on advanced technologies and the development of new systems for supporting retailers and consumers, the retail industry is often subject to a disruptive innovation process that makes available a large amount of new information systems able to modify the traditional organizational process. Capturing value from information technologies requires the development of new metrics and measurement tools. Because innovation in services is rather characterized by non-technological innovation and limited R&D, retail is often more devoted to developing new products than developing new tools for improving services. Although retailers generally lack innovative capacity and are usually adapters of innovations, innovative technologies for selling goods and services are spreading fast, by making available interactive and innovative systems supporting both customers and retailers (Pantano, 2014).

It is predicted that in the next decade, the Internet infrastructure will be an even more vital backbone to everyday life. Content and services will be all around us, enabling new ways of interacting, information-sharing, working and living. It will enable physical objects to interconnect with computing capabilities across a wide range of services and technologies, creating so-called 'smart' objects. This interconnection between the physical and visual realm will pave the way for new technologies and services. This linkage between physical and digital entities is known as The Internet of Things (Miorandi, et al., 2012). (Haller et al., 2008, p.3) defines the Internet of Things as the following: *"A world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in business processes. Services are available to interact with these 'smart' objects over the Internet, query their state and any information associated with them, taking into account security and privacy issues."* IoT builds around three pillars; 1) anything identifies itself 2) anything interacts and 3) anything communicates. These pillars are applicable either among themselves, with other connected objects or even with end-users (Miorandi et al., 2012).

(Pantano, 2014) identifies three main key drivers of innovation within the retail industry. *First*, the (customers) demand for innovating. Past studies showed that customers expect more entertainment and supporting tools while shopping. There is a growing need for technologies that increase interactivity (for instance by using sensors), support the purchasing decision, reduce waiting times etc. *Shortly*, tools that enhance the overall shopping experience. *Second*, the availability of new advanced technology-based tools for investigating market. Critical for retailers is to understand and predict market trends, furthermore

they need the capability to quickly react to the external environment when needed. Therefore retailers need systems that are able to match customer behavior, trends and analyze information to set up future strategies. This all will benefit the competitive advantage. *Third*, the uncertainty in adapting innovations. The attitude from consumers but also employees against certain technologies plays an important role when it comes to innovative success. Although there is some research on whether the consumer would accept a certain technology, research from the employee's perspective is still very limited (Pantano, 2014). (Gregory, 2015) recognizes that IoT will especially be disruptive to the retail industry. He expects that it will offer opportunities in three critical areas: customer experience, supply chain and new channel and revenue streams.

As mentioned before retailers are mainly adapters of innovation rather than developers of innovation themselves. They are focused on creating new products and selling them, rather than improving the technologies that enable their services. This, even though retail can be viewed as an service-oriented industry (Pantano, 2014). The nature of innovation in service-based sectors is heavily under-researched. The largest business database contains 31,000 articles regarding innovation, from which only 136 address service innovation (Reynolds, et al., 2007). Furthermore the emphasis is often put on supply chain logistics and other back-end aspects. Retailers are looking at what could save them costs, instead of looking at what could make them more money. This research will be of academic relevance since it will be the first scientific article (white papers excluded) that is completely focused on enhancing service innovation in retail by using IoT technology. On top of that it can be used by managers to recognize business opportunities and it will give them a clear overview of the existing IoT technologies and applications.

In this paper the goal is to give a better insight in the possible role that IoT systems could play as an service innovation tool for the retail industry, by critically looking at the key drivers of innovation within this industry.

Therefore the following research-question will be answered in this paper:

"How can the IoT systems (and the data they generate) serve as a tool for enhancing (service) innovation within the process of retail?"

By looking at the three key drivers of innovation within the retail industry as proposed by (Pantano, 2014) the author will try to see what the impact of IoT could be on those key drivers.

To find a sufficient answer to the main research question, the three following sub-questions are formed:

- 1) "How can the Internet of Things satisfy consumer demand for innovativeness by enhancing the overall shopping experience?"
- 2) "How can the Internet of Things help investigating the consumer market by being an analytical tool?"
- 3) "What are the possible limitations/difficulties of implementing the Internet of Things within the retail sector according to critics?"

2. METHODOLOGY

This paper contains of two parts; a critical literature review and an Expert Questionnaire. The literature review will be done accordingly to the guidelines of 'How To Write a Literature Review' as proposed by Emerald Group Publishing which is a specialist global Search & Selection company. By systematically reviewing and analyzing literature from academic articles, conference papers and company reports the author tries to give a complete and reliable overview of the existing knowledge. The main focus of this paper is to find answers to the main key drivers of innovation within the retail industry, by providing the Internet of Things as a possible tool of innovation. Therefore the criterion for all the acquired academic articles and conference papers is that they have a strong affinity with either the Internet of Things, retail process innovation, or general innovation within the retail industry. In the most ideal situation the academic article or conference paper addresses the Internet of Things as an possible innovator for the retail industry. The articles used in this research paper are derived from legitimate search engines such as: Scopus (via University of Twente), Google Scholar, ScienceDirect or Semantic Scholar. All the initially selected articles were selected by 1) scoring high on relevancy and 2) being acceptably recent. After the initial search, the reference lists of the selected articles were scanned in order not to forget other important articles that may have been overlooked during the initial search. Essential keywords used during the initial search are: "Internet of Things", "Internet of Things Retail", "IoT Ecosystems", "Retail Process Innovation", "Big data" and "Retail Industry Innovation".

After the literature review an Expert Questionnaire will be performed to gather more information and double check the validity of the findings of the literature review. The Expert Questionnaire used in this research will focus on a group of experts within the field of IoT technology. This could be either people working for companies that are using or are specialized in IoT technology, but also professors being expert in this specific domain. In order to gather enough respondents experts are contacted via several platforms, such as: LinkedIn, IoT Facebook groups, but also via personal e-mail. The final outcome of the Expert Questionnaire should give a good impression on whether or not IoT is an eligible innovation tool for the retail industry.

3. LITERATURE REVIEW

3.1 Satisfying Customer Demand for Retail Innovation

As discussed during the introduction, there is an increasing demand of innovating by consumers. Consumers expect to find more interactive and supporting tools that enhance the overall shopping experience (Pantano, 2014). A customer survey conducted by (Reddy, 2015) mentioned that according to an Infosys survey 86% of the customers said they'd be willing to pay 25% more for a better overall shopping experience. The Internet of Things will provide an interconnected environment in which products and services are highly customized for the individual. Furthermore it provides a sense of flexibility that is not known in traditional retailing. It allows to connect the physical and digital worlds allowing real-time interaction with

the customer (Gregory, 2015). In the following chapter we will see an overview of the most promising possibilities that the Internet of Things has to offer when it comes to satisfying this demand. In this paper when we talk about the retail we mean the physical retail environment, not online retailing.

3.1.1 IoT Store Lay-out and Customer Tracking

The Internet of Things can offer significant possibilities for optimizing instore lay-out. By using sensors managers can track customer movement and behavior while being inside the store, adapting their design based on this information. Hugo Boss has been using heat sensors to track customer movement and places premium priced products at crowded areas (Gregory, 2015). (Manyika, et al., 2015) expects that lay-out optimization could lead to a potential value of \$79 billion to \$158 billion in 2025 and an increase by 5% in productivity. As we can see in the example of Hugo Boss, products can be put in those places where they are most likely to be bought. Another complex task that can be achieved by using IoT is measuring the consumers' interest on certain products that are in the shelves. (Parada, et al., 2015), conducted a research in which they measured this interest by looking at the time of interaction between the customer and the product. They designed a system to reliably detect user-object interaction by using Radio Frequency Identification, also known as RFID. RFID, provides the opportunity to give everyday objects (such as food, clothing, furniture) a digital identity. The RFID allowed them to measure the *reading time*. Furthermore they placed LDR sensors behind the products to see whether or not the product was taken out of the shelf. If the sensor received light, it assumed that the product was taken out of the shelf. In an IoT environment, information like this is critical for managers to prevent products going out of stock. Finally, they proposed an user-object interaction measurement method with an performance above 80% in a real environment evaluation.

