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Digital transformation in the Spanish industry

An investigation of the current level of digital transformation in the Spanish metal manufacturing and automotive industry.

Master of Science Thesis in the Management and Economics of Innovation Programme

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Abstract

Problem: Industries are exposed to constant digitisation and the digital transformation resulting from the latter is one of the major challenges for industries today. Several digital indexes demonstrate that the Spanish industry in many aspects fall behind the average in Europe. Furthermore, digital transformation in Spain could contribute to an increase of earnings of €120.000 million until 2025. This thesis helps to clarify where the Spanish industry is today in their digital transformation and how the companies can approach the increased need for the same.

Purpose: The purpose of this study is to understand where the Spanish metal manufacturing industry and automotive industry are today in their digital transformation specifically in relation to Industry 4.0. Furthermore, the purpose is to suggest actions necessary to conduct by Spanish companies to obtain the benefits forecasted from the digital transformation towards industry 4.0

Literature review: The literature review first describes the concept of Industry 4.0 and its elements to create an understanding of where the industry is heading. This is followed by a section explaining digital transformation and provides the reader with three frameworks for evaluating the current level of digital transformation. Furthermore, the literature review treats theory about business model innovation which is a crucial part in the digital transformation.

Method: The study is interview based with profound interviews with ten participants. The process was divided into the parts preparatory work with literature research and development of questionnaire, interviews and then analysis. The interviews have been conducted by phone from Madrid with companies in the industry sector from different parts of Spain.

Results: The results are divided into the main categories current state and digital transformation. The current state contains the two subcategories business model and processes and products which demonstrates results in relation to the current state of the industry. The digital transformation category contains the subcategories business model, Processes and products and challenges which presents findings in relation to where the companies see themselves in the future and the challenges present.

Conclusion: The results show that many of the companies are in the beginning of their digital transformation and that joint efforts to digitise in the value chain is of importance for reaping benefits from the digital transformation. Furthermore, in addition to investments in technology to enable a connectivity the change management within each company is of crucial significance for the Spanish industry to approach Industry 4.0.

Key words: Digitisation, digital transformation, Industry 4.0, smart factory, cyber-physical systems, industrial internet of things, internet of things, internet of services.

Concepts and definitions

Industry 4.0	Referred to as the fourth industrial revolution and is described as "Industrial business will build global networks to connect their machinery, factories, and warehousing facilities as cyber-physical systems, which will connect and control each other intelligently by sharing information that triggers actions" (Gilchrist, 2016).
IoT	Internet of Things. A paradigm where everyday things are connected through embedded technologies enabling them to communicate with each other and other devices (Whitmore, Agarwal, & Da Xu, 2014)
IIoT	Industrial Internet of Things. A network of physical products sensing and communicating with each other or their internal state through embedded technology (Purdy & Davarzani, 2015).
ICT	Information's and communications technology.
Additive manufacturing	Most known as 3D printing. Refers to the technology that builds 3D models by adding layer-upon-layer of material.
Automation	Oxford Dictionaries (2017) defines automation as 'the use or introduction of automatic equipment in a manufacturing or other process or facility'.
Outcome economy	In the emergent outcome economy companies are focusing on delivering measurable results that matter to the customer instead of selling products and services.
Sensors	A device which detects or measures a physical property and records, indicates, or otherwise responds to it (Oxford Dictionaries, 2017).
Cyber-physical systems	A system in which embedded computers, monitor and control physical processes through a feedback loop in a networked environment (Albert, 2015).
Smart factory	The smart factory is based on smart machines and smart products with embedded technology enabling them to identify themselves, their origin, their current state and also allows tracing of the products throughout the manufacturing process (Gilchrist, 2016)
RFID	Radio Frequency Identification. "Describes any system of identification wherein an electronic device that uses radio frequency or magnetic field variations to communicate is attached to an item" - (Glover & Bhatt, 2006, p. 1).
Digitisation	The action of converting paper documents, microfilm images, photographs, sounds etc. from analog/physical form into a digital form that can be processed by a computer (Oxford Dictionaries, 2017).
Digital transformation	The business transformation where technology plays a key role to improve performance (Gilchrist, 2016; Uhl & Alexander, 2014). This is often equated with digitalisation which takes in consideration how the human behaviour changes due to digitisation and technology (Fardost, 2017). It is further is the process of the change through technology (Khan, 2016) and leveraging digitised data. (i-scoop, n.d.)

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1. Introduction

This chapter introduces the reader to the background of the study by putting the digital transformation in the Spanish industry towards Industry 4.0 into a context. The aim and purpose of the study will be presented together with the research questions. Furthermore, the delimitations will be presented followed by a disposition of this paper.

1.1. Background

Industries are exposed to constant digitisation and the digital transformation resulting from the latter is one of the major challenges for industries today (Schuchmann & Seufert, 2015). The changes in the business environment due to the digitisation are rapid and in many cases disruptive (Marchand & Wade, 2014) and affect the way business is conducted (Wade, 2015). This constantly changing reality for companies creates new business opportunities for those who possess the knowledge needed.

Industry 4.0 is often referred to as the fourth industrial revolution (Stävmo & Skoglund, 2016) and is a concept which stems from a German government-sponsored initiative for the industry (Schrauf, Vedsö, & Geissbauer, 2016). It is about the combination of and connectivity among major technology innovations (Schrauf et al., 2016).

Studies show that digitisation can bring opportunities and benefits in both qualitative and quantitative measures (Biecheler, Leutiger, Colin, Saint-Aubyn, & Figar, 2016). Business opportunities will be created due to an improved operational efficiency, the emergence of the so called 'outcome economy', connected ecosystems and software platforms and the collaboration between humans and machines (World Economic Forum, 2015). Digitisation and specifically Industrial Internet of things, equated with Industry 4.0, can come to create value up to $15 trillion of global GDP by 2030 (Daugherty, Banerjee, Negm, & Alter, 2015). They further state that the key is the operational efficiency and that productivity can be boosted up to 30%.

No organisation, country or company can afford not to adapt to the digital transformation which is occurring quick and inexorably (AMETIC, 2017). They further mean that the digitisation offers a competitive advantage which will not only be profitable but essential for the survival.

The Spanish government has realised the importance of a digital transformation among the enterprises in the country and specifically in the industry which constitutes 13% of the added value and 11% of the working population making the industry a highly important sector for Spain (MINETUR, 2016).

1.2. Research context

The ministry of industry, energy and tourism in Spain[1] have launched an initiative aiming to increase the contribution to GDP (Gross Domestic Product) of the Spanish industry through digital transformation of the same towards industry 4.0.

However, indexes show that there are improvements to be made regarding the digital readiness and development in Spain. The NAC[2] (National Absorptive Capacity) index, developed by Accenture, shows that Spain has an index number of 33 out of a 100. DESI[3] (Digital Economy &Society Index) indicates that Spain is lagging the average in the European Union in several aspects. What is more, in the NRI[4] (Network Readiness Index) Spain is ranked number 34 in the world.

The digital transformation in Spain could contribute to an increase of earnings of about €120.000 million until 2025 (Biecheler et al., 2016). The same study further states that the level of the digitisation among the digital leaders in the Spanish industry is far below the leaders in the global market. This makes the digital transformation the most important challenge for the competitiveness of the Spanish industry both short term and long term (Biecheler et al., 2016).

The initiatives initiated by the ministry of industry, energy and tourism are directed towards the Spanish industry and suggests 4 action plans for how to approach industry 4.0. However, these concerns how the initiative can help the industries and not what the industries needs to do to approach this paradigm. Hence, little is known about where the Spanish industry currently is in their digital transformation and what actions that needs to be undertaken for them reap the estimated benefits of industry 4.0. This study provides an important opportunity to advance the understanding of the current level of digitisation and digital transformation and analyse what actions that needs to be carried out by the firms in the industry to obtain benefits from the digital transformation.

1.3. Purpose and research questions

The purpose of this study is to understand where the Spanish metal manufacturing industry and automotive industry are today in their digital transformation specifically in relation to Industry 4.0. Furthermore, the purpose is to suggest actions necessary to conduct by Spanish companies to obtain the benefits forecasted from the digital transformation towards industry 4.0. This leads to the following research questions:

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[1] Industria conectada 4.0: La transformación digital de la industria española. Ministerio de industria, energía y Turismo (2016)

[2] Winning with the Industrial Internet of Things: How to accelerate the journey to productivity and growth by Accenture (2016)

[3] https://ec.europa.eu/digital-single-market/en/scoreboard/spain (accessed 2017-02-15)

[4] http://reports.weforum.org/global-information-technology-report-2015/network-readiness-index (accessed 2017-02-15)

RQ 1: What is the current level of the digital transformation in the Spanish metal manufacturing and automotive industry?

RQ 2: How can the Spanish metal manufacturing and automotive industry approach the goal of increasing the contribution to the GDP through a digital transformation in relation to Industry 4.0.

1.4. Delimitations and scope

For the digital transformation towards industry 4.0 to take place information and communication technology (ICT) is considered to be of great relevance. However, the thesis does not engage directly with ICT due to a request from the initiator company since they are currently running a parallel project regarding this matter. Furthermore, politics considering laws and regulations for trade and how to do business in the new ways a digital transformation brings will not be treated.

A customised discussion for each participating company is beyond the scope of this study. Instead it tries to find patterns and more general conclusion for the interviewees about where the industry is today and what focus that needs to be undertaken to approach Industry 4.0. Furthermore, the study is conducted with a predetermined time frame of 20 weeks and one researcher which limits the scope of the study as well as the number of interviews.

1.5. Disposition

Chapter 2 begins by laying out the theoretical dimensions of the research, and looks at what theory says about Industry 4.0, digital transformation and business model innovation. Chapter three is concerned with the methodology used for this study, followed by the fourth section which presents the findings of the research, focusing on the three key themes business model, processes and products and future plans. The section of empirical findings is followed by an analysis where the data is analysed in the light of the theory with the aim of discussing where the industry is today and how it can advance towards Industry 4.0. Chapter six discusses the analysis and suggests what further research could be done. The last section provides the reader with a conclusion derived from the analysis.

2. Literature review

This section aims to explore the theories which are the basis for the analysis and provide the reader with a deeper understanding of the subject. The chapter first describes Industry 4.0 followed by theory about digital transformation and later business model innovation.

2.1. Industry 4.0 and Industrial Internet of Things

The concept of Industry 4.0 refers to the fourth industrial revolution and originates from Germany (Stävmo & Skoglund, 2016). Prior to Industry 4.0 was the Industry 3.0 which concerns the automation of factories (MINETUR, 2016). Gilchrist (2016, p. 195) describes the vision of Industry 4.0 as "industrial business will build global networks to connect their machinery, factories, and warehousing facilities as cyber-physical systems, which will connect and control each other intelligently by sharing information that triggers actions". However, the exact definition of Industry 4.0 is somewhat vaguer. Stock & Seliger (2016) defines Industry 4.0 as a paradigm which is described from the three dimensions' horizontal integration through the entire value creation network, end-to-end engineering across the entire product life cycle (PLC) and vertical integration and networked manufacturing systems. This description also goes in line with the main characteristics of Industry 4.0 described by (Gilchrist, 2016) and (Schrauf et al., 2016).

