Digital Transformation of the Enterprise Value Chains

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Abstract

In today's world it is a fact that market competition has given an huge advantage for those who are able to better use data. The main reason is that they understand how to develop medium-long term correct strategies, with short-term pragmatic operational approaches. The challenge is not on how to get or how to produce data, but on how to use it and transform it, in something with business focus and business value. For that reason, it is fundamental to understand deeply on how companies apply the well-known Ackoff DIKW hierarchy (Data, Information, Knowledge and Wisdom) in their value chains. This ability to transform data into wisdom in a real-time mode is pressuring companies to transform themselves, which is known in a simple way as Digital Transformation, but what's happening is that they are transforming their own Value Chain. They are transforming the way they understand the power and how to use Information Systems as a strategic tool and as a strategic value added for decision making, meaning it is no more just a simple technological support activity, like it was originally defined by Michael Porter's Value Chain. This paper, being a conceptual paper, intends to address the importance of the digital transformation that the Value Chains need to face and the need to include Information Systems as a core activity nowadays, to achieve the best data to wisdom transformation. Those who will be able to address this transformation and continuously improvement from data to wisdom, leveraging their Value Chain, will have the ability to optimize their enterprise market value. Those who can address a digital and information systems strategies will be able to get faster optimization of their market value functions.

Keywords: Digital Transformation, Information, Strategy Plan, Value Chain, Information Systems

1. Introduction

This conceptual paper intends to present the impact that Digital Transformation is also a Value Chain Transformation, because companies are able today to address the DIKW cycle (data transformation into information, knowledge and wisdom) in real-time mode. Those companies that have a structured and innovative Information Systems and Digital Strategies will be able to achieve an efficient model for the referred DIKW cycle, which means these companies will optimize their internal operation function, referred as optimum market value function. So, the goal of this conceptual paper is to present evidences that today, the Information Systems are a core activity for companies, side-by-side of Logistics, Operations, Sales & Marketing and Post-services, meaning that they are proactive wheels in the enterprise strategy. Companies that understand these new trends of Digital Strategy, are the ones that will be more prepared to face future market competitions.

2. From the Information Age to the Information Prediction

In 1985, Michael Porter referred that "the information revolution is sweeping through our economy" (Porter and Millar, 1985). Today, after more than 30 years of this statement, we read it and think "it is obvious", but at that time, like today, the majority of the enterprises' decision makers tend to forget the new challenges. If in the 80's and 90's, companies were starting to face the challenge to create data and get information, today, data and information are already considered commodities, meaning that decision makers need to upgrade their information and digital ecosystems to get knowledge and wisdom, in order to be able to take the lead and be able to get a competitive advantage. This is known by the famous DIKW – data, information, knowledge and wisdom pyramid – supposedly identified by Ackoff (R.L. Ackoff, 1989).

There is a set of discussions about the relevance and the real applicability of the DIKW Hierarchy to enterprise methodologies, like the ones referred by David Weinberger in his HBR article (Weinberger, 2010) saying that "knowledge isn't determined by information, because it is the knowledge that decides which information should be important, or by Jennifer Rowley when in her research of several study analysis concludes that the main pain point to adopt the hierarchy is that there is "less consistency in the description of the processes that transform elements lower in the hierarchy into those above

them" (Rowley, 2007). Although these sceptics on the DIKW process, the majority of those researches don't refer that the DIKW hierarchy should be considered has a spiral of knowledge, meaning that the pyramid is in fact a virtuous cycle of growing knowledge (Fig. 1 - DIKW virtuous cycle searching for the optimum market value function), where the predictive models should be applied in the real-world environment and next collect the data from what really happen, which will be transformed into information, that will be analysed to get new knowledge and generate new predictive wisdom. Basically, and the next figure concept, tries to represent the Knowledge Management spiral to be considered and the mathematical function model that is always searching for the "perfect" function, named as "optimum market value function" (OMV function) with the exact reactions of the real world.