3.1.2 Automated Checkout

One of the most time-consuming and intensive processes during retail is the checkout. It is also a big source of frustration for customers, who have to wait in line before they can proceed to the paying process. Although some retailers are making limited use of automated checking out systems most are not using this at all. The Internet of Things can offer the potential to completely replace the original checkout procedure as we know it. It is able to automatically scan all the products in the shopping card and charge the sales to the customer its paying account via their mobile phone. At the moment of exiting the store all the electronic tags (RFID) will be read by the system, counting up the prices and finally transfer this information to the wireless paying system. This will allow the customer to pay and leave the store without any hick-ups. Not only will this save time for the customer, it will also save additional labor costs as it replaces cashier staff. (Manyika et al., 2015) estimates that using this kind of technology will reduce cashier staff requirements by 75%, which could result into \$150 billion to \$380 billion a year in 2025. At this moment Dinsney is already using the so-called MagicBand, which by using an RFID-tag allows customers to check-in for attractions, access to their hotel room, and cash and card free payment or food and merchandise. Furthermore it tracks customer activity to show how customers make use of certain Disney services (ComQi, 2015).

3.1.3 IoT-based Store Mapping

Another frustration for customers is when they are looking for certain products but are unable to find them, without any assistance or help available. Not only does this damage the overall shopping experience, but it also leads to a potential sales loss when instead of looking further the customer simply gives up searching for it. Therefore there is an increasing need for tools and applications that can function as shopping assistant. In the IoT ecosystem in which products are ‘smart’, products can be easily tracked and located by customers. (Hicks, et al, 2013) provide a mobile application called *SmartMart* that in combination with an Indoor Positioning System allows customers to track and locate products and make them appear on the store its floorplan. Again the RFID tags on the products allow them to connect with the *SmartMart* application. Furthermore by uploading a grocery list, the app shows the shortest pathway to retrieve the items on the list. This saves valuable customer time and significantly enhances the shopping experience.

3.1.4 IoT Shelf Availability

As mentioned in the section above, not being able to find certain products is a major frustration for customers. Not being able to find a certain product, because it is out-of-stock is therefore also a critical point of when it comes to customer satisfaction. On Shelf Availability (OSA) is thus a key metric in ensuring a positive customer experience. On Shelf Availability can be defined as: “the availability of the product in its designated location when the shopper is looking for it” (Vargheese, et al., 2014). (Vargheese et al., 2014) propose an automated IoT model that ensures on shelf availability. By using sensors and big data analytics, critical information about out-of-stock products are sent to store staff, notifying them to stock up their products if needed. If products are not available most of the time this triggers a series of reactions: 1) the customer buys the product at another store, 2) the customer is not buying the product at all. On average products being out-of-stock leads up to a potential annual sales loss of 4%. There are two major causes for products being out-of-stock: 1) not being able to properly forecast demand and 2) the products are available in the backrooms of the store, but are not on the shelves. In traditional approaches there are two ways of achieving OSA. Manual Shift Audit is the most basic manner in which an employee visually checks the shelves to identify out-of-stock products. Another approach is the Point of Sale model, which identifies the number of products that are taken from the shelves. Although both approaches are useful, they are not completely sound. The first approach its effectiveness relies heavily on the interval in which the staff checks the shelves and thus can still lead to customers ending up with out-of-stock shelves. In the second approach there is no saying in whether the product is really out of stock, or that it is possibly stolen or in the shopping cart of the customer. The proposed Internet of Things model consists of 5 stage algorithm that combines IoT elements to make decisions: detection, quantification, cross verification, replacement recommendation and finally resolution. The *first stage* identifies the deviation between the expected and current availability of the product in the shelves. The sensitivity of the detection system is based on the relative importance of a certain product. For instance, the availability of milk needs a stronger sensitivity for shoppers with small kids. The *second stage*, will identify the availability of the products in the shelves by using a

pushpin with a location identification sensor. The *third stage* uses IoT elements to ensure OSA at the lowest expense of labor. The elements are used to identify false alerts and to perform a double verification procedure. For example, a light sensor detects the missing product, additional sensors such as RFID and video cameras perform the double verification process. Once this cross verification process is performed, the store staff will notified with recommendations. The *fourth stage* identifies the source of the products available for replacement. Most of the times the replacement products will be found in the backroom. In the other possibility, where the products are misplaced by the customer, an RFID location map can track the misplaced products. The final and *fifth stage* is about the collaboration between the system and the store staff. This stage should pro-actively ensure OSA by providing information about the remaining products and creates advice on re-stocking moments to maintain OSA. Leveraging IoT capabilities for OSA will significantly enhance the overall customer shopping experience.

3.1.5 Real-time In-store Promotions

Another opportunity of the Internet of Things is that it can track customers and provide real-time in-store promotions. An example of this is the iBeacon, which allows mobile applications to connect with beacons in the physical environment and react to them. The customer will be identified by their phone then by extracting information about previous purchases and combining this with in-store location data, a real-time highly personalized offer can be launched. Furthermore this is also very valuable in the longer term, because gathering information about previous purchases also tells a lot about customer spending patterns. This information will give an indication about what customers are willing to spend for certain products, which can be used to increase revenues (Manyika et al., 2015). A survey conducted by Infosys showed that: “78% of customers said they’d be more likely to purchase from a retailer again if its offers were targeted to their interests, wants or needs” (Reddy, 2015) (Manyika et al., 2015) estimates that real-time personalized promotions can increase productivity by 3 to 5%, resulting in a potential economic benefit of \$89 billion to \$348 billion a year.

3.1.6 Augmented Reality

When we think about the future of shopping there is one thing that immediately pops up in one’s mind. A real world scenario in which we can change whatever we want and how we want it, by using virtual reality. This is better known as augmented reality and it is not something farfetched at all. Oak, a company that is specialized in retail store innovations, created a special hardware platform that uses mirrors to change the shopping experience. In their opinion trying on clothes was inconvenient and time consuming so they created what they call the Oak Mirror. Currently their technology is used in a couple of Ralph Laurens stores in the US. In these stores, all the items are tagged with RFID chips. Inside the dressing room a mirror can be found with an implemented touch screen. You can change outfits, colors and size by a few simple clicks on the touchscreen. All shopping assistants are equipped with corresponding Ipad on which they will receive a notification if you wish to change something. Furthermore the screen offers you recommendations and allows you to e-mail the outfit for possible further consideration. Using RFID tags also allows retailers to get a better insight in their products. It tells them

exactly which kind of products are in store, which products are often tried but never bought and what kind of combinations are often bought together (Lawrence, 2016).

3.1.7 Smart Customer Relationship Management

Another important factor of the customers' shopping experience is that they have the feeling that they are being listened to. They are seeking for some sort of empowerment that enables them to influence the way they are being treated by retailers. Therefore Customer Relationship Management (CRM) is an important part of retailing. By adding the 'smart' component to this process, CRM will become even more valuable. (Manyika et al., 2015) suggests a CRM program that uses sensor data to enable real-time responses to each situation. Furthermore by using face recognition software, store personal can identify specific customers and adjust shopping suggestions on the basis of previous purchases. When a customer doesn't want to be bothered by store personal during the shopping process, this can also be seen in the customer its specific profile, reducing unnecessary frustrations. Smart CRM is more a strategy than a technology on its own. It is the integration of relationship management with IoT components.