The horizontal integration through the value creation network is mainly outlined by the relationships between customers and business partners (Gilchrist, 2016; Stock & Seliger, 2016). These relationships are characterised by collaborative manufacturing and collaborative development environments which plays an important role for companies with limited amount of resources such as SME's (Brettel, Friederichsen, Keller, & Rosenberg, 2014). Furthermore, the horizontal integration could also refer to the integration of new business models (Gilchrist, 2016; Stock & Seliger, 2016).

The end-to-end engineering describes the digital transformation in all phases of the life cycle of a product and refers to technology which enable companies to trace their product throughout the entire life cycle (Gilchrist, 2016; Stock & Seliger, 2016).

Vertical integration refers to the network of digitised and intelligent manufacturing systems enabling manufacturing plants and factories to communicate and react to different variables (Gilchrist, 2016; Stock & Seliger, 2016). Furthermore, the dimension of vertical integration also refers to the integration of other value chain activities such as marketing and sales and smart services (Gilchrist, 2016; Stock & Seliger, 2016).

Industry 4.0 can further be equated with the concept of Industrial Internet of Things (IIoT) or considered as a paradigm resulting from the latter (Albert, 2015). IIoT is a network of physical products sensing and communicating with each other or their internal state through embedded

technology (Purdy & Davarzani, 2015) such as Internet of Things (IoT), big data, cloud computing and artificial intelligence (Wang, Wan, Li, & Zhang, 2016).

Another way of describing Industry 4.0 or IIoT, which will be used in this paper together with the three dimensions described above, is by outlining the components which are the base for the above-mentioned dimensions and hence Industry 4.0. Hermann, Pentek, & Otto (2015) identifies 4 key components of Industry 4.0; Cyber-Physical Systems, Internet of Things (IoT), Smart Factory and Internet of Services (IoS).

2.1.1. Internet of Things

The Internet of Things (IoT) can be described as a paradigm where everyday things are connected through embedded technologies enabling them to communicate with each other and other devices (Whitmore et al., 2014). The core concept of IoT is the integration of digital components into physical which results in new products and enables new business models (Stävmo & Skoglund, 2016; Wortmann & Flüchter, 2015).

The hardware needed for IoT already exists to a large extent (Whitmore et al., 2014). However, the transition to IoT means combining this hardware with software, sensors, microprocessors and data storage into interconnected systems (Hermann et al., 2015; Stävmo & Skoglund, 2016; Whitmore et al., 2014). Furthermore, Gilchrist (2016) argues that the building blocks of IoT are the technologies; big data and analytics, autonomous robots, simulation, horizontal and vertical system integration, cyber-security, the cloud, additive manufacturing and augmented reality.

2.1.2. Cyber-physical systems

Albert (2015, p. 79) defines a cyber-physical system as “a system in which embedded computers, monitor and control physical processes through a feedback loop in a networked environment”. This definition is also agreed upon by Gilchrist (2016, p. 36) who states that “a cyber-physical system can be just about anything that has integrated computation, networking and physical processes”.

Cyber-physical systems are linked to each other and exchange data through virtual networks and communicate with operators via human-machine interfaces in real time (Hermann et al., 2015; Stock & Seliger, 2016). Hence, cyber-physical systems enables interaction between software applications and the physical world (Gilchrist, 2016). Moreover, they make decentralised decision by creating virtual copies of the physical world through monitoring processes (Hermann et al., 2015).

2.1.3. Smart factory

The smart factory is by several scholars considered to be the centre of industry 4.0 (Gilchrist, 2016; Stock & Seliger, 2016; Wortmann & Flüchter, 2015). Gilchrist (2016) further claims that the smart factory is the focus around which everything revolves and that all processes, including external interfaces, are there to enable the smart factory.

The smart factory is based on smart machines and smart products with embedded technology enabling them to identify themselves, their origin, their current state and also allows tracing of the products throughout the manufacturing process (Gilchrist, 2016; Wortmann & Flüchter, 2015). Furthermore, a central aspect of the smart factory is that it is vertically, horizontally and end-to-end engineering integrated Forstner & Dümmler, 2014 (as cited in Stävmo & Skoglund, 2016) and Wang et al. (2016) which similarly are the three dimensions of Industry 4.0 suggested by Stock & Seliger (2016). Forstner & Dümmler, 2014 (as cited in Stävmo & Skoglund, 2016) and Wang et al. (2016) argues that this enables the value chain to create value through customisation of products which Stävmo & Skoglund (2016) claims, together with producing in small batches is the objective of the smart factory. Moreover, smart factories are able, through cyber-physical systems, to react to variables in the manufacturing process such as demand level, machine defects and stock levels (Gilchrist, 2016; Stock & Seliger, 2016; Stävmo & Skoglund, 2016).

2.1.4. Internet of Services

The internet of services refers to the concept of selling services instead of products through internet (Hermann et al., 2015). It can concern everything from a single factory to value added networks (Hermann et al., 2015). Furthermore, the internet of services is describes as "Services are offered and combined into value-added services by various suppliers; they are communicated to users as well as consumers and are accessed by them via various channels" by Buxmann, Hess, & Ruggaber (2009, p. 341).

2.2. Digital Transformation

Digital transformation refers to the business transformation where technology plays a key role to improve performance (Gilchrist, 2016; Schuchmann & Seufert, 2015; Uhl & Alexander, 2014; Wade, 2015) and is one of the main challenges for all industries (Schuchmann & Seufert, 2015). It can be applied, and be beneficial, to all industries as well as impacting all core functions of a business (Gilchrist, 2016) such as products, processes, sales channels and supply chains (Matt, Hess, & Benlian, 2015). As a result, Capgemini (as cited in Gilchrist, 2016) stresses the importance of closely aligning the business and IT in order to obtain a digital transformation and also that the project is driven from the top. They further address the difficulty with carrying out such a project due to the scope and that the external environment does not wait for the change to take place. Furthermore, Wade (2015) emphasises the importance of that the business model and the technologies outlining the transformation are not fixed and therefore vary over time and, potentially, geographically and over sectors.

There are six areas in which digital transformation enable performance improvement (Marchand & Wade, 2014). Smarter sales interactions are enabled through capturing and analysing real-time data about customers; continuous improvement by monitoring and tracking information regarding service, support solutions and products; acting across organisation boundaries through knowledge sharing; better decision making by more targeted and deeper analytics; rapid reaction to business change through efficient and agile processes and creating

disruptive change and innovation by adopting a more innovative business model (Marchand & Wade, 2014).

Several well-established companies claim that their non-digital assets and capabilities hinder them in their digital transformation (Marchand & Wade, 2014). However, Marchand & Wade (2014) further argues that these firms have resources such as an established brand, access to capital, product and industry knowledge and strong network relationships which are advantageous in a digital transformation.

There are several roadmaps for firms to follow to obtain their desired level of digital transformation (Gilchrist, 2016). He further argues that each company needs to adapt the roadmap to per what fits them best. Not all companies are ready or want a full digital transformation and just want to transform certain parts of their business (Gilchrist, 2016). Wade (2015) agrees and further argues that the digital disruption not always threatens the business at a large scale but rather as several small threats. Thus, the digital transformation in the company can be incremental instead of radical (Wade, 2015).

The PwC maturity model[5] is a framework to map the current level of digitisation within a company (Geissbauer, Vedso, & Schrauf, 2016). This model addresses the seven categories digital business model and customer access, digitisation of product and service offerings, digitisation and integration of vertical and horizontal value chains, data and analytics core capability, agile IT architecture, compliance, security, legal and tax and also organisation, employees and digital culture. Due to that the scope of this study concerns business model, processes and products only the first three are of relevance for this study and can be seen in figure 1. The categories are further evaluated on a scale of four stages of maturity which can be seen in figure 1. Companies in the beginning of their digital transformation, so called digital novice, have adopted the first digital solutions, their online and offline channels are separated from each other and they have digitised and automated sub processes (Geissbauer et al., 2016). Companies with a digital product and service portfolio which has managed to integrate online and offline channels together with a vertical integration are considered to have come slightly longer in their digital transformation (Geissbauer et al., 2016). The next level is to a large extent collaborate with external partners, share interfaces and have a horizontal integration in place (Geissbauer et al., 2016). Companies considered to have come a long way are characterised by an innovative product and service portfolio, being fully digitally integrated with customers and suppliers together with having access to real time data in the value chain.

[5] (Geissbauer, Vedso, & Schrauf, 2016), Industry 4.0: Building the digital enterprise. 2016 Global Industry 4.0 Survey developed by PwC, s 28. (www.pwc.com/industry40).

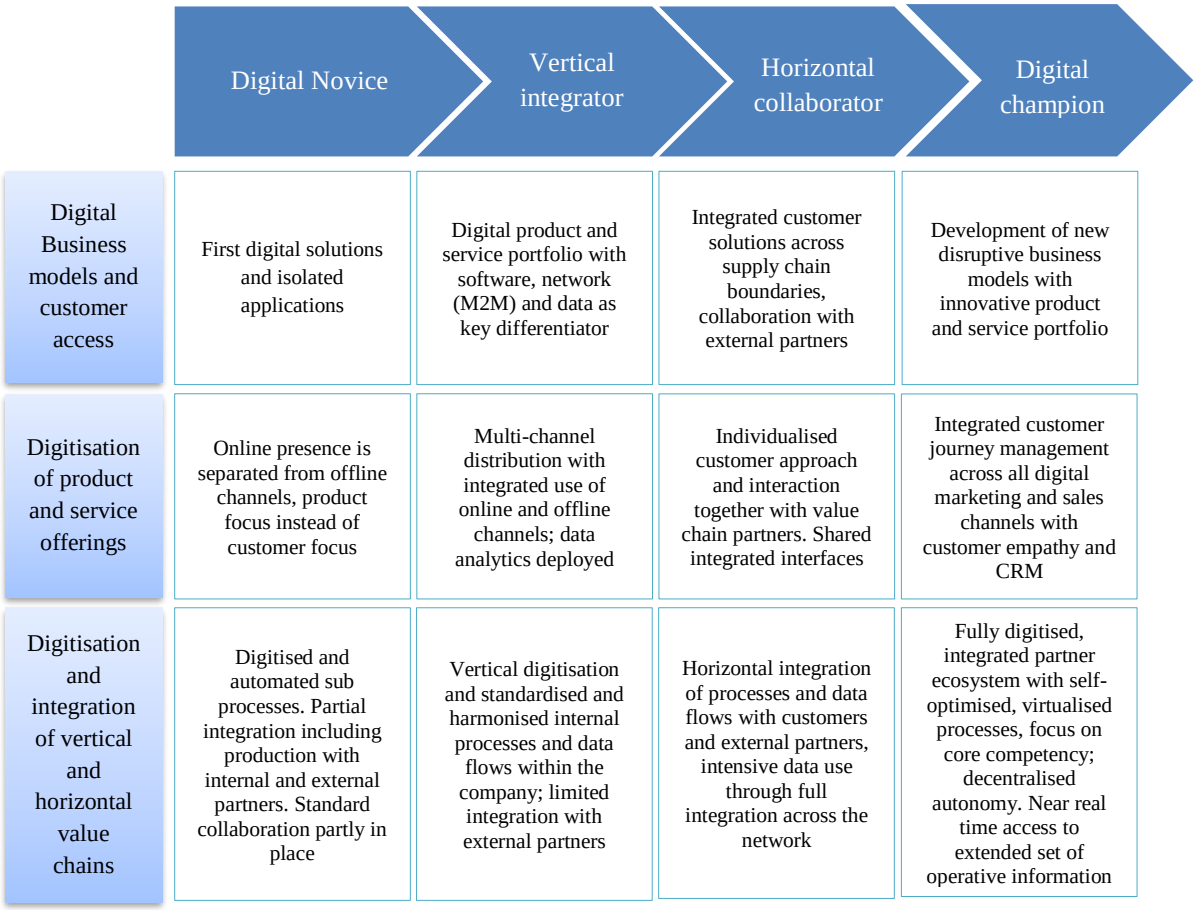

Figure 1. A reconstruction of the first three categories of the PwC maturity model developed by Geissbauer et al. (2016)