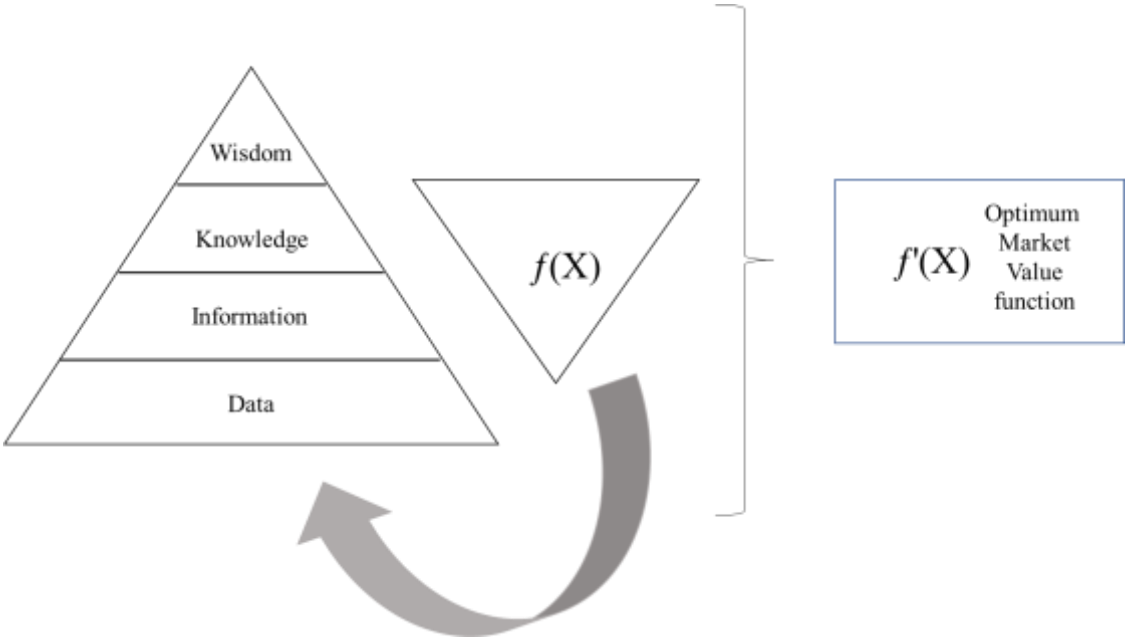


Fig. 1 - DIKW virtuous cycle searching for the optimum market value function

The reality is that the DIKW hierarchy, which is a Knowledge Management process basis, has surpassed the enterprise strategy concepts, being today a reality with the emerge of new technological and business trends based on Big Data (Rothberg and Erickson, 2017), Internet of Things (IoT) and Artificial Intelligence.

There are several cases in the real business world several, even on the primary sector, which is supposedly an analogic industry, but the transformation of this industry is searching to achieve exponential efficiencies with deployments of "connected farms", "soil-moisture sensors", "autonomous tractors" and "stock and animal wearables" (Kite-Powell, 2017). What are these changes? Basically, with IoT, the several sensors are data producers, that bring information to the farm management, which across time the knowledge is created and with technology the predictability will be achieve. This is only valid because there is a business goal, namely for controlling diseases, be more accurate in artificial insemination or milk quality. The real examples of the DIKW virtuous cycle applications are for instance develop by Fujitsu, the Japanese technology firm, and its customers. And this is not recent, because Fujitsu started this business and technological deployment, with a Microsoft cloud infrastructure (O'Reilly, 2015), in a Japanese farm in 2013 (Gallagher, 2015), where the sensors were pedometers attached to cows delivering the steps given by cows (data), which permitted to see the visualize the cows position (information) and understand the normal and the unnormal behaviour of the cows, which led to accurate detection of estrus (knowledge). This technology implementation (IoT + Big Data+ Artificial Intelligence together) permitted them to be 70% more productive than before, because they've got +95% of estrus detection accuracy versus 56% previously and a 67% pregnancy rate versus 39%. But this case gives us the fundamental vision to achieve the optimum market value function (OMV function) which was that after a set of cycles of data-information-knowledge, they've found the wisdom ambition, which was to get an high level of accuracy that making the insemination prior to the optimum point (16 hours after the first detection of estrus) they probably would get a female, but if they make the insemination after the optimum point of insemination they probably would get a male. This is an enormous capability for the business planning, which is to be able to control their operations and fit the future contracts, imagine a contract to sell meat or milk within 1 year. Basically, that farm will be