3.1.8 Technologies and their Applications

In this chapter a couple of new IoT technologies have been presented that all in their own way enhance the customer its shopping experience. This sub-chapter is used to give a clear overview of the presented IoT technologies and the applications connected to these technologies. (Chu, 2002) conducted a research among 1000 customers of 10 major retailers to see what factors are important drivers of customer satisfaction. He separated their survey into two parts, one part focused on the fact-driven, rational side of the brain and the other on the emotional side.

He discovered following five clusters of rational satisfaction drivers; "1) *person-to-person experience*; the store has helpful, friendly, knowledgeable employees, who anticipate customer needs and exceed customer expectations 2) *store experience*; the store is clean, well-designed, organized and adequately stocked with quality merchandise and provides "fun" experiences 3) *price and value*; the price that customers pay for goods is matched by the perceived value that they receive for making the purchase 4) *marketing and communications*; the store's promotions are well-communicated, easy to redeem and valuable to customers 5) *data integration and analytics*; the store provides the same product selection and product information across all sales channels, and uses information from a customer's past purchases to provide better service" (Chu, 2002, p. 3). Furthermore he acknowledged four relationship elements that play a role in the customer its shopping experience: 1) *ease-of use*; shopping is hassle-free, the retailer makes the customer feel welcome; the retailer meets all customer expectations. 2) *strong association*; (...) (...) the customer feels that the retailer provides the best value compared to competitors 3) *self-esteem*; shopping gives the customer a sense of familiarity: (...) (...) 4) *price-relationship*; the customer enjoys taking advantage of special offers and low prices" (Chu, 2002, p. 11).

Another more recent study on customer experience and satisfaction has been conducted by (Yasav, et al., 2015). They conducted an online survey amongst 1003 participants and ended up with the following four key findings; 1) customers are looking for ways to feel valued and make their lives easier 2) discover which experiences do not matter to customers, in order to focus on area's they value 3) factors determining a positive customer experience vary per retail category; apparel stores, department stores and mass merchants 4) finding and implementing the top experiences your customers value does have an impact on their behavior.

Taking into consideration all the previous findings, the following table will give an overview of: IoT technologies, their existing applications, for what kind of retail they are most suitable and in which way they enhance customer shopping experience and satisfaction.

Table 1: IoT Technologies & Applications Overview

	Shopping experience key drivers	Shopping Ease, Interactivity & Fun	Product Availability & Store Design	Price & Value	Marketing, Communications & Special Offers	Data Integration & Analytics	Type of Retail	Existing applications
IoT Technologies								
IoT Store Lay-out & Customer Tracking			X			X	Department Stores & Mass Merchants	Euclid ShopperTrak Aurora
Automated Check-Out		X				X	Apparel Stores, Department Stores & Mass Merchants	MagicBand Verifone BeanStore POS
IoT-based Store Mapping		X					Department Stores & Mass Merchants	SmartMart Linea Pro-4
IoT Shelf Availability			X			X	Department Stores & Mass Merchants	Kaa PowerShelf
Real-time in-store Promotions				X	X	X	Apparel Stores, Department Stores & Mass Merchants	iBeacon VMware
Augmented Reality		X			X	X	Apparel Stores	Oak Mirror Augment
Smart CRM		X	X	X	X	X	Apparel Stores, Department Stores & Mass Merchants	is more a combination of using all the aforementioned technologies (strategy)

In the table some factors mentioned above are either split-up or renamed in a way they are deemed more suitable. Furthermore some of the ‘emotional’ factors mentioned by (Chu, 2002) are left-out, since they are not measurable with a literature review. To be perfectly clear, the key drivers of the shopping experience are now defined as followed: 1) *shopping ease, interactivity & fun*; shopping can be done without any obstacles, it includes a lot of interactivity which makes it fun to do 2) *product availability & store design*; the store is well-designed, organized and products are adequately stocked and easy to find 3) *price & value*; the price customers pay for goods is matched by the perceived value that they receive for making the purchase 4) *marketing, communications & special offers*: the store’s promotions are well-communicated, easy to redeem and customers takes advantage of offers that are applicable to them 5) *data integration & analytics*: the store uses data from past purchases and shopping behavior to improve the overall shopping experience.

3.2 IoT/Big Data and Market Analysis

As recognized by (Pantano, 2014), another key driver of innovation within the retail sector is the availability of new-technology tools that are suitable for investigating the customer market. In the Internet of Things, everything is connected with each other, thus generating large amounts of data. The main challenge for retailers is how to make sense of this data in order to make it valuable, because collecting and processing data will help them to better understand their surroundings. In other words, how to turn raw sensory data into actionable intelligence. This can help retailers to add value to their products and services, because they exactly ‘understand’ the customer its needs. To better understand what the Internet of Things adds to current market analysis, it is good to understand how all the information is processed across the different information layers. This section will tell more about what the Internet of Things and the *big data* it produces offers to the retail industry in the form of customer segmentation and market trend analysis.

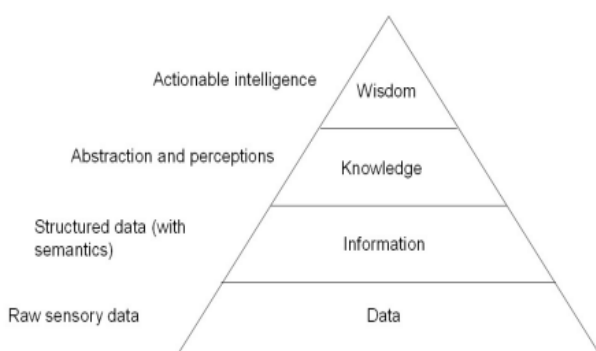


Figure 1: Internet of Things Knowledge Hierarchy (Barnaghi, et al., 2012)

3.2.1 Big Data and Cloud Computing

Big data is not a new concept, or idea. However, due to the recent development of sensors, computer hardware and the cloud, power is increasing and costs are decreasing. Big data is not called big data due to its size, but due to its big impact. (Hashem, et al. 2014, p. 100) describes it as follows: “*Big data is a set of techniques and technologies that require new forms of integration to uncover large hidden values from large datasets that are diverse, complex and of a massive scale*”. Although there is not one clear definition of big data, it can be described by three characteristics: 1) *volume*; the size of the data 2) *variety*; the different types of data 3) *velocity*; the frequency of the data generated. Data generated by sensors provide data with all the above mentioned characteristics. In order to receive valuable information, this data needs to be extracted by predictive analysis techniques. This can only be done in an environment where data processing and storing is cheap. This is where the *cloud* comes into play (Zaslavsky, et al., 2013). Cloud computing is a fast-growing technology used to perform complex and large-scale computing tasks. It allows managers to store, process and analyze large amounts of datasets without stressing them with issues such as infrastructure, flexibility, and availability of resources. Simply put, big data utilizes storage, using cloud computing as its elastic infrastructure (Hashem, et al. 2014). The science behind the extraction of information and knowledge from big data is called data science. In management data science is used to increase *data-driven decision making*; making decisions based on the analysis of data rather than on intuition. For example, a marketer could select advertisements based on his/her experience in the field or he/she could base the selection process on how customers react to different types of advertisement according to the analysis of data (Provost et al., 2013).