Another framework is the one developed by Marchand & Wade (2014) is shown in figure 2. This framework is based on a matrix consisting of 4 dimensions; Going digital, doing the basics; Strong e-commerce capabilities – separated from the core business; Exploiting digital data and business insights - building for the future and Digital business capabilities – a global transformation journey. To fully benefit from the digital transformation, the company must move upwards and outwards in the matrix, hence adopt a high usage of AMPS (Analytics, Mobile, Platforms and Social media) and commit to a high level of organisational change (Marchand & Wade, 2014)

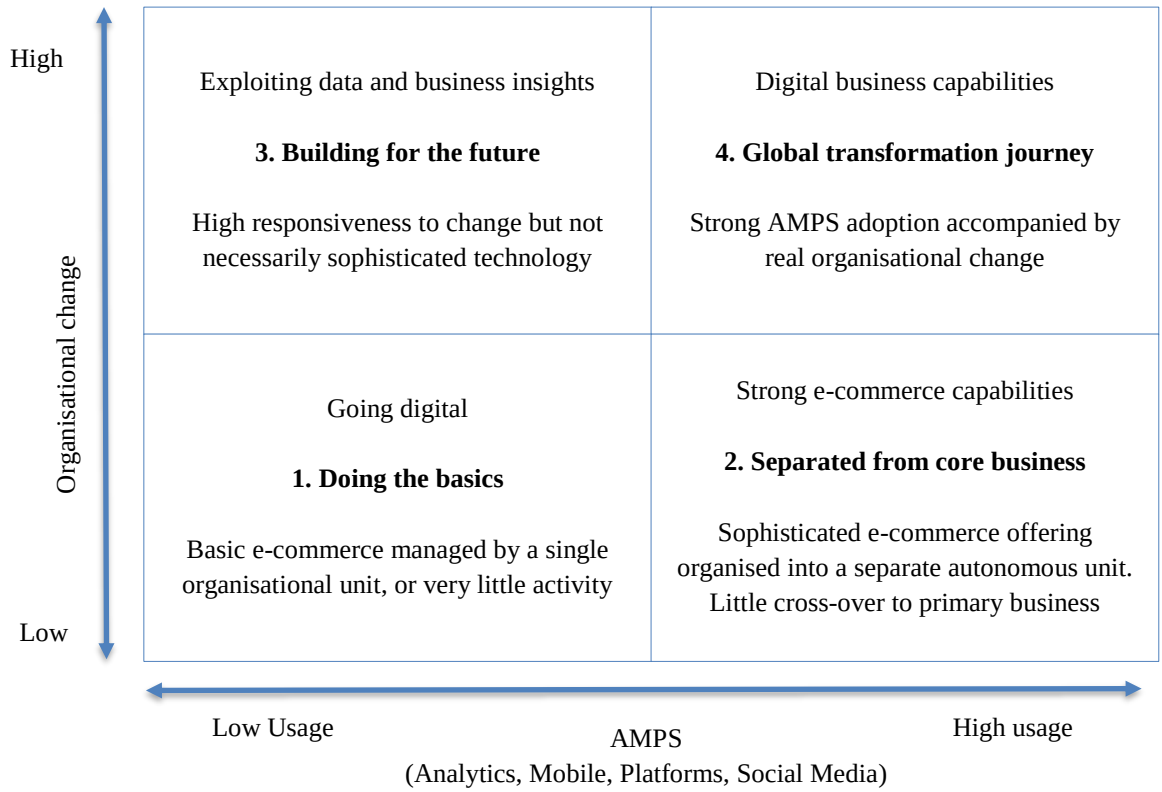

Figure 2. A reconstruction of the framework to map the current digital status developed by Marchand & Wade (2014, p. 3)

The first quadrant refers to companies characterised by strong non-digital assets and have, during the last decade, invested heavily in ERP (Enterprise resource planning) – systems and have developed a website together with intranets and extranets to connect partners and suppliers (Marchand & Wade, 2014). Furthermore, the company uses technology and e-commerce to a certain extent but there is an overall lack of mindset towards a digital transformation as well as a business model allowing such changes (Marchand & Wade, 2014). They also argue that the companies positioned in the first quadrant experience few of the benefits promised through going digital.

Companies in the second quadrant are in general more established industries with well-developed e-commerce capabilities (Marchand & Wade, 2014). Furthermore, digital transformation is recognised as important by the management but there is an absence of coordination and connection between the different functions within the company and IoT is not yet considered (Marchand & Wade, 2014).

The companies in the third quadrant have, by targeting specific areas within and outside their companies, responded to the rapid changes in technology the past years (Marchand & Wade, 2014). They are also characterised by strong digital capabilities within the targeted functions in their business (Marchand & Wade, 2014). Quadrant four refers to the companies which have managed to achieve a continuous evolvement and successfully adopted strong AMPS together with an organisational change (Marchand & Wade, 2014).

2.2.1. Digital capabilities

For a company to successfully digitally transform, several capabilities are essential (Uhl & Alexander, 2014). They identify six capabilities; innovation, transformation, IT Excellence, Customer centricity, Effective Knowledge worker and Operational excellence, and classifies them into the categories ‘enablers’ and ‘Goals’ according to figure 3. The digital transformation enablers concern the company’s ability to innovate and transform simultaneously, at the same time as using the best-suited technology (Uhl & Alexander, 2014). They further argue that these skills must reach a certain level of maturity and quality before a digital transformation can successfully take place and the company can pursue the digital transformation goals. In relation to the research questions this study focuses on the enablers which will be explained below.

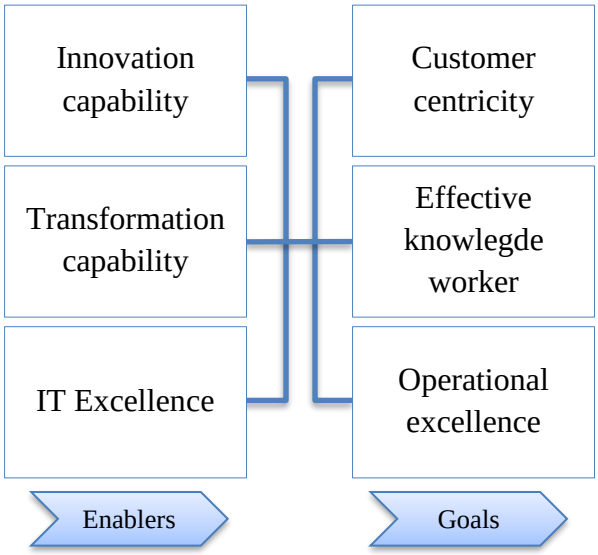

Figure 3. A reconstruction of the six Digital Capabilities of the Digital Capability Framework (Uhl & Alexander, 2014)

Innovation capability refers to the firm’s capability of managing innovation-related business processes and is a necessity for competitiveness among digital enterprises (Uhl & Alexander, 2014). Shelton & Percival (2013, p. 1), states that ‘leading innovators have grown at a rate 16 percent higher than the least innovative'. Furthermore, their forecasted growth rate is twice as large as the global average and three times higher in comparison to their less innovative competitors (Shelton & Percival, 2013).

Transformation capability is critical for companies and refers to the capability of handling the complex and extensive changes within the company which are essential for the future of the company (Uhl & Alexander, 2014). Practically this means using agile processes to enhance the flexibility and enable the adaption to new requirements (Uhl & Alexander, 2014). They further stress the importance of communicating a clear vision and strategy for the desired position within five to ten years.

The IT Excellence is one of the key factors to successfully implement a digital transformation (Uhl & Alexander, 2014). It refers to the enhancement of business technology and the business through the use of new technologies (Uhl & Alexander, 2014). However, Uhl & Alexander

(2014) points out the importance of a thorough investigation and a deep understanding of the possible usage, benefits and risks of the technology before investing.

2.2.2. Network externalities

To achieve a horizontal integration and hence benefits from the same it is of importance that the surrounding environment also digitally transform. Such network externalities can be of indirect or direct character (Katz & Shapiro, 1985). Direct network externalities are those which increases the utility of a good with the number of users while indirect network externalities affect development of complementary services around the product and price reduction (Lin & Bhattacherjee, 2008). Thus, Lin & Bhattacherjee (2008) claim that direct network externalities stem from the demand side and indirect from the supply side of the product. Furthermore, they argue that network externalities can be of both positive and negative nature hence, where the negative nature implicates that the effects from an increasing number of users is negative on the current users.

2.3. Business model innovation

A business model outlines the processes and the activities a company undertakes to create, capture and deliver value to its customers and stakeholders (Sorescu, Frambach, Singh, Rangaswamy, & Bridges, 2011; Teece, 2010; Zott & Amit, 2010). It is described as "the architecture for the firm's boundary-spanning transactions with external stakeholders" by Brettel, Strese, & Flatten (2012, p. 95). Another definition of business model is that it "depicts the content, structure and governance of transactions designed to create value through the exploitation of business opportunities" (Amit & Zott, 2001, p. 511). (Teece, 2010, p. 172) states that "The essence of a business model is that it crystallises customer needs and ability to pay, defines the manner by which the business enterprise responds to and delivers value to customers, entices customers to pay for value, and converts those payments to profit through the proper design and operation of the various elements of the value chain".