able to generate what they want, in their production environment, according to their sales order, it is the applicability of a Just-In-Time fulfilment operations in an industry that was miles away of this concept. This is a dream come true for any business, which is to control almost all the variables in their operations. The challenge is to keep moving on the DIKW virtuous cycle, maintain the enterprise ethics and to be able to control all the value chain. fi

Examples like this one are starting to happen in other industries, like healthcare, government, logistics, etc. with proven business values, not only on efficiency and also on effectiveness (AIG, 2016). The investments on these set of technologies to create the wisdom level are enormous, from big companies small and medium businesses. The movement to align the DIKW hierarchy with technology to achieve new business innovations to get competitive innovations, from big companies like Coca-cola, GE, Rio Tinto, Bank of America to small companies like Pulmonary Apps (Healthcare), Team Companies (HR Services), Harps Food Stores (Retail) and many others (Adam C. Uzialko, 2016; Svetlana Pyatakova, 2018).

If we analyse B2C market, companies would search and invest on the identification of the set of variables that influence their customers. Basically, and knowing that the main companies' goal is to generate value for its stakeholders, and in particularly to generate money to their stockholders. The challenge would be to have the "perfect" OMV function to control their customers as "puppets".

This is a process of creating the culture for an Enterprise Intelligence, which is the business transformation of understanding of the power that data can deliver, as a value added for the business.

A real known example of the "puppetization" is the basis of well-known public scandal about the data breaches of Facebook and used by Cambridge Analytica (Granville, 2018). The underneath concept of what happened, is in real, nothing new and shouldn't be a surprise, because since the beginning of the creation of the Business Intelligence concepts this was the goal (Liautaud, 2000). The title of the book of Liautaud is clarified: "e-Business Intelligence: turning information into knowledge into profit" and it was written in 2000. So, and knowing that Business Intelligence is a set of "mathematical models and analysis methodologies that exploit the available data to generate information and knowledge useful (…)"(Vercellis, 2011), a company makes profits selling more, and it only sells to customers, meaning that the mathematical models and analysis methodologies are in fact the first steps to achieve the OMV function, meaning that there was since the early stage of the decision support systems (D. J. Power, 2018) a goal to achieve the control of all the variable of the customer and the internal processes.

3. The Digital Transformation of Porter's Value Chain

Michael Porter in his book "Competitive Advantage: creating and sustaining superior performance" (Porter, 1998a) has introduced an important concept, that has established a standard in the economics science and which explains the systematic structure of the set of activities needed to deliver products or services value added by enterprises: the Value Chain. At that time, Porter also understood the Information value has a fundamental infrastructure to achieve efficient models, between the several flows that optimize the support and core activities of the enterprise. Although, today the Digital Transformation paradigm and the achievement of technology maturity higher levels, the importance of Information Systems has growth to be a fundamental source of sustainability and acceleration in the value chain, like described by Jim Collins when he refers that the Technology Accelerators are one of the explosions in the flywheel momentum (Collins, 2001), which means that the technology is in between of the processes and the several resources of the companies.

Knowing that Information Systems are different from Information Technology , because it is a set of three main components – People, Processes and Information Technology – (Bourgeois, 2014) and understanding the value of the information within today's business world, also predicted by Michael Porter and other authors, and the confirmation that technology is a fundamental accelerator for efficient and sustainable companies, means that the Information Systems are more than the Technology development within the support activities of the value chain. In this 21st century, Information Systems need to be understood as a primary activity in the daily basis of the company and essential for the product or service delivery (Fig. 2 - Second Generation Value Chain). This recognition as a primary activity is the assurance that there is a specific and critical area within the company that is always searching for the right fit between people, processes and technology. This will assure the today's and near future competitive advantage.