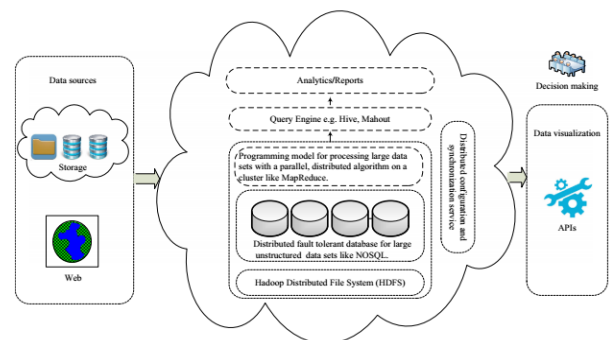


Figure 2: Cloud computing usage in big data (Hashem, et al. 2014)

3.2.2 Big Data in the Retail Industry

As mentioned before, big data analytics enables data driven decision making. Using data to improve decision making is of course not a new concept. What is new is that IoT technology enables retailers to extract retail data in ways that it is reliable to use for large-scale businesses. In the IoT environment sensors and devices are now able to offer us information about processes that were previously unconnected (Howe, 2014). Inside retail there is a lot of data available describing pricing, transactions, customer relationships and browsing and sales behavior. Furthermore one can predict trends within the market by looking at what is trending on social media (ComQi, 2015).

Analyzing social media to look for possible market trends is called *sentiment analysis*. Analyzing social media plays a key role within retail, because customers often make purchasing decisions relying on others in their environment. Therefore what is mentioned by one person on social media, can affect another person and end up becoming a trend (Manyika et al., 2011). The Internet of Things allows retailers to combine enterprise data with other relevant information to predict demand and market trends. IoT even allows them to use real-time analytics, meaning that they could adjust their pricing system to hourly demand, current inventory and their competition (Pittman, 2013). (Russom, 2011) conducted a survey amongst IT professionals (58%), business sponsors or users (22%) and consultants (20%), making a total of 325 respondents. They concluded that *anything involving customers could benefit from big data analytics*. This statement was based on the following findings, ‘big data analysis can result in’: better targeted social-influencer marketing (61%), customer-base segmentation (41%), recognition of sales and market opportunities (38%), can help define customer behavior (35%) as well as understanding customer behavior from clickstreams (27%). The amount of data available for segmentation has massively increased in the last couple years due to the Internet of Things. This allows retailers to move from traditional segmentation methods to new, better and more specific segmentation methods. (Manyika, 2011) describes this new method called *customer micro-segmentation*. It is based on the principle that due to the heavy use of analysis tools on big data, retailers are now engaged in personalization rather than simply segmentation. The Internet of Things allows retailers not only to use traditional market research data about previous purchases, but also allows them to track *individual* customer behavior, thus the term micro-segmentation. (Wolfgang et al., 2016) states that personalization and customization are a core value driver in the current IoT/Industry 4.0 environment. Customization per se does not provide any benefit for customers, but identifying how customers’ needs are different does make a difference. This is something customers are willing to pay for.

3.3 IoT Adaptability & Limitations

The final and third key driver of innovation within the retail industry described by (Pantano, 2014) is the uncertainty in adapting the new technology, in this case being the Internet of Things. He mentions that not only the customer its attitude towards the acceptance of the new technology is important, but also the attitude of the employee, or retailer in this particular case. Although firms are largely using Technology Acceptance Models to predict consumer’s usage, a lot still has to be discovered when it comes to the employee’s acceptance of new technologies. This section focuses on the (un)certainities, limitations and difficulties of implementing and adapting IoT as a technology within the retail industry. By looking at the existing literature and opinions of experts within the IoT and retail sector a clear overview of limitations will be brought to the table. The analysis will be done from two points of view; the customer point of view and the retailer its point of view. Since the interaction and relationship between buyer and seller is essential within retail, both views are equally important in order to conceive a complete image of the possible limitations of using IoT as a service enhancing technology.

3.3.1 Technology Acceptance Model (TAM)

(Davis, et al., 1989) developed the so-called Technology Acceptance Model. The model is used to show how people come to accept and use certain technologies. The TAM theorizes that a person’s attitude towards using a certain technology is primarily based on two factors: 1) *perceived usefulness* and 2) *perceived ease of use*. The first is the extent to which a person believes that the technology will enhance his/her job performance. The latter is the extent to which a person believes that using the new technology is possible without too much effort. Both factors are influenced by the system (technology) its characteristics. The TAM has become a successful and widely used model for predicting user acceptance. To better understand the Technology Acceptance Model take a look at figure 3.

Normally a questionnaire will be conducted in order to measure the cross-temporal stability correlations for perceived usefulness, perceived ease of use and the attitude towards using the technology. This is not something that will be done in this study as for this research there is no availability of an retail store setting that is based on IoT technology. Thus there are no resources to really measure perceived usefulness and ease-of-use. Instead the TAM will be used in the process of looking for limitations to stress the importance of the two factors mentioned above: perceived usefulness and perceived ease of use.

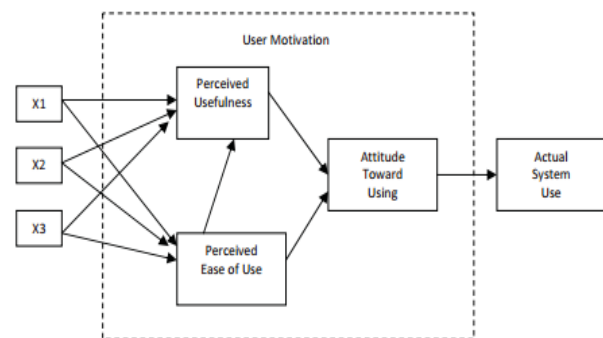


Figure 3: Original TAM as proposed by F. Davis (Priyanka, et al. 2013)

3.3.2 Limitations from the Customer Perspective

Two of the most important restraining forces when it comes to the customer’s adaption of IoT technology are: 1) *security and* 2) *privacy*. In order for the Internet of Things to become a success a sound solution has to be created that will guarantee both, security and privacy. Only then public acceptance and widespread adoption of IoT will be a realistic perspective. Therefore it is really important that while building and implementing an IoT network those two factors are always taken into consideration. Not only the technical side of security and privacy is important, but one should also keep in mind the perspectives from marketing, regulations and ethics (Tan, et al., 2010).

3.3.2.1 Security Issues

Due to a couple of reasons the Internet of Things is extremely vulnerable when it comes to attacks. First of all, most of its components are not under constant supervision and therefore easy to physically attack. Secondly, the IoT infrastructure will be wireless and therefore vulnerable for eavesdropping. In other words, it is easy to 'hack' the connection and retrieve information. Finally, most IoT components have low capabilities when it comes down to energy and computing resources. As a result they are not able to implement and process complex schemes that can provide security. Related problems to security concern authentication and data integrity. In the IoT infrastructure, passive RFID's and node sensors lack the ability to frequently exchange authentication messages with the server. Some solutions have been proposed but they can only be applied when the sensor nodes are part of a sensor network connected to the Internet, using other nodes as gateways. In the IoT infrastructure, these solutions are not sufficient. Nodes in the IoT scenario are not nodes of the network, but nodes of the Internet. This means that these nodes should also be authenticated even by sensors that do not belong to the same network. Furthermore there are severe problems when it comes down to data integrity. Data can be modified by others while stored in the node or the tag, as they are unattended most of the time. Therefore they have to be protected with passwords, which again is hard to realize due to the limited energy and computing capabilities (Atzori, et al., 2010).