Technology by itself does not have any value or that technological innovation automatically leads to economic success (Chesbrough, 2010; Teece, 2010). They mean that value is created first when the technology is commercialised through an appropriate business model. Chesbrough (2010, p. 355) further stress the importance of adapting the business model to yield the value of technology by stating "it is probably true that a mediocre technology pursued within a great business model may be more valuable that a great technology exploited via a mediocre business model".

A business model somewhat outlines the boundaries and constraints the company is facing (McGrath, 2010). However, new technology contributes to a change of these boundaries and enables, and sometimes forces, business models to transform in line with these new changes (Larsson, 2016; McGrath, 2010). These changes are also essential for the development of sustainable business strategies (Larsson, 2016). Furthermore, Teece (2010) points to the development of the global economy and argues that technology has changed the traditional relationship suppliers and customers which results in the need for businesses to become more

customer centric. Thus, value propositions must be re-invented to enable firms to create, deliver and capture value of their offer (Teece, 2010). They further emphasise the importance of the business model meeting customer needs for the firm to obtain competitive advantage.

In addition to the change of value propositions digital solutions convey, they also bring alternative revenue streams which can be captured through an increased focus on services instead of products (Larsson, 2016). Teece (2010) points out the need for business model innovation in order for a firm to fully reap the benefits of technological innovation and transformation. Hence, technological innovation needs to be accompanied by business model innovation to increase the capacity of capturing value (Björkdahl, 2009; Teece, 2010).

The leading change in the organisation is vital for a company to successfully undertake a business model innovation (Chesbrough, 2010). This requires that the organisation has a clear view about who is responsible for business model experimentation (Chesbrough, 2010). What is more, he argues that this kind of experimentation needs to be tested in several divisions of the organisation and that functional heads thereby might not be optimal due to the lack of authority. On the other hand, he states that the CEO of SME's would be ideal leaders in this matter apart from the fact that they have reached their position via the current business model. Hence, there is a risk of them acting in a way that would prevent the experimentation of a new business model (Chesbrough, 2010). Besides the leading change, Chesbrough (2010) also highlight the importance of organisational change in conjunction with business model innovation. The organisation needs to adopt an attitude embracing and encouraging experimentation and change (Chesbrough, 2010; Hayashi, 2009).

3. Methodology

This section addresses the execution of the study. It provides a brief presentation of the initiator of the study and further describes the research approach, what kind of data that has been used together with a description of how data has been collected and analysed.

3.1. Initiator of the study

The study is conducted at the request of the company Business Sweden, more specifically the local office in Madrid, Spain, henceforth denoted as 'BuS'. BuS is a consultancy firm partially owned by the Swedish government and partially privately owned. The company supports internationalisation of Swedish companies by working on the local market and offers Swedish companies support in terms of counselling, information, education, services and a network on the local market.

3.2. Research approach

The research approach is based on an inductive approach which according to Woo, O'Boyle, & Spector (2017) means that the research is bottom up and data driven. This approach was chosen since the study aims to map and analyse the current state of the Spanish industry by conducting personal interviews with a few selected enterprises. Woo et al. (2017) together with Bryman & Bell (2015) argues that the inductive research aims to generalise theories by finding patterns in the observed data.

3.3. Data Collection

A study based on primary data from interviews with ten interviewees from ten different companies was chosen to gain a detailed understanding of the firms' current and future relation to digital transformation. Furthermore, qualitative profound interviews with one person from each company was chosen appropriate for the study. Glaser and Strauss (as cited in (Shah & Corley, 2006) states that the qualitative interview can give an understanding and a profound description of the area studied.

3.2.1 Definition of scope and preparatory work

The purpose and scope of this study was framed in collaboration with Business Sweden who, with this study, aims to understand where the Spanish industry within the sectors of metal manufacturing and automotive, is today in relation to industry 4.0 and digital transformation to find business opportunities for Swedish companies based on the results.

In the early phase, literature studies were made to understand the concept of Industry 4.0 and digital transformation. This also contributed to set the structure for the theoretical framework. The literature review was thereafter revised continuously throughout the study. Furthermore, informal conversations were held with people involved in different initiatives regarding automation, industry 4.0 and smart factory in Sweden to appreciate what areas and questions

that would be suitable to investigate in the Spanish market. This resulted in that the scope of the study was going to concern the business model, the processes and the products.

3.3.2 Sample

The study was built on ten profound interviews with general directors, operation directors and CEOs in small and medium enterprises (SME's) in the Spanish industry. The companies are active within either metal manufacturing and/or the automotive sector. The study is built on interviews with five companies in each sector. The companies within each sector were chosen from http://www.guiasgtp.com/ and "Kompass" which is a tool for searching for businesses within specific sectors. Companies considered of relevance for the study was contacted and those who showed interest in participating were then interviewed.

The time frame of the study together with the fact that the study has been conducted of a single researcher limited the amplitude of case studies to ten. Furthermore, the company's relevance to the study was considered more important than the number of interviews conducted. Table 1 below gives an overview of the participating companies who all were promised anonymity and are therefore in this report called company A-J.

Code	Description	Title
Metal manufacturing		
A	Development and design of aluminium products for architecture.	Operations director
B	Cooperation working with cast iron	General director
C	Distribution of special steel qualities	CEO
D	Distribution and transformation of steelworks products	CEO
E	Distribution of steel products.	General director
Automotive		
F	Surface treatments and technical coatings	Operations director
G	Manufacturing of cooling systems	CEO
H	Manufacturing of flexible brakes	General director
I	Manufacturing of cold drawn tubes and tubular sections in carbon or low alloy steel.	CEO
J	Industrial process automation	CEO

Table 1. Participating companies and the title of interviewees

As stated above the interviewees were conducted with general directors, operations directors and CEOs in the participating companies. These were chosen due to their overarching knowledge about the three areas the interviews aimed to cover. The table 1 above also shows the title of the interviewee in each company.

3.4.3. Interviews

Primary qualitative data was gathered through semi-structured telephone interviews with interviewees from respective company due the nature of the study. When the primarily aim is to learn about a phenomenon otherwise hard to observe interviews is the most appropriate strategy (Easterby-Smith, Thorpe, & Jackson, 2015). One of the advantages of using a semi-structured interview is that the different interviews are similar at the same time as it gives a certain degree of flexibility to the interviewee in how to reply and to the interviewer to follow up on relevant topics that may arise during the interview (Bryman & Bell, 2015). To conduct interviews over telephone was chosen due to the geographical distance between the researcher and the participants.

The interview with the operations director of company A was conducted together with the trainee and the supervisor from BuS, and the interview with the general director of company B with the trainee from BuS since these were booked through BuS. The rest was conducted only by the researcher. The role of the trainee in the interviews has been to introduce BuS and what they do and she has had no further participation in the research. The role of the supervisor in the interview was as well to introduce BuS and he further asked some additional questions in the end of the interview. Furthermore, all interviews have been held in Spanish since the interviewees expressed that they were more comfortable with that.

The questionnaire was developed based on the aim of the study, the research questions and the insights gained from the literature study. Furthermore, the questionnaire was outlined by the three areas business model, process and product and future, without relative order which Trost (2010) argues is important in a qualitative interview. Each area in the questionnaire contained guiding open questions intended to be treated during the interview. The questionnaire was, before used, validated by the supervisors both from Chalmers and BuS. Moreover, one test interview was conducted with a company within the metal manufacturing industry whereupon the questionnaire was revised and once again validated by the supervisor from BuS. The interviewee for the test interview was selected by its relevance in relation to the study which enabled gaining insight in the industry at the same time as the researcher could test how the questions were perceived. The changes made in the questionnaire regarded some formulations to make the interviewee understand the question better without further explanation and also the elimination of mentioning digital transformation in the beginning of the interview to make the conversation more natural and less constrained for those companies who perceived themselves as not very digital.

All interviews begun with a short introduction of the study and why it was conducted. Furthermore, information was given to the interviewees that they will be anonymous and they were asked for permission to be recorded to enable transcription. They were also asked if they had any additional questions before starting. Thereafter the interview started with a question about the activities within the company and the role of the interviewee in the company in an attempt to make the interviewee feel comfortable. This was followed by questions about their business model concerning their offer to clients, their relationships with clients and suppliers

and the way of selling products. The second part of the interview regarded the value creating process in the company and the product and offer to the customers. Here questions about what digital solutions that are used and where in the company were asked. The last part of the interview concerned the future vision regarding digital transformation within the company and the challenges they see in relation to digital transformation. Furthermore, this part let the interviewee share how they perceive that their company would conduct business if digital solutions were used in all parts of the company.

The interviews were recorded to enable transcription and hence facilitate processing and analysis. The transcription of each interview was made within a few days after the interview was conducted. Thereafter a third person with no relation to the study went through the material to check the accuracy of the transcriptions due uncertainties regarding the language.

3.4.4. Secondary data

The literature study was, to a large extent, conducted before the gathering of empirical data but also partly during the process when new data arose. Secondary data has been collected mainly from scientific reports and books retrieved from the online library of Chalmers University of Technology, the online library of KTH (Royal Institute of Technology) and through searches in Google Scholar. Data has also been gathered through reports provided by BuS mainly from consulting agencies.

3.5. Data Analysis

All interviews were recorded and transcribed verbatim. Thereafter the transcriptions were read through by the researcher to create an understanding of the outcome from each interview. The transcriptions were then gone through in detail and similar information from the different interviews were grouped into categories which Easterby-Smith et al. (2015) claims is important when analysing qualitative data. Every piece of data was placed in an already existing category or became the first part of data for a category in a separate document containing all categories and quotes organised. Thereafter the data in the categories was further divided into unit findings (see table 2 in chapter 4) containing data from several interviewees. These unit findings were then summarised by the author by stating the meaning of it followed by quotations from the interviewee in a tell-show section in the empirical findings. This to enable finding patterns in the answers among the participants which is the base for the induction approach as argued before by (Woo et al., 2017) and (Bryman & Bell, 2015).

When all interviews had been gone through and all data were grouped into categories and unit findings the quotations were translated from Spanish to English. The categories were further divided into current state and digital transformation to separate the actual reality from the imagined reality in the future. The analysis aimed to understand the current state and future plans of the participating companies by comparing the data to the theoretical framework and later draw conclusions about how to best approach the concept of Industry 4.0. The analysis of

the current state was partly inspired by the PwC maturity model [6] and the matrix for digital transformation developed by Marchand & Wade (2014).

3.6. Limitations

A natural limitation of any kind of communication, and so also in interviews, is the risk of information not being perceived as wanted both from the point of view of the interviewer and the interviewee. Furthermore, the interviews have been conducted in the researcher's third language which might have resulted in a less flexibility than desired for a semi-structured interview. Also, the strived for building of trust might be affected both by not meeting face to face and also the restriction of the researcher not being completely fluent in the language used.