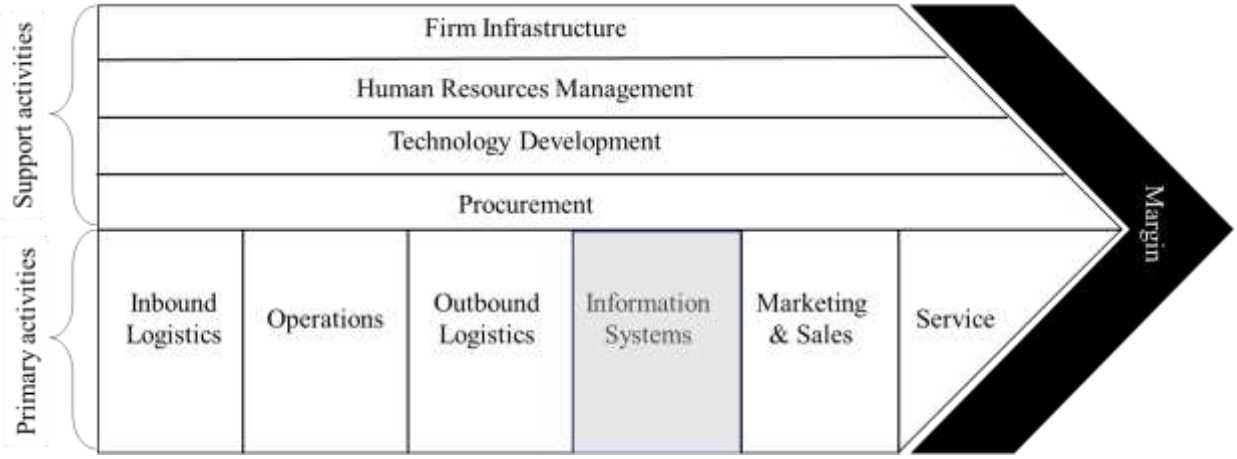


Fig. 2 - Second Generation Value Chain

Several authors analysed that Information Technology, by their own, suffer from the "productivity paradox" (Erik Brynjolfsson, 1993), which means that they didn't improved business productivity and pointed out a set of mismanagement activities, neither their usage would bring true advantages to higher productivity (Erik Brynjolfsson and Lorin M. Hitt, 1998). Additionally, Nicholas Carr in is article "IT Doesn't Matter" (Nicholas Carr, 2003) touched the pain point, when he understands that Information Technology is a commodity for enterprises, like water and electricity. In 2003, when Carr wrote this article, he knew that the competitive advantage was not on technology, but the way that companies used it and leverage it as a strategical issue. This is an example that the competitive advantage is not on Information Technologies, but on Information Systems.

Companies need to have this Information Systems Management has a focal point in the company, to assure that the DIKW virtuous cycle, previously explained, is a strategical and core activity in the value chain. The appearance of roles like Chief Information Officer (CIO) and Chief Digital Officer (CDO), in the organizational structure of several companies, are examples of that value chain change. They are not the Chief Technology Officer (CTO), which manages only the technology infrastructure (the commodity factor), meaning that they assure that the technology is working in the expected delivery of the operational flows within the company. A CTO isn't expected to be a strategic engine, but an operational engine aligned with the day-to-day support of the enterprise infrastructure, like viewed in Porter's Value Chain (first generation). CIO and CDO are engines for the Enterprise Intelligence, meaning that their roles are more aligned with strategic future and long-term movement of the enterprise.

Information Systems need today to be understood as a strategical influencer of the company, meaning it is not the "old" IT of a company, or in terms of an analogy with the 'well known' ecologic food chain, popularized by Charles Elton in 1927 (Elton, 2001) in his book "Animal Ecology", Information Systems has climbed up from the producers and decomposers to the Top Carnivores, meaning that they were seen just has the technology support and are (should) now a fundamental strategic decision maker in the "Decision Chain". This happens due to the fact we're now in the world that data is transformed in information, where the business transactions are no longer made in traditional ways (supplier + distributer + customer), but are a set of possible networked transactions (Angela Andal-Ancion et al., 2003), in other words the knowledge and the ability to understand that the Information Systems are a strategic competence and a primary activity to achieve a sustainable company with competitive advantages. For that reason, Information Systems are the engine that can join business, technology and information. Information Systems (people, processes and technology) ensure that the long-term strategy and goals are present in the overall decisions.