3.3.2.2 Privacy Issues

Privacy is deeply rooted within our cultures and therefore recognized in all civilized countries' regulations. This already emphasizes its importance and therefore it is no surprise that privacy is an important restraining factor when it comes down to the diffusion of IoT technology. The IoT will play a totally different ball game when it comes down to data collection, mining and provisioning. There will be a tremendously amount of occasions when personal data will be collected, more than ever before. This will make it impossible for individuals to personally control the disclosure of their own personal information. Furthermore data is getting cheaper to store, which will practically mean that once certain data is generated it will stay stored and saved for an unlimited amount of time. In the IoT environment privacy is a serious issue and it's different from the privacy issues we know from the 'regular' Internet. In the traditional scenario privacy problems occur for the active user. In the IoT scenario not only the active user is affected, but also persons that may not even be making active use of any IoT service. Due to the issues mentioned above users should be able to decide when data is generated, who is collecting the data and which personal data is actually being generated. Furthermore the collected data should only be used for its sole purpose which is supporting authorized services and be stored only until, and when it is strictly needed. In the traditional scenario the factors above can be controlled by setting up requirements for the used applications. This problem becomes way harder to control in the IoT scenario due to the use of sensor networks. Individuals entering an area where sensors are deployed cannot control what kind of information is gathered about them and how it is stored (Atzori, et al., 2010). According to TRUSTe only 22% of Internet users agreed that the benefits of smart devices outweighed the privacy concerns. It may be clear that the acceptance of the IoT will depend on the protection of the user its privacy (Lee, et al., 2015).

3.3.2.3 Trust

Another concept that is highly correlated with the two factors mentioned before is trust. Trust is hard to measure and therefore an important but difficult matter when it comes down to information science. In this particular science, trust refers to security policies that regulate access to resources and credentials. These policies are very important, because systems may have to exchange credentials before they are able to exchange resources. This exchange process is also known as the trust negotiation process. Trust negotiation relies on the interaction between two parties, both verifying their credentials in order to create mutual trust. The IoT is a very challenging environment when it comes to this matter. In a surrounding where all the objects in the room take decisions themselves (being the smart objects that they are) the first obstacle is the perception of trust between the human individual and the objects surrounding him or her (Miorandi, et al., 2012).

3.3.3 Limitations from the Retailer Perspective

3.3.3.1 Store Employee Challenges

The rise of the Internet of Things will have a huge impact on the day-to-day activities of retailers. Knowing how to sell products or how to approach customers is not enough anymore. Retailers have to understand what it is to analyze and work with data and how to collaborate with IoT technology. This not only asks a severe commitment when it comes down to the willingness of understanding the technology itself, but also to accept the technology as a valuable addition to their job instead of feeling replaced. Furthermore due to the incredible amount of generated data by the IoT systems, severe challenges arise in the domain of data management. (Manyika et al., 2015) recognizes these challenges. There may be less need for certain types of workers. Think about sales clerks that help consumers find the products they need. Mobile applications and IoT-based store mapping, decreases the need for these kind of employees. On the other side there will be an increased need for data analysts and people that are able to design smart CRM systems. McKinsey estimates that in the US only, 140.000 up till 190.000 more workers are needed that possess the necessary analytical skills. Furthermore they expect that 1,5 million managers and analysts with analytical skills to make business decisions are needed.

3.3.3.2 Data Management Issues

As mentioned multiple times before, the large amount of data will bring new challenges to the table. All the data generated has to be stored, understood and analyzed by using mathematical models. The average retailer is not ready yet to deal with all this data. Only a few retailers would be able to invest in data storage that are suitable for storing all their enterprise its IoT data. Therefore some serious decisions have to be made when it comes down to prioritizing what data to store and back-up. Also from a technical side, the IoT infrastructure can cause retailers some major headaches. In the traditional scenario a small error does not shut down a whole system. In the IoT for that matter, where everything is in connection a small error can translate in something way bigger, causing a disorder in the whole system (Lee, et al., 2015).

3.3.4. Attitude Towards Using IoT (TAM Continued)

Using IoT technology will without a doubt be perceived as useful by both, customers and retailers. For customers it enhances the shopping experience, as it allows applications to better fulfill personal needs and wishes. And for retailers it will be useful, as it allows them to better predict consumer market trends and demand. When it comes down to the ease-of-use, most customers will not find it hard to use IoT Technology as it is something that is mostly happening at the back-end. Meaning that they only have to use the devices supporting IoT, the data extraction and analysis will be done by the retailer. Therefore the ease-of-use from the retailer's perspective is a lot lower. Management is confronted with this new thing called big data analysis and has to make severe investments in order to make IoT Technology a success. First they have to invest in an in-store IoT infrastructure and secondly they need to invest in employees that possess the necessary analytical skills. Of course without doing a large questionnaire and analysis of the outcome it is hard to say what the attitude towards using IoT as a technology really is. What can be stated for sure is that security and privacy issues are the major restraining forces for the wide-spread acceptance of IoT technology and that due to these factors the customer's attitude at this moment is predominantly negative towards IoT technology.

4. EXPERT INSIGHTS

To get some better insights in the possibilities of IoT for the retail industry a number of 32 experts had been contacted. Unfortunately, only 4 of the experts responded and confirmed to participate in the questionnaire. Although this is not a lot of response, the questionnaire provided some interesting findings. The most important and useful findings will therefore be provided in this chapter. The whole questionnaire can be found in the appendix of this paper.

(Pantano, 2014) indicated that retailers are mainly adaptors of innovation rather than innovators themselves. When the experts were asked what they thought of this statement (100%) of them agreed. The experts indicated that retailers are not technology experts. Their innovations are mostly focused on the area of processes. This confirms the research gap, which was found earlier on, that retailers are only focused on cost reduction by looking at supply chain innovations. Furthermore they indicated that innovating is not the core business of retailers, which could be an explanation for their passive attitude towards innovating. On top of that it was mentioned that only large retailers are able to innovate themselves due to economies of scale. Finally, all experts mentioned that the Internet of Things will have an enormous/severe impact on retail as we know it today. One of the experts even mentioned that whole business model of retail organizations will change to 'everything-as-a-service'.

All the experts agree (100%) that currently shopping is not interactive enough and that the average retailer does not provide enough tools and applications that enhance the overall shopping experience. The most important function that IoT can offer to customers according to the experts is the ability to connect offline with online, through seamless integration. Furthermore (66,7%) acknowledges in-store customer tracking as the IoT invention that will have the biggest impact. One of the experts recognized that IoT provides great possibilities for identifying customer needs as it provides 'two-way traffic' that allows to adjust and optimize products from a distance. All (100%) the experts mention that they are not willing to pay (+25%) more

for a better overall shopping experience. This does not really tell if they are not willing to pay more, but at least not +25%.

All the experts agree (100%) that big data has the greatest potential to be used by big retailers. Their main argument here is that big retailers have more resources, manpower and readily available data than small retailers do. Interesting side-note here is that one of the experts mentioned that in the future 'vintage' support from a human being could be sold a premium experience. When asked if big data would be as valuable to invest in by small retailers as it will be for retailers (66,7%) disagreed with this statement. In the line of expectation, most of the expert mentioned that big retailers will have more data and possibilities to take advantage of the results based on this data. One of the retailers mentions that it doesn't matter big or small, both should in the long term invest in big data analytics.

Finally a couple of questions concerned the possible limitations of the IoT technology. About (66,7%) of the experts mentioned 'privacy' and 'customer attitude towards using IoT technology' as the two biggest challenges. Interesting here is that (66,7%) of the experts would mind giving a company more personal information even if this would allow the company to better understand and respond to their personal wishes.