The study is based on interviews with companies from different parts of Spain and due to the time frame and costs this thereby restricted the study to conduct the interviews by phone. Hence, the location also limited the study since some areas in the interview, which were complex for the interviewee to explain by words, would have been preferable to both observe and talk about to get a better understanding. Furthermore, the number of interviews were limited due to time and that the study was conducted by one single researcher. The selections of interviews were desired to follow a more structured segmentation based on contribution to GDP in terms of size and location in Spain. However, due to difficulties to access the most relevant person for the study among many companies the selection was instead made based on the company's relevance for the study and from those who expressed an interest to participate and where a person relevant for the study was accessible. This is something Easterby-Smith et al. (2015) addresses by stating that the access and selection of participants can be one of the biggest challenges in research since the researcher in most cases is dependent on participants to volunteer large amounts of time that they could have used for something more valuable to them.

Since the participants are CEO's and directors the results only show the perspectives of managers in this matter which is important to be aware of. Based on the assumption that very few managers want to say something disadvantageous about their company the answers may be angled in a more positive way than the reality. Furthermore, there are several people involved in decisions about investments and future actions which needs to be considered when interpreting the results.

3.7. Research quality

Scholars have criticised the qualitative approach and argued that it is too subjective, difficult to replicate, hard to generalise and that there is a lack of transparency (Bryman & Bell, 2015). The criticism stems from the researcher's often subjective perception of what is important which further causes difficulties in replication of the study and knowing exactly what has been done to obtain the results (Bryman & Bell, 2015). Due to the aim of studying the current situation and the difficulties in 'freezing time', replicability can be hard to achieve if attempted with a

[6] Industry 4.0: Building the digital enterprise. 2016 Global Industry 4.0 Survey developed by PwC. (www.pwc.com/industry40).

significant gap in time from when this study was conducted. Regarding ethical aspects of the research anonymity was promised to all participants and the raw data has therefore been treated carefully and with high confidentiality.

This study is said to conduct research on where the Spanish metal manufacturing and automotive industry are today and how they can approach industry 4.0. Assessing the construct validity means validating if the study investigates what it is said to investigate (Kidder and Judd, 1986 (as cited in Stuart et al., 2002), Denzin & Lincoln, 1994 (as cited in Dubois & Gibbert, 2010). The participating companies has been selected due to their relevance and after interest in being a part of this study and it is necessary to take in consideration that these are not distributed geographically such that they can represent the Spanish industry in general. However, the sectors in which the companies are active are among the sectors contributing most added value and occupation in the Spanish industry (MINETUR, 2016)

In the empirical findings, a tell-show structured was used, which to some extent allows the reader to determine the accuracy of the stated findings. This also increases the transparency of the conclusions and hence if the results are true which is referred to as the internal validity (Easterby-Smith et al., 2015). It must however be considered that the original transcriptions were made in Spanish and thereafter translated to English for the empirical results.

As argued before the selection of participants cannot be considered to represent the general industry within the chosen sectors and cannot be generalised. Furthermore, the study is of qualitative character and does not aim to generalise. Hence, the argued low external validity (Dubois & Gibbert, 2010; Easterby-Smith et al., 2015) must be borne in mind when interpreting the results. However due to the impact of digitisation and digital transformation regarding the interplay between a company and their environment the results can be considered as an indicator about where this industry segment currently stands.

4. Empirical findings

This section presents the data gathered through the interviews with the CEO's, general directors or operations directors at the companies A, B, C, D, E, F, F, G, H, I and J. The findings are divided into the two main categories current state and digital transformation derived from the research questions and can be seen in table 2. The current state is subdivided into business model and processes and products and the digital transformation into Business model, processes and products and challenges.

Categories	*Findings*
Current state	
Business model	Service based offer Close relationships Sales through personal meetings
Processes and products	Wide range of usage of digital solutions Enterprise resource planning system (ERP) Somewhat automated manufacturing 3D printing No need for digital and/or automated solutions No technology in the product
Digital transformation	
Business model	Strive for more digital relationships
Processes and products	Digital transformation is beneficial 3D-printing, drones, RFID, sensors, chip and QR-codes ERP systems Automation, collaborative robotics and predictive maintenance Intelligent warehouses and smart factories
Challenges	Costly Keeping up with large enterprises with less resources Convince customers and suppliers Changes of job descriptions Selecting solutions Security Change management

Table 2. Categories and unit findings from the empirical data

4.1. Current state

The current state demonstrates how parts of the companies' business model are shaped at the moment and how the processes and products are related to digital technology.

4.1.1 Business model

The business model concerns how the interviewee describes their way of selling products to their customer, what relationship they have and the interviewees point of view on what their companies are offering their customers. The first finding was that the companies tend to have

a *service based offer* rather than a product based offer which is illustrated by the CEO of company E: “We offer security in the identification of the products. We offer that the product is delivered to your home after being drilled, cut and painted. We offer minimisation of the costs of provisioning”. Furthermore, offering flexibility, good quality and being able to adapt to the needs of the customers is factors emphasised as important: “We are more flexible, faster and we are competitive. We have a good quality, that is, we differentiate ourselves because we offer ‘tailored solutions’ for shorter series.” – CEO (G).

Many of the participating companies are working in *close relationships* with their customers and suppliers characterised by personal meetings and customised solutions: “The relationship with our clients is a partnership where we, in the majority of the cases, collaborate through very detailed requests. In other cases, we collaborate with them through first defining the problem” - General director (B).

The way of selling products concerns how and through which channels the company are selling and distributing their offer. The current most common way of selling products and services among the participants is through *personal meetings* where the products are sold as a direct response to a customer demand which is exemplified by the general director of company H: “The way we are selling is through a commercial network that we have. In the case of automotive the client come to our warehouse and look for products, i.e. ‘ex-works’”, and also by the CEO of company C: “When we receive an order or a customer need, if we have it in stock we give them a price and if they agree we send it. If we don’t have it we investigate where we can find it or set it up with a manufacturing plant to be able to deliver it to the customer”. In addition, some claim the use of e-commerce for a small percentage of their sales, but which has the main function of finding new customers: “Our sales are spot sales. E-commerce, we have a website to capture clients and where we have contact information. However, it is more focused on capturing clients. After that it is a more personal matter” - CEO (C), and being visible online: “At the moment, we are working to establish some kind of web, mostly to spread knowledge about who we are and social networks and all that” – CEO (I).

4.1.2 Processes and products

The processes and products demonstrates what digital and automated solutions that are currently used in the company in general and in the value creating process. There is a *wide range of answers regarding the current use of digital solutions*. Some highlight the use of computers, internet and email and others their use of technologies in the office which enables them to handle all documents digitally, cameras and software to simulate robots which is illustrated through comparing the statements of the CEO at company I and the CEO at company J: “We handle the traceability control through computers and the creation of physical labels to move material in the production. We also monitor the production through computers” – CEO (I). “A software to simulate robots and for about 12 years ago we obtained licenses of different software” – CEO (J). Several also highlight the use of, and in some cases newly implemented, *Enterprise Resource Planning (ERP) systems*: “At this moment, regarding digital information, we are exclusively using an ERP program for global management. Billings and manufacturing. And we are currently implementing CRM for client control” - Operations director (A).

Furthermore, when talking about manufacturing processes, some of the participating companies emphasises the current use of certain *automated solutions* in their value adding process: "The tools that we are using today are automatic" – Operations director (F): "These are drilled with a 'KUKA' robot" – CEO (D).

The CEO of company G and the general director of company H report that they use digital solutions in form of *3D printers* in their manufacturing: "Nowadays we are also using 3D printers". More common is the suggested low complexity in the value adding activities among the companies which evokes a perception that there is *no need for digital and/or automated solutions* in the company: "Our kind of processes are simple so place robots there wouldn't be of any use" – CEO (I). The general director of company B acknowledged the trouble of finding a digital solution suitable for the kind of processes in use without success: "We don't use any digital solutions. We have conducted a study to try to find digitised solution for quality etc. But for the kind of product that we have, this has not been successful".

In relation to the products a recurrent reaction is that the interest for incorporating *technology into the product* is low: "I do not see anything with a direct character, for the digitisation or for the company" - Operations director (A). They neither see the benefits of doing so: "We have a very industrial product and I don't really see the benefits" – CEO (I).

4.2. Digital transformation

This part concerns the future of the companies in relation to digital solution and hence the digital transformation. This specific section is outlined by the managers' visions about the future of their company in terms of business model, products and processes and the challenges they are and believe they will be facing along the way.

4.2.1. Business model

There is a certain *strive to develop more digital relationships* with the suppliers to obtain more data to increase the attention to the customers: "We would like to have a digital relationship with the majority of our suppliers and use this information for our clients" – General director (E). This strive for more digital relationships is also seen regarding customers and then mainly improve and increase the sales through e-commerce: "We want to develop E-commerce, but at the moment we are not"– CEO (D).

4.2.2. Processes and products

Even though some, as seen before, do not see the benefits of automation and digital solutions in their companies several still underlines that a *digital transformation would be beneficial* for their manufacturing processes: "Digitalisation is the urbanisation of production. In the production control, in the quality control, in the product design and the robotization. They way of manufacturing would be much more efficient" – CEO (G). Not only the manufacturing would benefit but also other processes in the company where digital transformation contributes to

more data possibly resulting in better decision making: “We would be able to calculate the consumption of the client more efficiently, take much more efficient decisions such as have more correct stocks, more correct delivery dates and more correct terms of service” – General director (E).

A digital transformation would mean implementing new technologies and digital solutions into the manufacturing processes and in the products. The interviewees answered questions about what digital solutions they could imagine would be beneficial to incorporate in their products and how their processes would look like if it was all digital. One company have a vision about *3D printing, drones and RFID tags*: “There are very interesting things such as artificial vision and 3D printing. We are also working with an idea about a drone with a labelling system that can fly and capture and read the RFID tags” – CEO (D). Another one emphasises an interest in *QR codes and sensors* to capture and transfer information automatically in the system and trigger actions: “Furthermore, with the use of QR codes the client could send the orders directly to our SAP. We could also set up warehouses at the site of the client that could send orders automatically through QR codes, or sensors that send an order when the weight of a shelf goes below a certain value” – General director (E). Company G express that it is hard to imagine a *chip* in their product and also the benefits of it except that the logistics would be simpler: “I don’t see the benefits of that yet. But well, I don’t see that there would be a chip in the cooler but it could, and then the logistics would be much simpler” – CEO (G)

When talking about what could be handled differently in their processes considering digitisation and automation some emphasise *that automated solutions* and robotics would be beneficial for their processes: “Yes, we have a series of processes that require a lot of effort from our operators in which we could use robotic equipment. We would gain a lot of agility” – General director (B). Also, *collaborative robotics and predictive maintenance* is brought up as something that could be implemented within a short future to improve the processes: “In short term, it is collaborative robots, predictive maintenance and keep digitising everything that we today have in paper form” – General director (H). These solutions are also the ones some companies are planning on investing in in the near future: “We want to automate all inventory processes that take a lot of time” – CEO (D). More common however, are planned investments and improvement of the *Enterprise Resource Planning system*: “To have more machines that are automatic with better process systems, and the maintenance of the ERP and all that” – CEO (C). To summarise, the CEO of company J claims that Spain still has a lot to do regarding automation and digitisation in the industry: “There are many manufacturing plants in Spain that needs to digitise. Collaborative robots, 3D printing, information systems in the cloud etc. There is a lot to do” CEO (J).