It is also relevant to confirm that in IBM CIO Study 2009 (IBM Corporation, 2009), it is referred that "*CEOs are more dependent on CIO insights to innovate and improve these processes*", confirming the climb up on the "food chain" of the enterprise decision make, which in practical terms is the recognition of the importance of the constant and fundamental work made by the Information Systems, to leverage data and analytics and creating efficiency in new or existing processes within the company.

4. The Importance of a Strategy

It is a fact that Marketplaces today are living very competitive and saturated times with products, offerings and other services to a global consumer base, meaning that no business can afford to be without detailed information about: their business (financials, accounting, revenues, costs …), their

customers (profiles, psychographics, new habits …) or changes that are impacting their business future. That is a primary reason to develop a strategy, to assure that managers can have a decision support guideline and rules to create the path of their business scope and growth, even knowing that they will make decisions under partial ignorance (Ansoff, 1965). Defining a strategy is to make a business approach to define goals and policies which need to be carry out to achieve the competitive positioning in the environment of the company (Porter, 1998b).

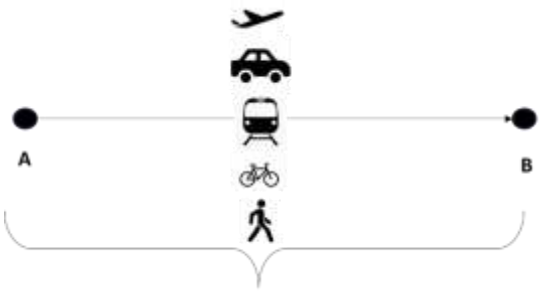
One way to understand the concepts of the word Strategy is to know the origin of the word. Strategy derives from the Greek word *stratēgos,* which is formed by two words: stratos (army) and ago (ancient Greek for leading). This meant that *stratēgos* referred to the military general during the age of Athenian Democracy, which was able to understand the environment and lead the troops in the field. So, it is easy to understand, that a corporate strategy is the set of guidelines with a scope under the internal and external environment of the company, knowing which resource capability the company has, in order to be able to allocate and reallocate them in the field, according with a set of values, expectations and goals to be achieve in the long term (Johnson and Scholes, 1993).

It can then be resumed that Strategy is the pattern of resource allocation decisions made throughout an organization. These decisions encapsulate both desired goals and beliefs about what are acceptable and, most critically, unacceptable means for achieving them. One of the most important decisions, when a company is defining its strategy, is to know exactly what are the paths that doesn't want to go, because de way to achieve its goals there will be several temptations to change, several opportunities to allocate new resources that aren't at the core values, etc.

A strategy starts always with a vision, which determines exactly what is the target to be achieved, or at least, the field of opportunity to be surpassed. This vision milestone definition is the trigger for the strategy process definition, which can be resumed in three main steps: analysis, choice and implementation (Johnson and Scholes, 1993).

The analysis can be described as the process of internal and external understanding of the environment, the culture, the capabilities and beliefs.

The choice is the generation of paths to achieve the vision, meaning that, for example, we have several route options to go from city A to city B (by car, by train, by air, by bicycle, etc.) and each option has an economic cost (Fig. 3- Economic function cost of strategy route options), where it need to be understood which are the variables that need to be considered (for example time to achieve, toll costs, comfort of the travel, among others) and the weight of each variables. This symbolic exercise is the same work that a company needs to do when is analysing the several routes it has when it knows what wants to be and to achieve. This means options like acquisitions, like technology investments, integrating more human resources, installing factories, and so, are examples of variables that need to be analysed and weighted to compound the economic function cost of each route option and choose the best one to implement.