5. CONCLUSION & DISCUSSION

The goal of this paper was to give a better insight in the possible role that the Internet of Things could play as a service innovation tool for the retail industry. The literature review showed that there is a severe gap in retail between 'wanting to be innovative' and literally 'being innovative'. Furthermore it showed that retailers are mainly focused on creating innovative new products and innovate logistic processes, rather than innovating their services. This was later confirmed by the experts as they mention that retailers are mainly adaptors of innovations rather than being innovators themselves as innovating is not their core business. They also acknowledged that retailers are not technology experts and that most innovation within retail is performed by large retailers and mostly focuses on process innovation. These statements could explain the passive attitude from retailers towards 'service innovation'. On the upside, both, literature and experts recognize that the Internet of Things will have a large impact on the retail industry as we know it today, because it allows the retailer to better understand the customer's in-store journey and gives them the opportunity to deliver highly customized information. During this whole paper the study conducted by (Pantano, 2014) played a key role in the writing process as it provided the key drivers of innovation in the retail industry. By looking at these three key drivers the innovative component of the Internet of Things was tested. In this paper the Internet of Things has been tested on three aspects; **1)** the way IoT is able to satisfy consumers demand for innovativeness by enhancing the shopping experience **2)** the way IoT is able to investigate the consumer market by being an analytical tool **3)** the uncertainty of the IoT technology its acceptability.

First of all, the literature review indicated that consumers expect to find more interactive and supporting tools that enhance their overall shopping experience. This is something that the experts confirmed, as they also indicated that currently shopping is not interactive enough and that the average retailer does not provide enough tools and applications that enhance the shopping experience. Positive here is that experts recognize a massive opportunity for IoT, as it provides great opportunities

to achieve a higher level of personalization. The critical literature review showed that the Internet of Things is able to provide several supporting and interactive tools that are suitable to be implemented in the retail environment. *Customer tracking, augmented reality and real-time in store promotions* provide the retailer with opportunities to create a more personal shopping experience, by adapting store design and promotions based on the consumer its shopping behavior. The first, customer tracking, was mentioned by the experts as the IoT invention that will have the biggest impact on retail. Furthermore the Internet of Things is able to take away some major sources of shopping frustration. Waiting lines during the pay check-out procedure will be reduced due to *automated check-out*. Not knowing where to find certain products will no longer be the case, as *IoT-based store mapping* will directly lead you the right way and products being out-of-stock is no longer a problem due to *IoT-enhanced shelf availability*. Shortly, the literature review and expert questionnaire both indicate that the IoT is certainly able to satisfy the consumer its demand for innovativeness. Not only does it provide tools that make the shopping process more easy, by taking away some major sources of frustration. It also offers a highly customized shopping journey, by connecting the offline experience with online content. In *Table 1* a clear overview can be found of the aforementioned most promising IoT technologies, their existing applications, for what kind of retail they are most suitable and in which way they enhance the overall shopping experience. This table gives the average retailer a practical insight in how IoT technology can be used across a wide scale of services within their store. As some retailers might think that the IoT is something of the future, the table also includes existing applications that are already being used in some stores and proved themselves successful.

Secondly, the literature review indicated that there is a demand for new technology-based tools for investigating the consumer market. In the Internet of Things infrastructure everything is connected thus generating large amounts of data. This data is known as big data and it enhances data-driven decision making. Although this is not a new concept, in the Internet of Things the extraction of data is now also suitable to run large-scale businesses. The Internet of Things is better than other existing market analysis tools as it allows retailers to perform *customer micro-segmentation*, meaning that it is able to fulfill individual needs by tracking consumer behavior. This is something that the experts recognized as a unique aspect of IoT. It turns simple traditional segmentation into personalization, which according to the literature is something customers are willing to pay for. Furthermore the Internet of Things allows retailers to combine enterprise data with other relevant information, to predict market trends and demands. New in the IoT is that real-time analytics also allows retailers to adjust their pricing mechanisms to hourly demand, current inventory, but also to competitors. In practice this will result in new ways of achieving competitive advantage. The retailer that is best at generating data and extracting information out of it, will perform better than its competitors. Additionally, the experts mention that big data analytics has the greatest potential to be used by, and invested in by big retailers, as they have more resources, manpower and readily available data. Therefore IoT has better chances of succeeding in big retail companies.

Finally, the literature review indicated that in order for a technology to become a wide-spread success the uncertainty of adaptability is an important factor. Although the perceived ease-

of-use and usefulness are expected to be high, the overall attitude is predominantly negative, especially from the consumer perspective. The literature showed that consumers recognize privacy, security and trust as the biggest restraining factors of IoT technology. From the retailer its perspective, data management and employee allocation are the two biggest points of concern. The expert questionnaire also indicated that privacy and the customer's attitude are the two biggest challenges for IoT technology. Interesting point here is that the majority of the experts indicated that they would mind giving away personal information, even if this would allow a company to better understand their personal wishes. The fact that even IoT experts are not comfortable with sharing personal information confirms the overall negative consumer attitude towards using IoT technology.

So to conclude, "*How can the IoT systems (and the data they generate) serve as a tool for enhancing innovation within the process of retail?*"

- 1) The IoT is able to satisfy the customer its demand for innovativeness, as it provides several tools that enhance the overall shopping experience by making it more easy, fun, interactive and personal.
- 2) The IoT is better than other existing tools in predicting and analyzing the consumer market, as it allows retailers to gather information about existing processes, but also processes that were previously unconnected. This new data allows retailers to analyze needs per individual, resulting in micro-segmentation instead of traditional segmentation of groups. On top of that real-time analytics creates a new level of flexibility and better chances to adapt to the ever-changing consumer market.
- 3) Although the perceived usefulness and ease-of-use of the IoT are high, there are some severe problems when it comes down to security and privacy. These limitations have to be solved in order to successfully implement and adapt IoT technology in the retail industry.

The Internet of Things scores positive on two out of the three key drivers of innovation within the retail industry as proposed by (Pantano, 2014). It partially fulfills the third key driver, but in this area there is still some more room for improvement. **Overall, one could say that based on above score the IoT is a great tool to enhance innovation in the service-based retail industry.**

6. LIMITATIONS & FURTHER RESEARCH

As mentioned before in the section Expert Insights, only four experts responded from the total of 32 personally contacted. Also, one of the experts indicated that he does not consider himself as an IoT-expert and therefore his opinion has not been taken into consideration during the data analysis process. A total of three real experts is a relatively low number and it is hard to say if this amount is significant for drawing any conclusions. The experts were contacted via personal e-mail and in addition to that the questionnaire had been posted in several IoT-based Facebook and LinkedIn groups in order to

generate more respondents. Unfortunately, no responses came from these groups. Therefore I have to conclude that the expert questionnaire only plays a minor role in this paper and can be only used to indicate some 'gut feelings' about IoT technology. The critical literature review thus forms the most important part of this research. For future research I would recommend to take more time to collect a sufficient amount of respondents. There is a severe difference between gathering respondents from a random group of people, than to gather expert opinions. Experience has taught that overall experts are really busy people and hard to approach. The timeframe of 10 weeks is a relatively short period of time to structure an interesting research, perform a critical literature review and conduct a questionnaire with a sufficient and significant amount of respondents. This is also why the timeframe of 10 weeks can be considered as the major limitation of this research. Finally, since the third key driver of innovation is only partially fulfilled I would recommend some more research on the adaptability of IoT technology and the creation of possible solutions to tackle its existing limitations. This is needed to assure a wide-spread adoption of IoT technology. I think it would be interesting to really test the Technology Acceptance Model by placing consumers and retail employees in an all IoT retail environment to measure the perceived ease-of-use and usefulness. This is in my opinion the only real method to measure acceptability of IoT technology. Another interesting topic is to look at the success factors of store's mobile applications, especially since the mobile phone is one of the most important enablers of the IoT. This could give new insights in what customers deem as important and useful and how retail stores can improve their applications in order for them to add something extra to the shopping experience. Looking at things that already exist, such as these mobile applications, is in my opinion the first step of IoT implementation.