Intelligent warehouse is a concept that the CEO of company C express an interest in for the future: “Intelligent warehouses would be an important improvement”. Moreover, *smart factories* where raw material enters in one end and comes out as a finished product in the other without any interference of humans and where the machines are digitally connected and communication is something that the CEO of company D imagines in the future: “Today we have a concept where every machine has an operator and what we could do is to substitute this

to a system that controls all of the machines together and, when you leave a product in the beginning, the systems makes sure that this product goes through the whole process, that is that it is run by a software controlling all movements in the manufacturing. Everything is programmed, automated and digitised. This is where we want to go and for what we are preparing" – CEO (D).

4.2.3. Challenges

Even though digitisation and automation potentially can bring benefits for the companies there are several challenges to face when going through a digital transformation. This section shows the challenges related to digital transformation the managers perceive they are facing in the future. A common challenge is that automation is *costly* and therefore hard to achieve: "Look, automation would be interesting, but that is a very important investment for our activity. Because of that there are very few in our sector that have automated means. The truth is that I don't know how to automate it" – CEO (C). The same applies to digital transformation in general: "Digitisation, digitalisation and robotization require large investments, and these are paid off for large series but for short series as we do, it is hard to make it pay off" – CEO (G). One of the participants further expresses the challenge to *keep up with large enterprises with less resources*: "The challenge is to manage with few resources, to do the same as the big multinational companies" – General director (E).

Convincing customers and suppliers to do a digital transformation in order to create more digital relationships and enable information sharing is another prominent challenge: "To convince the suppliers and customers. It is also about culture, we cannot sell products anymore we have to sell relationships" – General director (E). Furthermore, the SMEs' customers face the same challenge regarding costly investments which further complicates the process of convincing them: "The customers are usually small medium-sized enterprises who have no means to have a greater common digital development, they do not have B2B platforms. We don't either have much margin to digitise many areas" – Operations director (A). In addition, the general director of company E states that the buying habits in Spain are still relatively basic resulting in difficulties to benefit from digitally transforming relationships: "The sales through the web is about 0,5-1% and we are trying to make our relationship with our clients more digital but it is hard since the customers and the habits of buying in Cataluña and Spain are still relatively primary".

A digital transformation brings a challenge of *changing of job descriptions* within the company for the employees: "We are five at the moment and we might be 10 in some future. But it is a challenge in terms of reducing the repetitive jobs and replacing them with jobs regarding systems instead" – General director (E).

In relation to automated solutions, company B illustrates the challenge of *selecting the right solution* to invest in: "That is, you need to find out what equipment, what software and what digital tools you must apply to your business and at the moment, there are many" – CEO (D). Furthermore, to decide which solution that results in the best outcome: "We are in a project of

digitisation where we have a manual production line that we want to make as automatic as possible. We are working with two companies to give us offers in line with new technology but we are in some way waiting to see what technologies would give the best outcome" – General director (B). Before taking a decision, it is also of important to have knowledge about possible benefits and capacity which is illustrated as a challenge by the general director of company B: "At the moment, I believe, for me the most important thing is the knowledge of the development, that is what I don't know about the capacity of the technology in terms of qualitative means". There is also an expressed concern over the *security* when data becomes digital: *"The external part, the problem of 'pirates'" – General director (H).*

Even though there is a wide range of challenges regarding the technology a common challenge seen among the companies is the challenge of *change management* and motivating the employees: "The biggest challenge is the staff, to make them adapt. Young people does not have that problem because they know how to manage the smartphone for example but there are others for whom it will be more difficult" – General director (H). Another aspect of change management is the leadership where there are examples of a somewhat unclear view on who will lead the digital transformation: *"*Actually, we have not developed the area of digitisation yet. There are mangers above the property of the company and we are in the organisational chart, I am the operations director, there is a finance director and commercial director" - Operations director (A). On the contrary, many already have this in place and a clear view on how to proceed: "Well, my role is to boost the digitisation and digitalisation and we are working hard at the moment to invest both in software and teams finding electronic systems to capture data" – CEO (D).

5. Discussion

This section will discuss the outcome of the empirical findings in the light of the theoretical framework with the aim of understanding where the Spanish industry in metal manufacturing and automotive sector is today in their path towards industry 4.0.

5.1. Current state

This section will analyse where in the process of digital transformation the participating companies currently are. First the business model will be treated and second the processes and the products. These are also a part of the business model but due to their significance to industry 4.0 they will be treated separately.

From the results, it has been seen that a common way of seeing the offer is that it is of service character which according to Larsson (2016) and Teece (2010) helps capture the revenues of digital solutions and hence is essential for reaping the benefits of a digital transformation. This also concerns the internet of services which is one of the pillars in the concept of Industry 4.0 (Hermann et al., 2015). However, the internet of services concerns selling the service via digital means which is not something seen in the results. Hence, it can be argued that the participants have a mindset of selling services but are not yet at the state of internet of services. Furthermore, the result shows that the relationships with customers and suppliers usually are close, yet the processes within the companies are separated from each other. In relation to the PwC maturity model in Schrauf et al. (2016) this would indicate that these companies are in the beginning of their digital transformation. Furthermore, this indicates an absence of horizontal integration. However, Marchand & Wade (2014) states that strong and close relationships are advantageous in a process of digital transformation. Even though they might be in the beginning of their digital transformation close relationships with customers and suppliers might be essential when it comes to creating a more digital relationship aimed towards horizontal integration which is one of the building blocks of Industry 4.0 according to Gilchrist (2016) and Stock & Seliger (2016).

In addition, many of the participants states that their companies are currently using physical sales to a large extent and have a small percentage of sales through e-commerce. These characteristics goes in line with the description of the first quadrant in the matrix developed by Marchand & Wade (2014). Marchand & Wade (2014) further claim that companies in the first quadrant of their model have created intranets and websites mostly to connect with customers which can be seen from the results where some participants claim that their companies are mostly using the web to find new clients and be visible. Hence, it can be argued that the distributions channels, currently used to a large extent by the companies, does not drive or enhance the digital transformation within the company.

The results show that the current use of digital solutions vary among the participants. As seen some state that they use computers, internet and email while others emphasise technology

enabling them to handle documents digitally. This indicates, with base in the PwC maturity model in Schrauf et al. (2016), that these companies are in an early stage of their digital transformation. Marchand & Wade (2014) argues that companies in an early stage of a digital transformation, located in the first quadrant are as well characterised by having invested heavily during the last years in ERP systems which is something many of the participating companies emphasise as their current use of digital solutions. This is reinforced by the results revealing that several interviewees states that their companies are planning further investments in the ERP systems and some consider this to be one of the most important things to consider for the future. What is more there is a tendency among the companies in the first quadrant of not experiencing any benefits of digital transformation (Marchand & Wade, 2014), something that is prominent among the interviewees that perceive their manufacturing processes as simple and not in need of digital or automated solutions. This could possibly be an effect of non-existing network externalities where the companies do not see the leverage of adopting such technologies.

That the participating companies are in an early phase of their digital transformation is further reinforced by the fact that companies in the first quadrant, hence doing the basics, of the matrix by Marchand & Wade (2014) are using technologies to a limited extent. Uhl & Alexander (2014) emphasises the IT as an important capability to succeed with a digital transformation and with base in the results it can be argued that the companies with a limited use of technology are not yet prepared to digitally transform. On the contrary, there are a few participants emphasising the current use of cameras and software to simulate robots which indicates a slight step towards technologies that according to Gilchrist (2016) constitutes industry 4.0.

From the literature, it has been argued by Stock & Seliger (2016), Gilchrist (2016) and Schrauf et al. (2016) that industry 4.0 is a paradigm described from the three dimensions' horizontal integration through the entire value creation network, end-to-end engineering across the entire product life cycle and vertical integration and networked manufacturing systems. From the results, it is seen that none of the participating companies currently engage completely in activities defined for horizontal integration which according to Gilchrist (2016) and Stock & Seliger (2016) concerns the digital transformation in the value creating processes and relationships between partners and customers. As for the end-to-end engineering outlined by the digital transformation in all parts of the product life cycle (Gilchrist, 2016; Stock & Seliger, 2016) the results show that the participants' product life cycles are partly digitised in terms of the use of technologies in the office and in the manufacturing, but not yet completely. The vertical integration concerns according to Stock & Seliger (2016) and Gilchrist (2016) the intelligent manufacturing systems. Once again it is hard to find evidence in the results demonstrating the current use of technologies enabling the manufacturing plants to communicate and react to different variables. Instead the companies claim the use of automated solutions in parts of their manufacturing processes. This indicates that companies are currently at a level in their digital transformation more in line with industry 3.0 outlined by the automation of processes rather than being ready for industry 4.0. In addition, some companies express that their future investments will regard automation and that one of the most relevant areas to consider in the near future is to increase the level of automation in the factory which further strengthens the analysis about the position in industry 3.0 rather than industry 4.0.

None of the participants use all technologies nor reap the promised benefits of industry 4.0 since this would require business models, processes and product to be digitised and connected. The literature describes industry 4.0 as equal to IIoT which is composed by the components internet of things, cyber physical systems the smart factory and Internet of services (Hermann et al., 2015) which all require a connectivity and digitisation among the companies that is not yet existing. Only two interviewees express that their companies use 3D printing which is one of the technologies increasing the responsiveness and facilitates customisation which is a characteristic of increased digitisation (Schrauf et al., 2016).

The results show that none of the companies which have a physical product have incorporated any technology into the product. As seen in the literature, Internet of Things is one of the core concepts of IIoT and Whitmore et al. (2014) argues that IoT is products with embedded technologies allowing them to connect and communicate with each other. Hence, it can be argued that the participating companies have not adopted the concept of IoT into their portfolio. What is interesting is that very few of the interviewees brought up any kind of interest if incorporating technology into their product and stated that they do not see any benefits doing so. Perhaps this is due to previous lack of benefits from digital transformation as argued by Marchand & Wade (2014) and that they do not have the technologies and the knowledge to obtain the benefits from incorporating technology in the product. One of the companies who claim that they don't see the benefits also stated that they are not very digital in general which could be a possible explanation.

5.2 Digital transformation

In the findings it is to be seen that several participants express a desire to further digitise their relationship and their sales which facilitate the transition to a more horizontal integration (Gilchrist, 2016). Hence the companies are partially transforming their business models. However Chesbrough (2010) argues in the literature that a continuous experimentation of the business model is of importance when undergoing a digital transformation. Furthermore, achieving horizontal integration is desirable for SME's since a collaborating increases the resources and hence the ability to compete with large enterprises.