$$f(x) = a_1 * p1 + a_2 * p2 + a_3 * p3 + \cdots$$

$$\sum_{1}^{n} p_n = 100\%$$

$$a_n - variable\ economic\ vaue$$

Fig. 3- Economic function cost of strategy route options

The strategy implementation is the operational deployment details of the strategic route option that has been choose, which is normally known as the action plan of the strategy. This implementation plan needs to have the set of milestones and the key performance indicators, that will guide the confirmation acknowledge, during those years of implementation, of the control range if the company is being of the right path for the 3 to 5 years of the strategy definition plan. The milestones and key performance indicators will deliver the BHAG – Big Hairy Audacious Goals, introduced by Jim Collins

and Jerry Porras (Collins and Porras, 1994), which means that a strategy will need to push for the overall company to achieve more, to higher its limits, and like those authors also refer the company has to leverage and develop their strengths to surpass to other level of competitive capabilities.

5. Digital and Information Systems Strategy

Once Stephen Hawking as said "The world has changed far more in the past 100 years that in any other century in history. The reason is not political or economic but technological – technologies that flowed directly from advances in basic sciences". This is an enforce of what is described in the previous sections of this article, that the business and the way companies are doing businesses is changing, and is changing fast and, each year, is being faster. There are several evidences that the technology adoption is pushing much faster the product or services consumptions than ever. An amazing infographic created by Nicholas Felton for the NY Times (Nicholas Felton, 2008) is an example of an artefact where it can be seen the speed of adoption of a set of common commodities like the electricity that took almost 30 years to achieve 50% of the US households and Internet took around 10 years, or that the telephone took more than 30 years to achieve those 50% of US households and the cell phone took just 5 years. But when we enter in in the digital world, the speed of the production of digital data growth starts to be even faster transforming the rates in exponential growths, because all the numbers "explode", meaning rates around 50x growth between 2010 and 2020 and 90% of that data has been produced in the last 2 years (Peter Ffoulkes, 2017).

These fastest times is consequently introducing changes in the marketplace, where the disappearance and rise of new companies is being amazing. As it can be seen in "Fig. 4 - Average Company Lifespan on S&P 500 Index - adapted from Innosight, Credit Suisse and other public sources marketplace change in the S&P500 index has been enormous. The lifespan of companies in that index in 1958 was 61 years and in 2012 was 14 years, with an estimated lifespan of 10 years in 2027 (Anthony et al., 2018; Michael J. Mauboussin et al., 2017; Mochari, 2016).

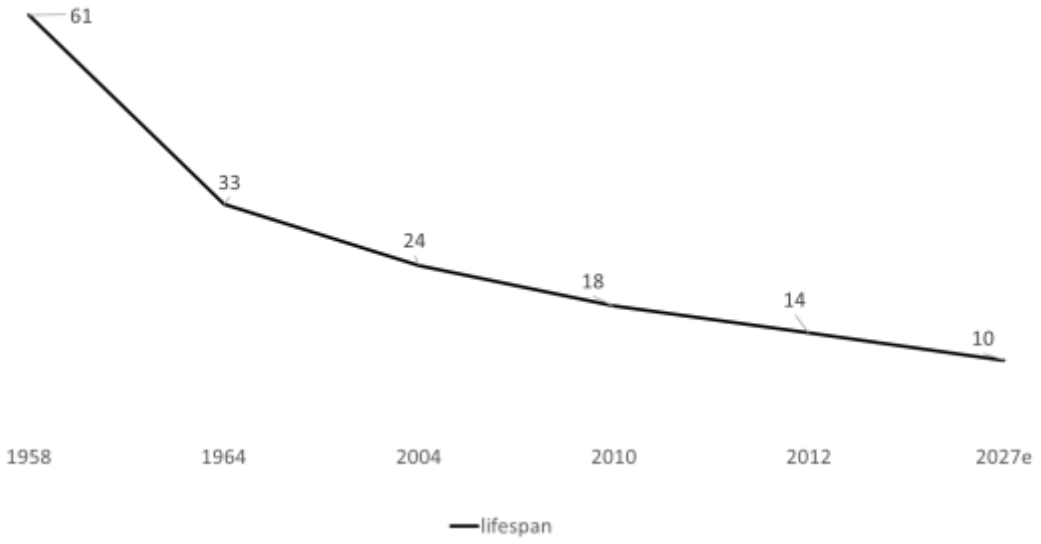


Fig. 4 - Average Company Lifespan on S&P 500 Index - adapted from Innosight, Credit Suisse and other public sources