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8. APPENDIX

8.1 Expert Questionnaire

Section 1 of 8



Internet of Things as an innovation tool

Dear participant,

One of the effects of the IoT is the generation of data from connected devices that are equipped with sensors. Examples are the NEST thermostats, geographical/behavioral information provided by GPS systems, various wearables and data gathered from sensors in automobiles.

Such data reveals not only actual use of devices and products but may also reveal information on customer behaviour, needs, intentions and more.

We are interested in finding out what roles such data might play for the development of new products (innovation). Your assessment of the questions below can help us identify possible links between IoT data and innovation.

Completing this questionnaire will take approximately 15 minutes. Personal information will be kept confidential. At the end, we will be happy to share our findings with you.

Thank you in advance for your time,

The students

Section 2

Before we start please indicate..

... your name (for organizational purposes only)

(short answer text)

... your company/organization

(short answer text)

... your position in your organization

(short answer text)

...your e-mail (so we can send you the results)

(short answer text)

Do you give us permission to use your name in our research?

- Yes
- No

Would you consider yourself an expert in the IoT field?

- Yes
- No

Section 3

IoT as an innovation tool within the Retail Industry

Globally retailing is facing severe changes. The growth of the Internet has caused radical change in the retail landscape. It is predicted that in the next decade, the Internet infrastructure will be an even more vital backbone to everyday life. Content and services will be all around us, enabling new ways of interacting, information-sharing, working and living.

Could IoT significantly enhance the service-oriented industry we know as Retail?

***IMPORTANT NOTE*:** In this section when we talk about retail we mean the physical retail environment (in-store), not online retailing.

- 1) 1) "Retailers are mainly adaptors of innovation, rather than developers of innovation themselves.."
- Agree
 - Disagree

Why do you think that?
(long answer text)

- 2) What impact do you think the Internet of Things will have on the Retail Industry as we know it today?
(long answer text)
- 3) What kind of interactive/supporting tools could IoT offer consumers to enhance their personal shopping experience? Please, be as specific as possible.
(long answer text)
- 4) The following IoT invention will have the biggest impact when implemented within Retail stores..
 - In-Store Customer Tracking
 - Automated Check-out
 - IoT-based Store Mapping (knowing where to find certain products)
 - Enhanced Shelf Availability (by for instance using RFID)
 - Real-Time In-Store Promotions
 - Smart Customer Relationship Management
 - Other

If you picked 'other' in the previous question. What IoT inventions do you think will have the biggest impact when implemented in Retail stores?

(long answer text)

- 5) What tool do you think is most appropriate for analyzing 'big data'? It could be that some of the tools in the list are complementary or an extension of another tool in the list. Please, select the tool you deem as most complete.
 - Hadoop
 - Jaspersoft BI Suite
 - Pentaho Business Analytics
 - Karmasphere Studio
 - Skytree Server
 - Tableau Desktop
 - Splunk
 - Other

If you picked 'other' in the previous question, what tool do you deem as most appropriate?

(short answer text)

- 6) In the near future Big data has the greatest potential to be used by..
 - Big Retailers
 - Small Retailers
 - Both

Please elaborate. Why do you think that?

(long answer text)

- 7) "Big Data Analytics will be as valuable to invest in by small retailers as it will be for big retailers.."
 - Agree
 - Disagree

Why do you agree or disagree? Please elaborate.

- 8) What do you think will be the biggest challenge(s) of implementing IoT within the Retail sector? Please choose two.
 - Privacy
 - Data Storage and Processing
 - Internet Scalability
 - Heterogeneity (ability to integrate many types of devices/services/technologies)
 - Customer's attitude towards using IoT technology
 - Employee's (store personal) attitude towards using IoT technology

Section 4

- 1) Do you feel that in-store shopping is interactive enough?
 - Yes
 - No
- 2) Do you think that there are enough tools/applications available that enhance your shopping experience? Think about tools that allow you to: compare products/reduce waiting times/trace and track products in store.
 - Yes
 - No

Please explain, what do you miss while shopping? What could be better?

(long answer text)

- 3) Are you willing to pay (e.g. 25%) more for a better overall shopping experience?
 - Yes
 - No
- 4) Would you mind if a company would track your phone which would allow them to offer you personalized in-store real-time promotions?
 - Yes
 - No

- 5) What is your main irritation while shopping?

- Waiting in line before pay check-out
- Products being out-of-stock
- Advertisement that is not applicable to me
- Store Personal that does not know my needs
- Not being able to find certain products, when no help available

- 6) Would you mind giving a company more personal information, if this would allow them to better understand and respond to your personal wishes?
 - Yes
 - No

If you answered 'no' on the previous question, could you please elaborate? *(long answer text)*

8.2 Expert Responses

Section 2

... your name (for organizational purposes only)

Paul de Metter
David Langley
Markus de Haan
Joris Castermans

... your position in your organization

Arlanet - Digital Engineers
TNO / RuG
Datacon
Caesar Experts

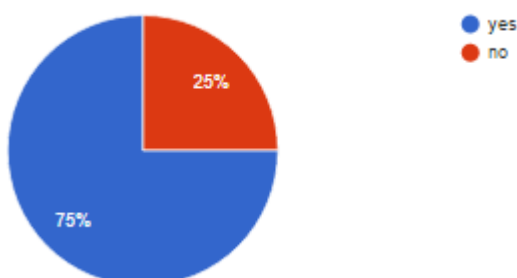
...your e-mail (so we can send you the results)

paul@arlanet.com
david.langley@tno.nl
mdh@datacon.nl
j.castermans@caesarexperts.nl

Do you give us permission to use your name in our research?

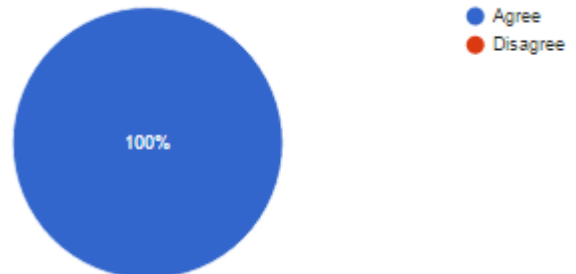


Would you consider yourself an expert in the IoT field?



Section 3

1) "Retailers are mainly adaptors of innovation, rather than developers of innovation themselves.."



Why do you think that?

The starting point of IoT innovation is the business case which earns money for the innovation. It is not the core business of retailers to innovate, but to adapt to innovations.

Retailers are not technology experts. Their innovations are more in the area of processes.

Main innovators are suppliers to retailers. Only large retailers are able to innovate themselves because of economies of scale

2) What impact do you think the Internet of Things will have on the Retail Industry as we know it today?

Severe. Customer journeys become even more important offline, helped with digital innovations.

Enormous. I believe that the whole business model of retail organizations will change to 'everything-as-a-service' through the IoT.

indoor location is key to identify customers and feed them customized information

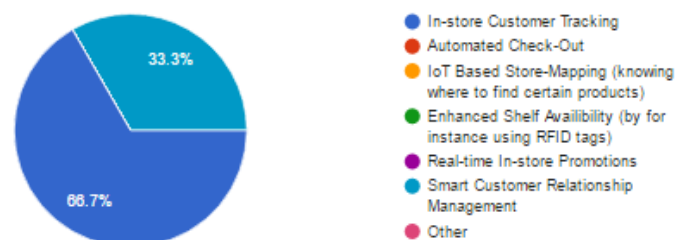
3) What kind of interactive/supporting tools could IoT offer consumers to enhance their personal shopping experience? Please, be as specific as possible.

