

DRIVERS OF DIGITAL TRANSFORMATION IN PRODUCT DEVELOPMENT, BUSINESS MODELING AND HUMAN RESOURCES MANAGEMENT

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Abstract: *Digital transformation profoundly affects the business world, with both positive and negative outcomes. The purpose of this paper is to analyze how three business areas have been affected by the digital transformation. Therefore, we analyze the digital transformation of product development, the human resources management process, and business models. The analysis provides information and knowledge to researchers who address technological development in their work. A literature review on the evolution of the three fields has been performed. The comparative analysis reveals the existence of three main drivers concerning DT adoption in the three fields: improving communication, costs reduction, and increasing efficiency. The findings are relevant both for the three domains analyzed and for future research on the development of digitalization in general.*

Keywords: *Digital transformation, business model, product development, business process, human resource management*

JEL Classification: *M10; M15; O32*

Introduction

Companies worldwide are increasingly prioritizing the subject of digital transformation (DT). This reality underscores the critical need to be able to adjust and embrace new trends and technologies, as ignoring them is not an option (Ismail et al., 2017). Innovating new business models and creating new smart processes and services by using digital technologies and data in an organization, are considered

aspects that are related to digital transformation according to many researchers in the field (Schwertner, 2017). Digitalization is currently having a major impact on the economy (Annarelli et al., 2021), also identified from the perspective of the emergence of new companies with a digital tentacle or the disappearance of other well-known companies from the market that have not been able to integrate technology into their business model (Schmidt et al., 2016).

Digitalization significantly impacts a multitude of industries and provides competitive advantages in all fields of activity (Verhoef et al., 2021). Although there are articles that follow technological development in various domains, we can affirm that there are extremely few articles that pursue a comparative analysis of how major business aspects have been affected by DT. The present work follows the evolution of DT in three areas: business models, product development, and human resources management. Thus, we encompass the most important aspects, namely: the business domain, the products offered to the customer, and of course, the workforce. In this context, we address the following research question:

RQ: How have business modelling, product development, and human resources been affected by DT?

To answer the question, we rely on a literature review. We can consider this framework to be suitable for analyzing and understanding how business models, product development, and human resources management embrace and support digital transformation.

This paper is structured as follows. Chapter 1 is represented by a literature review on each field. The second chapter presents the three variables that we use to analyze the similarities of each field in relation to DT, the discussions and the comparison between the three fields' DT paths. Finally, Chapter 3 concludes and details avenues for future research.

1. Literature review

1.1. The evolution of Business Models through the digital transformation

Researchers commonly agree that there isn't only one single way of defining business models (Fehrer et al., 2018), thus we can find ideas regarding the "way firms do business" (Osterwalder et al., 2005; Zott and Amit, 2010; Fehrer et al., 2018; Luz Martin-Pena et al., 2018; Bican and Brem, 2020), correlating to the value creation (Porter, 1985; Nielsen and Lund, 2014; Schallmo and Williams, 2018), the formalization of components and elements of business models (Osterwalder and Pigneur, 2010), or capturing the network and connections which are creating around them (Zott and Amit, 2010; Bican and Brem, 2020; Li, 2020).

The first major changes in businesses models started to appear in the 1990s (Nielsen and Lund, 2014; Luz Martin-Pena et al., 2018; Schallmo and Williams, 2018). The existence of the term “E-Business” aligns with the evolution of the Internet, chronologically speaking (Nielsen and Lund, 2014; Luz Martin-Pena et al., 2018). This period can also be identified as the 1st wave of digital transformation (Kotarba, 2018). As a result of incorporating information and communication technologies (ICT) in their activities (Luz Martin-Pena et al., 2018), companies have developed a new business model – “E-Business”. The most important changes appeared in the way that the company communicated with its customers, suppliers, employees, and partners (Luz Martin-Pena et al., 2018; Schallmo and Williams, 2018). In their study in (Amit and Zott, 2001), Amit and Zott concluded that there were four major value drivers which enhance the value creation in E-Business. These dimensions had a direct impact on the profit of the company: efficiency compared to other businesses, being able to lock-in customers, and offer complementary goods (Zott and Amit, 2010).

In early 2000s, the Digital Business Model has replaced the E-Business concept. This change from ‘E’ to ‘D’ was questioned by researchers (Luz Martin-Pena et al., 2018), because at the first look it just seems as one is a continuation of the other. Business models started to modify due to the development of new ICT, such as mobile devices, platforms, analytical tools and IoT (Luz Martin-Pena et al., 2018; Schallmo and Williams, 2018; Bican and Brem, 2020). There are also new terms which start to be present in the literature, such as business actors, internet-enabled commerce, digital product and digital service (Cîmpan et al., 2022).