The shrink of companies' longevity puts a pressure in the overall stakeholders, namely investors, which need to rethink even their valuation methods, portfolio sizing and capabilities new and traditional variables for a company to have a sustainable competitive advantage. This is quite important, because for instance Credit Suisse February 2017 Report identifies a quite good correlation between longevity and their innovation index (Michael J. Mauboussin et al., 2017).

The common challenge identified by several studies is the power of the present and near future digital disruption that is changing markets. That power is pushing operations to be efficient as they never have been, which means that technology needs to be present and correctly deployed, because only technology can help reengineering the existing processes in companies, can understand more deeply new digital interactions within the various channels. Market globalization and its global competition creation is a daily unknown challenge and a run for a wheel of continuous innovation speed, pressuring the product life cycles and existing business models. Basically, the term digital transformation is

transversal to all industries value chains. And companies and leaders that understand it, are the ones that will prevail.

Several research analysts, like MIT Center for Digital Business, like McKinsey, Gartner or IDC, have common conclusions, namely that best digital companies are 26% more profitable than their industry competitors and generate 9% more revenues. Recently, a new pattern recognition of those studies have found that companies that are effectively using the new Data Science capabilities are more productive and profitable in 5% to 6% than its peers. (Anthony et al., 2018; CapGemini and MIT Center for Digital Business, 2012; Court et al., 2015; Kasturi, 2018).

Gartner predicts for 2020 that 75% of the businesses will be digital or are preparing to become digital (Mohammed Hashim, 2016). This understanding of becoming digital is a strategic first movement for companies to redesign their business strategy and culture. Basically, the appearance of a Digital Strategy Plan, beside the Business and Information Systems Plans, is starting to be understood as an essential tool for companies' future sustainability. This Digital Strategy Plans are the first steps for companies to understand how to convert digital value propositions of their businesses into revenue-generating digital offers (Ross, 2018). Today, this means to create hybrid solutions (digital and physical) able to engage new experiences to customers. Experiences that can create a new emotional relations and new views of loyalty between the customer and the company, in a continuous operation. Today, methodologies of Design Thinking to understand customer needs and expected experiences with a continuous business applications development of the business and information strategies, based in DevOps methodologies, are essential to create competitive advantages and future value added for the stakeholders. Next figure represents the fit of this overall strategies.