The results demonstrate that some of the participants have planned investments in digital solutions such as robotics, collaborative robotics for their manufacturing. In addition, the results show a certain interest for future use of 3D printing and drones for the manufacturing and sensors, QR-codes, RFID tags and chips, to incorporate in the product which would create conditions for IIoT (Purdy & Davarzani, 2015). However, as argued for in the literature by Chesbrough (2010) and Teece (2010) technology has no value in itself but needs to be commercialised through an appropriate business model. Hence, in order to yield benefit from a digital transformation and the planned investments the business model needs to be adapted (Björkdahl, 2009; Chesbrough, 2010; Teece, 2010). As stated by McGrath (2010) in the literature the business model somewhat outlines the boundaries and constraints for the company which further stresses the importance of adapting the business model.

Thus, it can be argued that adapting the business model is vital for experiencing benefits from digital transformation. Chesbrough (2010) argues in the literature that change management and hence leadership plays a crucial role for success. The interviews have shown that the clarity about who will lead the digital transformation varies among the companies. Chesbrough (2010) further claim that in most cases the CEO is the most suitable leader due to the overarching responsibility. Perhaps there exists a lack of clarity regarding who and how to approach a digital transformation due to, what has been detected in the results, that companies have not seen any benefits or have no demand from their customers of adopting such solutions. Although it can be seen in the results that several interviewees emphasise that they value to be able to offer flexibility, good quality and the capability of adapting the solutions to the individual customer's needs. These capabilities are argued in the literature by Marchand & Wade (2014) to be enhanced due to a digital transformation. When the numbers of companies going through a digital transformation increases it can then be argued that this perhaps could result in negative network externalities, described in theory by Lin & Bhattacherjee (2008), where the capabilities that today are considered as differentiators among companies become features all companies have. What is more, the capabilities of flexibility and adapting to the customer need and the fluctuating market is one of the capabilities Uhl & Alexander (2014) claims needs to have a certain maturity level for a digital transformation to be successful.

However, the results further show that there exists a certain optimism regarding the adoption of digital solutions. Several participants express that they believe that their manufacturing processes would benefit from a digital transformation. Some of the interviewees more specifically express that they believe that collaborative robots and more automated solutions would be beneficial for their processes. In addition, the results show an interest in the benefits that intelligent warehouses and intelligent manufacturing would bring. This show that the leaders within these companies have a vision about the digital transformation which goes in line with what Capgemini stresses (as cited in Gilchrist, 2016) that digital transformation projects need to be driven from the top. Marchand & Wade (2014) argues that companies where management consider digital transformation important should be placed in the second quadrant of their matrix. They also state that companies in quadrant two are not yet considering IoT. Thus, there is a gap between the theory and reality since the companies on one hand are considered to be in the beginning of their digital transformation but has a stronger vision about IoT and future technologies than what is supposed for companies in this stage. Perhaps this is due to efforts by several initiatives in Spain which inform companies about industry 4.0 and the possible benefits it would bring even though the companies themselves are not there yet.

A challenge expressed by several interviewees is to manage the cultural change within the company and motivate the employees to adapt to new technology. Furthermore, the challenge of a change in job description especially for smaller companies is highlighted. Chesbrough (2010) and Hayashi (2009) underlines this difficulty and stresses the importance for the organisation to adopt an attitude encouraging change and experimentation. What is more, some interviewees claim that digital transformation and automation is costly and also underline the challenges of keeping up with the large companies with less resources in this aspect. This

mindset however presumably stems from the thought that automated and digital solutions must be bought. Perhaps this is due to a business model constraining the mind to think of other solutions of doing business as argued for by McGrath (2010). There might be options for companies with less resources to collaborate with companies leasing solutions needed instead of engaging in large investments.

Another challenge brought to light from the results is that of finding the solutions suitable for the company both regarding new technology and how to transform digitally something that Gilchrist (2016) and Uhl & Alexander (2014) stresses the importance of. Furthermore, the results also highlighted the challenge of influencing customers and suppliers to also digitally transform in order to reap the full benefits of their own transformation. In addition, the result also states that one company perceive the buying habits in Spain in general as basic and non-digital. Convincing customers and suppliers to digitise can bring what Katz & Shapiro (1985) call direct network externalities which means that the benefits and utility of the digital transformation increases with the number of users. Hence, when customers and suppliers digitise and these systems are compatible with each other the companies can obtain data which has previously been unavailable due to manually handled processes. The capturing and analysis of this new data could possibly result in the benefits argued by Marchand & Wade (2014) of smarter sales interactions, continuous improvement, acting across organisation boundaries and a better decision making due to access of real time data.

6. Conclusion

The aim of this paper has been clarifying where the Spanish metal manufacturing industry and automotive industry are today in their digital transformation specifically in relation to Industry 4.0. Furthermore, the purpose was to suggest actions necessary to conduct by Spanish companies to fully obtain the benefits forecasted from the digital transformation towards industry 4.0.

The empirical findings reveal that many of the participants today emphasises the use of ERP systems and that this is what they are currently investing in, improving and implementing. It also shows that many participants have close relationships with their customers and suppliers but there is an absence of connectivity in the value chain. Furthermore, the extent to which companies use e-commerce is limited and in those cases when it is used it represents only a small percentage of the sales of the company. However, there is a strive for obtaining more digital relationships with customers and suppliers, something that is also considered to be difficult due to an absence of digital means in the offices of the customers and suppliers and due to basic buying habits in general in Spain.

It has also been seen that many interviewees perceive that their processes are not complex enough for them to invest in digital and automated solutions. This reasoning is also applied for the product where many participants claim to see no benefits of incorporating technology in the products. Furthermore, the empirical findings show that companies think that a digital transformation and automated solution are costly and therefore hard to achieve together with the challenge of investing in the best solution for the specific company.

When looking at the future, many participants look for improving and keep implementing ERP systems and further automate the manufacturing and investing in robotics. They mean that the challenges they must manage is to motivate employees and handle the change management within the company as well as handling the security when more data becomes digital and hence, needs to be protected from unauthorised actors.

From the analysis, it can be seen that many of the interviewed companies are in an early stage in their digital transformation. As argued for in the analysis, even though some companies have knowledge and visions more in line with a higher level of digital transformation, it can be concluded that the findings indicate that many of the participants is in the first quadrant of the matrix developed by (Marchand & Wade, 2014). The conclusion that the companies are in the beginning of their digital transformation is enhanced when analysing the data considering the PwC maturity model which indicates the same.

The business model can in some respects seen as relatively developed and ready for industry 4.0 and in some aspects less prepared. This means that the companies need to continuously adapt the business model after the digital transformation and instead of letting the business

model constrain the mindset of what is possible, adapt the business model to what is possible when undertaking the transformation.

In relation to Industry 4.0 it can be concluded that only a few companies currently use some technologies considered to be the base for this paradigm but that none of the companies yet have horizontally and vertical integrated systems as well as end-to-end manufacturing. Instead the majority is currently automating the manufacturing or not at all seeing any benefits by doing so. Hence, it can be concluded that these companies are currently in industry 3.0 rather than industry 4.0.

To implement the technology for industry 3.0 is essential to advance towards industry 4.0 since this technology enables the company to create the connectivity characterising industry 4.0. However, even though this technology is important it is more important for the companies to have a clear vision and leadership to manage the changes within the company. When taking decisions about investing in a technology it is of great importance that there is knowledge about how to use the technology and what the aim with the investment is to enable the investment to pay off in as short time as possible. Furthermore, since many companies expresses that these investments are costly and therefore hard to go through with, a suggestion is to consider working with start-ups providing specific solutions needed and considering leasing agreements to avoid locking the company into large investments, yet use the technology available in the market.

Moreover, for the companies to reap the benefits of a digital transformation it is also of importance that the companies in the value chain also digitally transform to enable an exchange of data and a more horizontal integration. The companies already have close relationships with customers and suppliers which can be used to their advantage and together make joint efforts towards creating more digital enterprises. They further need to adopt solutions securing the new amount of data in digital form.

What is important to bear in mind is that there is no general solution but every company needs to find their way in the journey. For some companies, incremental changes might be the best and some might need revolutionary changes. Hopefully this report can contribute to some insight in the digital transformation in the Spanish metal manufacturing and automotive industry and also contribute to some ideas of how to approach the need for digital transformation and overcome the perceived obstacles.

For the future, it would be of interest to include a larger number of small and medium sized enterprises as well as large ones to see if there is a difference in current use, future investments and what challenges they see ahead. It could also be of interest to do further research on the change management as case studies on certain companies and hence, interview employees and their view of digital transformation within the company to analyse how to deal with change management.

Another aspect of interest would be how laws and regulations affect the digital transformation within the Spanish industry. Hence, to investigate if there are regulations constraining the development and/or adoption of new technologies in the market.

References

Albert, M. (2015). Seven Things to Know about the Internet of Things and Industry 4.0. *Modern Machine Shop*, *88*(4), 74–81. Retrieved from http://www.redi-bw.de/db/ebsco.php/search.ebscohost.com/login.aspx?direct=true&db=buh&AN=109184251&site=ehost-live%5Cnhttp://content.ebscohost.com/ContentServer.asp?T=P&P=AN&K=109184251&S=R&D=buh&EbscoContent=dGJyMNHr7ESepq84zOX0OLCmr02ep7FSsa24TLCWxWXS&C

AMETIC. (2017). Transformación Digital. Visión y Propuesta de AMETIC, 23. Retrieved from http://ametic.es/es/publicaciones/transformación-digital-visión-y-propuesta-de-ametic-0

Amit, R., & Zott, C. (2001). Value Creation in E-Business. *Strategic Management Journal*, *22*(6), 493–520. https://doi.org/10.1002/smj.187

Biecheler, P., Leutiger, P., Colin, J., Saint-Aubyn, J., & Figar, P. (2016). *España 4.0: El reto de la transformación digital de la economía*. Madrid.

Björkdahl, J. (2009). Technology cross-fertilization and the business model: The case of integrating ICTs in mechanical engineering products. *Research Policy*, *38*(9), 1468–1477. https://doi.org/10.1016/j.respol.2009.07.006

Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M. (2014). How virtualization, decentralization and network building change the manufacturing landscape: An industry 4.0 perspective. *International Journal of*, *8*(1), 37–44. https://doi.org/scholar.waset.org/1999.8/9997144

Brettel, M., Strese, S., & Flatten, T. C. (2012). Improving the performance of business models with relationship marketing efforts - An entrepreneurial perspective. *European Management Journal*, *30*(2), 85–98. https://doi.org/10.1016/j.emj.2011.11.003

Bryman, A., & Bell, E. (2015). *Business research methods* (4th ed.). Oxford Univ. Press.