The implementation of new technologies has changed different parts of the business model. First, we notice an enhanced resource optimization, which permits interactions between different actors and systems (Bican and Brem, 2020). Communication continued to change in the 2nd wave of DT (Kotarba, 2018), now being almost entirely digital and in real time, facilitated by the smart devices and social media platforms (Schallmo and Williams, 2018). The use of smart devices has significantly increased the value proposition of the company (Bican and Brem, 2020). They are used for value creation for both the company and the customers. The mobile technologies are collecting personalized customer data, which is being used for creating tailored products and services, which aim to closely serve the customer needs (Schallmo and Williams, 2018). The customers are not only given the best-fitted product/service but they are also being emerged into a rich customer experience (Bican and Brem, 2020). The commerce has also shifted to an online environment, being sustained by multiple digital payment options though secure online platforms (Luz Martin-Pena et al., 2018; Schallmo and Williams, 2018). The

changes appearing can be divided in three main categories: automation - businesses automate or improve their activities and procedures using digital technologies, extension - businesses use digital technologies to foster new business models that complement current activities and processes rather than replacing them, and transformation - new business models could substitute established ones thanks to digital technologies (Li, 2020).

Finally, at this moment digital platforms have been rapidly adopted by the companies and placed at the core of their activities. Their most important trait is their openness, impacting many layers: the platform user layer, the platform infrastructure layer, and the platform provider layer (Fehrer et al., 2018; Rahman and Thelen, 2019). Platform business models are thought of as open business models because they are built on a collaborative infrastructure that links numerous different actors (Fehrer et al., 2018). Though sometimes the platform offers very little value to its users, if it successfully involves and links more kinds of actors, it can develop a successful business ecosystem around it (Cîmpan et al., 2022) and support the centralization of all the activities, resources and actors surrounding the firm (Rahman and Thelen, 2019). The shift of value creation from inside the firm to outside the firm, between different actors, implies counting on a larger, more varied set of resources (Fehrer et al., 2018). The cost reduction for most actors is a key value capture mechanism for the platform business model (Fehrer et al., 2018).

1.2. The evolution of product development through the digital transformation

Product development has been defined in multiple ways. Krishnan & Ulrich (Krishnan and Ulrich, 2001) defined it by adopting an entrepreneurial perspective as „the transformation of a market opportunity and a set of assumptions about product technology into a product available for sale”, while Florén & Frishammar (Florén and Frishammar, 2012) adopt a process perspective, defining it as „a set of transformations of input elements into output elements”. DT influence on product development has been observed by analyzing the evolution of technologies and of product development paradigms.

Concerning technology use in product development, in the year 1963, (Ross and Rodriguez, 1963) introduced us to the concept of CAD (Computer-Aided Design), a software used for generating electronic files that can be employed in various manufacturing operations such as printing and machining. Its advent significantly enhanced designers' productivity and heightened design quality, amongst other benefits. The next step in the evolution of product development was the emergence of the concept Computer-Aided Manufacturing (CAM) software (Spanninga, 1979) which enabled manufacturers to use computers to control and automate the

manufacturing process, reducing errors and increasing efficiency (Schweitzer et al., 2019). The evolution of product development continued with the Product Lifecycle Management (PLM) system, a software solution that captures, manages, and shares product-related information, including data on various versions of a product throughout its lifecycle (Schweitzer et al., 2019). More recently, the concept of Digital Product Development appeared in the field and with-it technologies like 3D printing, virtual reality, and the Internet of Things (IoT) (Albukhitan, 2020). Additive Manufacturing, also known as 3D Printing, combines different materials and processes that share the ability to convert 3D data directly into physical objects (Albukhitan, 2020). The Internet of Things (IoT) typically refers to situations in which objects, sensors, and other everyday items that are not typically considered computers are enabled with network connectivity and computing capabilities (Rose et al., 2015). This allows these devices to exchange, generate, and consume data with minimal human intervention, thereby enabling a wide range of new applications and services (Li et al., 2015). Finally, Industry 4.0 encompasses a wide range of areas and technologies aimed at improving the efficiency, productivity, and quality of industrial processes (Kurasov, 2021). Some of the key technologies associated with Industry 4.0 include additive manufacturing technologies, such as 3D printing, as well as modeling and visualization tools that also involves the integration of systems, leveraging the Internet of Things and cloud services while ensuring cyber security (Kurasov, 2021). Artificial intelligence, big data analytics, energy-efficient technologies, and alternative energy solutions are also important components of Industry 4.0 (Santos et al., 2017).