Connect online with offline through seamless integration. Know the customer journey offline as well as online and optimize in the store as you do with e-commerce. Discount offers at the counter, for instance, should be personalized to the customer or customer basket.

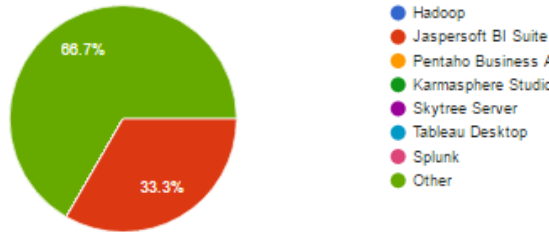
The IoT could mean that consumers can choose continually what suits them at any given moment. A large stationwagen for going on holiday, and a sporty cabriolet for a daytrip to the beach.

mobile phone is key, combinations with f.e. Beacons or LiFi. Traceability is also very hot topic. Developments like printed electronics with low costprice will help adopt these innovations

4) The following IoT invention will have the biggest impact when implemented within Retail stores..



5) What tool do you think is most appropriate for analyzing 'big data'? It could be that some of the tools in the list are complementary or an extension of another tool in the list. Please, select the tool you deem as most complete.



If you picked 'other' in the previous question, what tool do you deem as most appropriate?

a whole suit, rather than any single tool
 icrosoft Azure HDInsight / HDP

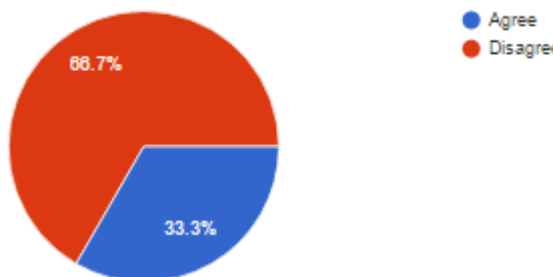
6) In the near future Big data has the greatest potential to be used by..



Please elaborate. Why do you think that?

Big Data needs analysis, which means manpower. Small retailers may not be able to afford those tools and/or manpower. On the other hand, maybe small retailers are better served with a 'vintage' customer support of a human being which could be a premium experience in the future.
 because, in the short term, they have more resources and readily available data.
 gathering data is not that difficult, doing meaningful things with it is

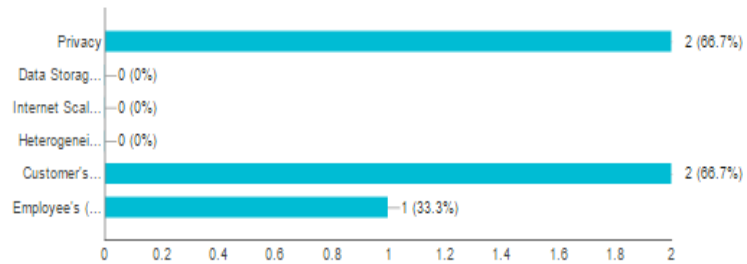
7) "Big Data Analytics will be as valuable to invest in by small retailers as it will be for big retailers.."



Why do you agree or disagree? Please elaborate.

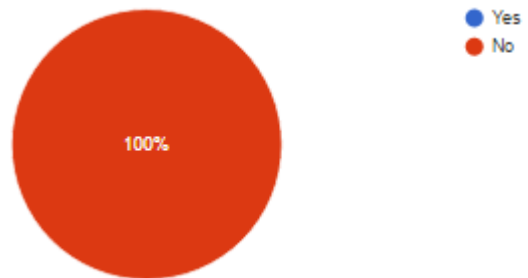
Big Retailers have more data and more possibilities and impact to take advantage of the results based on this data.
 All organizations will need to make use of data analytics.
 see above

8) What do you think will be the biggest challenge(s) of implementing IoT within the Retail sector? Please choose two.

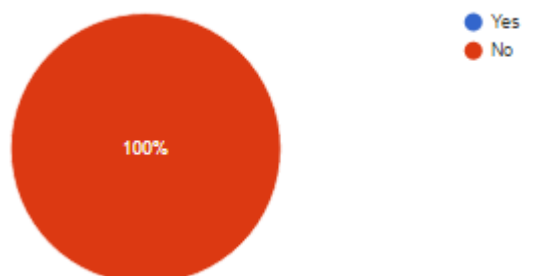


Section 4

1) Do you feel that in-store shopping is interactive enough?

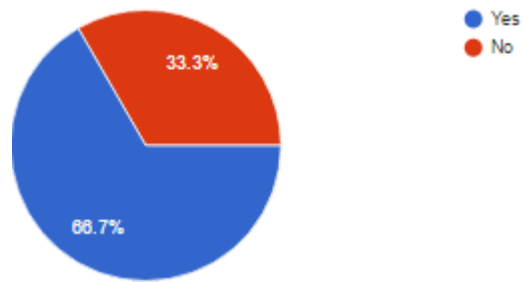


2) Do you think that there are enough tools/applications available that enhance your shopping experience? Think about tools that allow you to: compare products/reduce waiting times/trace and track products in store.

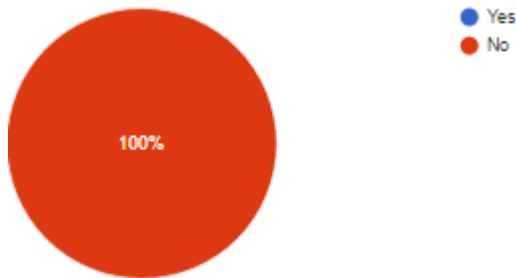


Please explain, what do you miss while shopping? What could be better?

- Depends on store.
- A product passport, specifying the history of parts and raw materials.
- price comparison



3) Are you willing to pay (e.g. 25%) more for a better overall shopping experience?

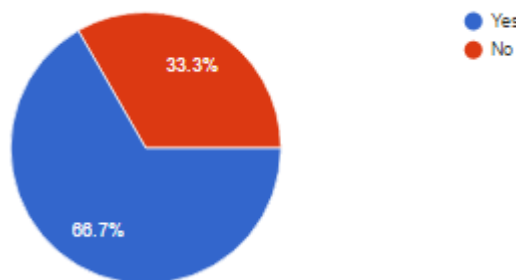


If you answered 'no' on the previous question, could you please elaborate?

I would do the same if a store employee asks me questions. I would mind if it was used for unsolicited promotions when not there.

Question derived from same questionnaire, but not my specific section

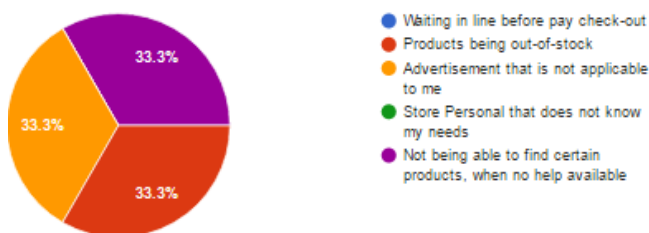
4) Would you mind if a company would track your phone which would allow them to offer you personalized in-store real-time promotions?



*) What are the benefits IoT has over current used techniques (e.g. brainstorming, focus groups, observations) for identifying customer needs?

- It can measure the customer better than ever before.
- Finer detail. Real time. And don't forget, IoT is two-way traffic. Products can be adjusted and optimized (intelligently) from a distance.
- I do not see IoT as a design technique, but as a (extended) possibility for a product and better customer journey. The design process can still use the techniques mentioned.

5) What is your main irritation while shopping?



6) Would you mind giving a company more personal information, if this would allow them to better understand and respond to your personal wishes?