Buxmann, P., Hess, T., & Ruggaber, R. (2009). Internet of Services. *Business & Information Systems Engineering*, *1*(5), 341–342. https://doi.org/10.1007/s12599-009-0066-z

Chesbrough, H. (2010). Business model innovation: Opportunities and barriers. *Long Range Planning*, *43*(2–3), 354–363. https://doi.org/10.1016/j.lrp.2009.07.010

Daugherty, P., Banerjee, P., Negm, W., & Alter, A. E. (2015). Driving Unconventional Growth through the Industrial Internet of Things. *Accenture*. Retrieved from https://www.accenture.com/us-en/labs-insight-industrial-internet-of-things

Dubois, A., & Gibbert, M. (2010). From complexity to transparency: managing the interplay between theory, method and empirical phenomena in IMM case studies. *Industrial Marketing Management*, *39*(1), 129–136. https://doi.org/10.1016/j.indmarman.2009.08.003

Easterby-Smith, M., Thorpe, R., & Jackson, P. . (2015). *Management and Business Research* (5th ed.). Sage.

Fardost, A. (2017). TengbomTalks i Linköping: Digitisering vs. Digitalisering. Retrieved May 16, 2017, from https://tengbom.se/event/linkoping-dataton/

Geissbauer, R., Vedso, J., & Schrauf, S. (2016). *Industry 4.0: Building the digital enterprise*. *2016 Global Industry 4.0 Survey*. https://doi.org/10.1080/01969722.2015.1007734

Gilchrist, A. (2016). *Industry 4.0: The Industrial Internet of Things*. Nonthaburi: Apress. https://doi.org/10.1007/978-1-4842-2047-4

Glover, B., & Bhatt, H. (2006). *RFID essentials* (1st ed.). O'Reilly.

Hayashi, A. M. (2009). Do You Have a “Plan B”? *MIT Sloan Management Review*, *51*(1), 10–11. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=44574554&site=ehost-live

Hermann, M., Pentek, T., & Otto, B. (2015). *Design Principles for Industrie 4.0 Scenarios: A Literature Review*.

i-scoop. (n.d.). Digitization, digitalization and digital transformation: the differences. Retrieved May 16, 2017, from https://www.i-scoop.eu/digitization-digitalization-digital-transformation-disruption/

Katz, B. M. L., & Shapiro, C. (1985). Network Externalities, Competition and Compatibility. *The American Economic Review*, *75*(3), 424–440.

Khan, S. (2016). *Leadership in the digital age – A study on the effects of digitalisation on top management leadership*. *Stockholm University*. Stockholm Business school.

Larsson, Ö. (2016). *Industriell digitalisering - En avgörande faktor för Sveriges framtida konkurrenskraft och en svensk tillväxtbransch med stora internationella möjligheter*. *Strategiska Innovationsprogrammet PiiA*.

Lin, C.-P., & Bhattacherjee, A. (2008). Elucidating Individual Intention to Use Interactive Information Technologies: The Role of Network Externalities. *International Journal of Electronic Commerce*, *13*(1), 85–108. https://doi.org/10.2753/JEC1086-4415130103

Marchand, D. A., & Wade, M. (2014). Digital Business Transformation: Where is your company on the journey. *Perspectives for Managers*, (187).

Matt, C., Hess, T., & Benlian, A. (2015). Digital Transformation Strategies. *Business and Information Systems Engineering*, *57*(5), 339–343. https://doi.org/10.1007/s12599-015-0401-5

McGrath, R. G. (2010). Business models: A discovery driven approach. *Long Range Planning*, *43*(2–3), 247–261. https://doi.org/10.1016/j.lrp.2009.07.005

MINETUR. (2016). *La Transformación digital de la Industria Española: Informe Preliminar*. Madrid. Retrieved from www.industriaconectada40.gob.es INDUSTRIA

Oxford Dictionaries. (2017). English Oxford Living Dictionaries. Retrieved May 16, 2017, from https://en.oxforddictionaries.com/definition/sensor

Purdy, M., & Davarzani, L. (2015). The Growth Game-Changer: How the Industrial Internet of Things can drive progress and prosperity. *Accenture*, 24. Retrieved from https://www.accenture.com/t20150523T033052__w__/us-en/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub_7/Accenture-Industrial-Internet-Things-Growth-Game-Changer.pdf

Schrauf, S., Vedsö, J., & Geissbauer, R. (2016). A Strategist’s Guide to Industry 4.0. *Operations & Manufacturing*, (83), 1–15. Retrieved from http://www.strategy-business.com/article/A-Strategists-Guide-to-Industry-4.0?gko=7c4cf

Schuchmann, D., & Seufert, S. (2015). Corporate Learning in Times of Digital Transformation: A Conceptual Framework and Service Portfolio for the Learning Function in Banking Organisations. *International Journal of Advanced Corporate Learning*, *8*(1), 31–39. https://doi.org/10.1057/rpm.2013.27.Assuntos

Shah, S. K., & Corley, K. G. (2006). Building Better Theory by Bridging the Quantitative – Qualitative Divide. *Journal of Management Studies*, *Volume 43*(8), 1821–1835. https://doi.org/10.1111/j.1467-6486.2006.00662.x

Shelton, R., & Percival, D. (2013). Breakthrough innovation and growth. *PwC Innovation Survey*, 1–42. Retrieved from

http://www.pwc.com/gx/en/innovationsurvey/index.jhtml?WT.mc_id=link_9-13_Innovation-Suvery-Social
Sorescu, A., Frambach, R. T., Singh, J., Rangaswamy, A., & Bridges, C. (2011). Innovations in retail business models. *Journal of Retailing*, *87*(SUPPL. 1), S3–S16. https://doi.org/10.1016/j.jretai.2011.04.005
Stock, T., & Seliger, G. (2016). Opportunities of Sustainable Manufacturing in Industry 4.0. *Procedia CIRP*, *40*(Icc), 536–541. https://doi.org/10.1016/j.procir.2016.01.129
Stuart, I., McCutcheon, D., Handfield, R., McLachlin, & Samson, D. (2002). Effective case research in operations management: a process perspective. *Journal of Operations Management*, *20*(5), 419–433.
Stävmo, F., & Skoglund, P. (2016). *Industry 4.0 – Only designed to fit the German automotive industry?* Jönköping Univeristy, International Business School.
Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning*, *43*(2–3), 172–194. https://doi.org/10.1016/j.lrp.2009.07.003
Trost, J. (2010). *Kvalitativa intervjuer* (4th ed.). Lund: Studentlitteratur AB.
Uhl, A., & Alexander, L. (2014). *Digital enterprise transformation: a business-driven approach to leveraging Innovative IT*. Gower Publishing Company.
Wade, M. (2015). Digital Business Transformation. *IMD and Cisco, Working Paper*, (June), 1–16.
Wang, S., Wan, J., Li, D., & Zhang, C. (2016). Implementing Smart Factory of Industrie 4.0: An Outlook. *International Journal of Distributed Sensor Networks*, *12*(1). https://doi.org/10.1155/2016/3159805
Whitmore, A., Agarwal, A., & Da Xu, L. (2014). The Internet of Things—A survey of topics and trends. *Information Systems Frontiers*, *17*(2), 261–274. https://doi.org/10.1007/s10796-014-9489-2
Woo, S. E., O'Boyle, E. H., & Spector, P. E. (2017). Best practices in developing, conducting, and evaluating inductive research. *Human Resource Management Review*, *27*(2), 255–264. https://doi.org/10.1016/j.hrmr.2016.08.004
World Economic Forum. (2015). *Industrial Internet of Things:Unleashing the Potential of Connected Products and Services*. Geneva.
Wortmann, F., & Flüchter, K. (2015). Internet of Things: Technology and Value Added. *Business and Information Systems Engineering*, *57*(3), 221–224. https://doi.org/10.1007/s12599-015-0383-3
Zott, C., & Amit, R. (2010). Business model design: An activity system perspective. *Long Range Planning*, *43*(2–3), 216–226. https://doi.org/10.1016/j.lrp.2009.07.004

APPENDIX A: Questionnaire in English

- Can you start by telling me about your company and your role?

- Your role in relation to digitisation?

- How are you differentiated from your competitors?
    - What is it that you are you offering your customers? /Can you tell me about your product and your offering to your customers?
    - Can you describe the company's relationship with its customers?
    - What type of customers are your main ones?
    - In what way, does your company sells its products?
        - Physical stores? E-commerce?
    - What is the main source of income for your company? What way of selling your product/offering do you use?

- Can you describe the manufacturing process your product/service/offering goes through from the beginning to a complete offer used by the customer?

- Does your company use digital solutions today? In that case where in the business and what?
- If your company was fully digitised, how do you think your process would look like?

- What areas would you say could be handled differently (in comparison with how it is handled today) due to digitalisation(digitisation?) and automation?

- What areas/technologies/digital solutions is your company planning on investing in in the future regarding? – five years? Ten years?
    - Do you see any challenges with these investments? In that case, what?
    - Which areas would you consider to be the most relevant to address?

- If we look at the more technical aspects of your product/offering, what digital solutions do you think could be beneficial to incorporate in your product that you are not using today?

- Do you see any challenges regarding your product due to digitalisation/digitisation? What kind of challenges?

- What challenges do you see in the future for your company specifically in relation to the digital transformation?
    - Internally?
    - Externally?

APPENDIX B: Questionnaire in Spanish

- ¿Puede contarme sobre lo que hace su empresa y también sobre su rol en la empresa?

- ¿Cuál es su rol en relación de la digitalización?

- ¿En qué manera está su empresa diferenciado a sus competidores?
    - ¿Puede contarme qué es lo que la empresa ofrece a sus clientes?
    - ¿Puede describir la relación con sus clientes?
    - ¿De qué tipo son los clientes principales?
        - ¿Mercado de masas?
    - ¿De qué manera vende la empresa los productos/servicios?
        - ¿Venta física? ¿Comercio electrónico?
    - ¿Qué formato de venta usa la empresa?
        - (¿Cuál es la principal fuente de ingresos en la empresa?)
        - ¿Suscripciones? ¿Ventas? Etc...

- ¿Puede describir el proceso de manufactura?

- ¿Utiliza su empresa soluciones digitales en este momento? En ese caso, ¿En cuáles áreas del negocio y qué soluciones?

- ¿Si su empresa fuese totalmente digitalizada, cómo cree usted que el proceso de manufactura sería?

- ¿Qué áreas en el proceso diría que podría manejarse de manera diferente (en comparación con cómo se maneja hoy) debido a la digitalización y la automatización?

- ¿Si consideramos un aspecto más técnico del producto o la oferta, que tipo de soluciones digitales que no usan hoy en día, cree usted que traería un beneficio para incorporar en su producto?

- ¿Ve algún desafío sobre el producto en relación de digitalización? En ese caso, ¿qué?

- ¿En qué áreas / tecnologías / soluciones digitales planifica invertir su empresa en el futuro? - ¿cinco años? ¿Diez años?

- ¿Ve algún desafío con estas inversiones? En ese caso, ¿Cuáles?

- ¿Qué áreas consideraría que son las más relevantes para abordar?

- ¿Qué retos ve usted en el futuro para su empresa específicamente en relación con la transformación digital?
    - ¿Internamente?
    - ¿Externamente?