Concerning product development paradigms, a major change is represented by the adoption of Agile development for software products (Trott, 2012), a flexible product development which allows modifications to a product or to the development process, even during the later stages of development, without causing significant disruptions. It encourage adaptive planning and delivery, using a time-boxed iterative approach that responds quickly to changes (Reifer, 2002). Unlike conventional methods, these approaches prioritize the creation of early versions of functioning products, using mostly collaborative techniques such as pair programming, refactoring, and customer involvement (Racheva et al., 2008). Overall, digital transformation has transformed product development from a slow, linear process to a fast, iterative, and highly collaborative one. Companies that embrace digital technologies are better equipped to stay competitive in a rapidly changing market (Cooper, 2019; Schweitzer et al., 2019; Barrane et al., 2021).

1.3. Evolution of digital transformation in HRM

The human resource management (HRM) function has undergone a change over time with the advent of digital technologies (Bondarouk and Brewster, 2016; Schmidt et al., 2016). Therefore, the requirements for HR professionals have also changed, they must be able and open to develop new digital skills in order to manage roles and responsibilities that are constantly changing due to the evolution of information technologies (Ulrich et al., 1995). HR personnel are forced to go beyond the administrative side and acquire new knowledge on the strategic side with the role of achieving strategic partnerships within the company, having knowledge in managing change and technology (Bell et al., 2006; Vrontis et al., 2022).

E-HRM (e-Enabled Human Resource Management) is part of an effective human resource management strategy and practice in various organizations (Ruël et al., 2004; Bondarouk and Ruël, 2009; Strohmeier, 2020). At a theoretical level, e-HRM is defined as a way of implementing HRM strategies, policies and practices in companies by using web-based channels (Ruël et al., 2004; Strohmeier, 2020). However, the transition from classical to digital HRM was achieved gradually because there was a lack of knowledge about the terminology, practices, and theories of this new field of digital HRM (Strohmeier, 2007; Bondarouk and Ruël, 2009; Parry and Tyson, 2011; Bondarouk and Ruël, 2013). Before digital technologies made their presence felt in HRM, formerly known as "people management", the work of employees in that department was repetitive and hampered by various processes and procedures (Bondarouk and Ruël, 2009; Bondarouk et al., 2017).

The need for HR professionals to understand all digital tools has also increased greatly. A broader perspective of the impact that technology has on the entire organization should also be known by the HR department, as they are part of the integration and development of new processes in a company (Bondarouk and Ruël, 2013; Strohmeier, 2020). Any change within an organization brings with it a disruption of the current state of affairs, having a significant impact at all organizational levels. Thus, it is important that HR is prepared for change and, at the same time, has the ability to provide flexible solutions to adapt to change for the entire organization (Ebersold and Glass, 2015; Strohmeier, 2020).

The new trend of companies introducing e-HRM processes and the adoption of new technologies brings a series of advantages and disadvantages that are expected both by the organization and especially by the HR department and its employees (Ismail et al., 2017; Nikolaou, 2021). Among the most important processes in HRM are the recruitment, selection, and performance evaluation of employees, which are directly affected positively or negatively by technologies (Thompson et al., 2008; Nikolaou, 2021). The presence of digital tools in HRM is variable from company to company

and this is given by the stage at which organizations have decided to implement digitization processes (Zhou et al., 2021). In other words, we can have companies that are currently in the early stages of digitalization (often they are small companies or companies with a more rigid organizational culture) and fully digitalized companies (Strohmeier, 2020; Zhou et al., 2021; Chugunova and Danilov, 2022).

2. Drivers of DT evolution in the three fields

The digital transformation process has transformed all three considered areas along the years, being quite slow and tardive at first, but incremental, and coming at a fast pace due to the development of ICT, therefore, constantly catching up with the trends. Product development was the first area where the impact of the DT process can be noticed, in the form of CAD and its successor, CAM software, which were created in order to enhance the designers' productivity and quality, control and automate the manufacturing process (Ross and Rodriguez, 1963; Peddireddy et al., 2020). The improved CAM software was created in a time spawn when the other considered areas started being impacted as well. The 1990s were a common changing point, due to the creation of Internet facilitated technologies. We can identify three common drivers for adopting digital transformation in all three considered areas: improving communication, costs reduction, and increasing efficiency.