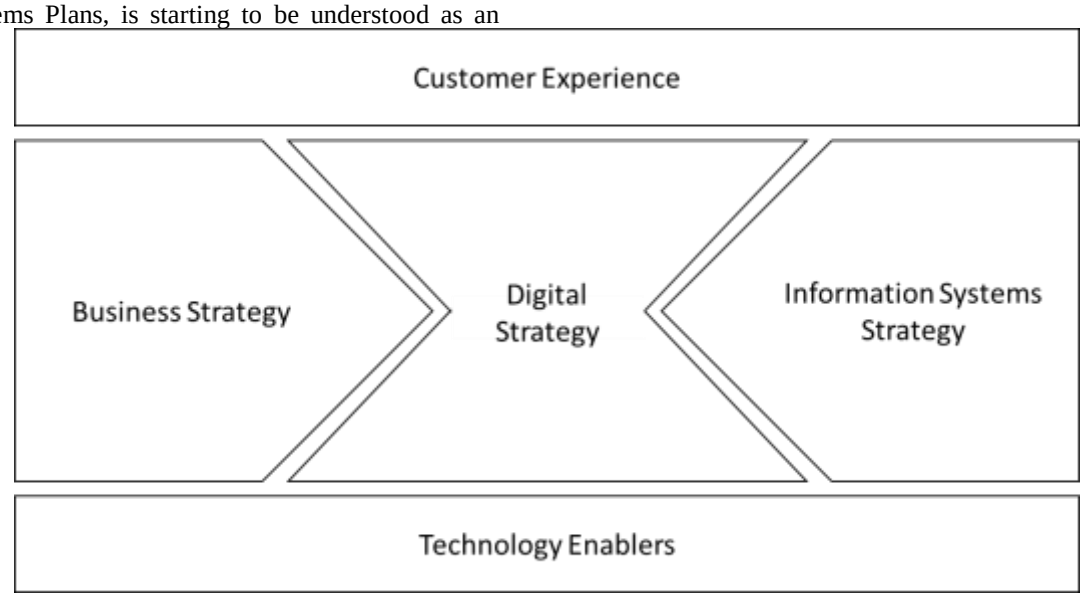


Fig. 5- Digital Strategy has the center of an Enterprise Intelligence

The previous figure represents, in fact, the reality of the new culture that has appeared: Digital Strategy as the center of an Enterprise Intelligence (Fig. 5- Digital Strategy has the center of an Enterprise Intelligence). It links technologies, namely the new disruptive trends of Analytics, IoT, 3D Printing, Blockchain, Natural User Interfaces, Artificial Intelligence, with Customer Experience, Business Strategy and Information Systems Strategy.

The digital strategy will deliver a digital governance, which is fundamental to define a clear responsibility of aligning digital strategy, policies and digital standards. A digital governance, when effective defined and implemented, will for sure help the development of a digital and agile business and sustainable company (Welchman, 2015).

6. Future research

This article permitted to identify a set of paths for deeper understanding of the digital business impacts, meaning that it is a basis for future researches like:

- Analysis of correlations of companies P&L growth, the existence of digital strategy, presence of formal CIO and CDO
- Analysis of digital transformation (un)successful cases and the presence of the CIO or CDO roles
- Analysis of digital framework strategy definitions, governance and

implementation methodologies, to identify additional optimization processes

7. Conclusions

With this conceptual article, it can be understood the impact that information systems have in the knowledge and business management inside companies, namely the creation of capabilities of leveraging data analytics able to understand deeper the value chain. Basically, these analytics intend to automate the Data, Information, Knowledge and Wisdom (DIKW) hierarchy, potentiate that managers and decision makers within companies are capable of maximize their business value generation. This means that, if a company is considered as a set of processes, a company by itself is a business model function where this DIKW analytics and virtuous continuous and interactive cycle of adopting strategic or tactic actions in the market, will analyse the impacts and reactions of the market. A manager or decision maker is then searching for its optimum market value function (OMV function).

The digital transformation of a company is in fact a process reengineering inside the companies, adding technologies that will create a vision of "real time" everywhere in the value chain and will run as an automation authority, creating additional efficiencies and competitive advantages (OMV function optimization).

This trend of digital transformation, to get the OMV function optimization, is changing the way that companies understand its core strategic activities. What Michael Porter (Porter and Millar, 1985) has structured as a set of Inbound Logistics, Operations, Outbound Logistics, Sales & Marketing and Post Sales services activities, is changing with the need to incorporate Information Systems as a core and strategic activity of the enterprises value chains, because Information Systems are more than the "old and only" Information Technologies. In reality, an Information Systems is the set of people, processes and technologies! Information Systems are fundamental to address the strategic optimization of the automation and efficiency transformation within a company. This means that when a company is building a business strategy, needs today not only to create, but fundamentally to assure the right alignment with Digital and Information Systems strategies.

It is a fact that the speed of new technologies appearance can create market disruptions and add continuous pressures to existing markets *status quo*. The most adaptive and digital companies, according to several studies, are 26% more profitable than their industry competitors and generate 9% more revenues, which represents an output of the intentions this article conceptual terms. The future challenges are to understand the several steps and variables that comply a set of best practices strategies that can transform the duo "data and information" basis in a digital and business optimized company.

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