DT impacted the way communication was done at all business models' levels. It not only improved communication inside the firm, among the employees, but in the environment around it, between all the actors which are involved (such as customers, suppliers and partners) (Luz Martin-Pena et al., 2018; Schallmo and Williams, 2018). One of the long-term benefits of the DT process is the development of platforms, which are constructed on a collaborative infrastructure (Fehrer et al., 2018), process automation and outstanding communication between the actors. However, the advantages of DT on communication improvement can be mostly noticed at micro level, inside and between each department of the company. The mobile technologies help to collect personalized customer data, which are used in order to create the best fitted product for the customers (Schallmo and Williams, 2018; Bican and Brem, 2020). This can only be possible due to the complex systems which help collect, consolidate, visualize, and analyze data in a systematic manner (Santos et al., 2017), thus creating a flexible product development, where modifications can be made in the product development process up to the later stages of development and without disrupting it (Trott, 2012). In the HR department, ICT are breaking the barriers on a global level, permitting the recruitment process to access candidates from all over the globe (Strohmeier, 2020; Nikolaou, 2021).

Another area with a recurrent impact of DT is related to the incurred costs. The DT has triggered an essential change by reducing costs and adding value to the businesses. The platforms technology has reduced the costs involved for the transactions (Fehrer et al., 2018) and has centralized all the activities and resources, for a better allocation (Rahman and Thelen, 2019). In a similar way, the HR department has benefited from platform adoption by reducing repetitive work, and improving the administrative systems (Bondarouk and Ruël, 2009, 2013). However, not all companies have this adoption level, and the HR department is one of the last ones where the automatization processes are introduced (Ruël and van der Kaap, 2012). In production development the interconnected devices help to exchange, generate, and consume data with minimal human interaction, thus reducing the costs for the human resources allocated in the development processes (Li et al., 2010).

Adopting platforms and ICT has not only contributed to costs' reduction for the company, but also for increasing efficiency at all levels. First of all, we can observe the creation of an enhanced resource optimization, regarding all resources, financial, material or human (Bican and Brem, 2020). The e-HRM processes promise efficiency through the implementation of technology supported HR policies and practices, and most importantly they increase employees' performance, thus allowing them to acquire new technical skills (Ruël et al., 2007; Bondarouk and Ruël, 2013). This can also contribute to the achievement of strategic objectives on a higher organizational level (Ruël et al., 2004, 2007). In product development, at first, the DT was focusing on improving efficiency by automating processes and reducing errors in the manufacturing process (Schweitzer et al., 2019). Later on, we notice a different type of efficiency, in systems like PLM, which are performant in collecting and managing product-related data. A consequence to these types of systems is the possibility of expanding to new markets and audiences (Cooper, 2019; Schweitzer et al., 2019; Barrane et al., 2021). Last but not least, the DT has contributed to the overall financial performance of the companies, by providing a basis for new profit-generation methods for the companies (e.g. commission-based, advertising (Nielsen and Lund, 2014)).

3. Conclusion

The purpose of this article was to identify common patterns of digital transformation in areas such as business models, product development, and human resources management. Through a literature review, we observed the evolution of each domain through the lenses of digital transformation. The research reveals how technology was adopted in each field and which was its impact. Each field has a different pace

of adaptation to new trends. If in the case of product development and business models, technological advancements have been a perfect fit for their evolution, in the case of human resources, there is still a reluctance to fully implement the systems created by technological development. Although digital transformation affects each field differently, we have identified common drivers which have affected DT adoption in all three areas: improving communication, costs reduction, and increasing efficiency. Digital transformation has left its mark on each analyzed field and continues to impact them in the present.

Naturally, our research has some limitations due to the constant and extremely rapid development of technology and the large flow of information that spreads quickly regarding the analyzed subject. Hence, these limitations offer us the opportunity for future research in each analyzed field. Therefore, regarding business models, the ones that guide future studies are blockchain, artificial intelligence, and the internet of things. In the case of product development, Industry 4.0 is pursued, which aims to improve the efficiency, productivity, and quality of industrial processes. This supports the direction of business models and aims to implement systems such as the Internet of Things and cloud services while ensuring cyber-security. The field of human resources is affected differently by digital transformation; therefore, it is in a continuous process of adaptation to change, and the implementation of high-performance digital systems seems to be much slower compared to the other two analyzed fields.

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