

ARTÍCULO 2

A FRAMEWORK TO ASSESS ORGANIZATIONAL READINESS FOR THE DIGITAL TRANSFORMATION¹

UN MARCO DE REFERENCIA PARA EVALUAR LA PREPARACIÓN ORGANIZACIONAL PARA LA TRANSFORMACIÓN DIGITAL

UM MODELO PARA AVALIAÇÃO E PREPARAÇÃO PARA A TRANSFORMAÇÃO DIGITAL NAS ORGANIZAÇÕES

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ABSTRACT

The digital transformation puts to the test the sustainability of traditional business models. The aim of this research work is to formulate a framework that explains resources, capabilities and management choices necessary to respond to the new environment. The proposal based on literature review of both theoretical and empirical research. The framework abstracts complexity to isolate a few key variables. Its specification based on system dynamics since it naturally models forces of change in a complex system so that their influences can be better understood.

Keywords: Digital transformation, digital strategy, The Five Competitive Forces Model, Value Chain Analysis, System Dynamics.

RESUMEN

La transformación digital pone a prueba la sustentabilidad de los modelos de negocio tradicionales. El objetivo de este trabajo de investigación es formular un marco de referencia que explique los recursos, capacidades y decisiones gerenciales necesarias para responder al nuevo ambiente. La propuesta se basa en una revisión literaria de investigaciones tanto teóricas como empíricas. El marco de referencia abstrae la complejidad para aislar unas pocas variables clave. Su especificación se basa en dinámica de sistemas dada que naturalmente modela fuerzas de cambio en un sistema complejo de modo que sus influencias pueden entenderse mejor.

Palabras clave: Transformación digital, estrategia digital, Modelo de las Cinco Fuerzas Competitivas, Análisis de la Cadena de Valor, Dinámica de Sistemas.

RESUMO

A transformação digital testa a sustentabilidade dos modelos de negócios tradicionais. O objetivo desta pesquisa é desenvolver um modelo para explicar os recursos, capacidades e decisões de gestão necessárias para responder ao novo ambiente. A proposta é baseada em uma revisão da literatura tanto da pesquisa teórica e empírica. O modelo abstrai a complexidade para isolar algumas variáveis-chave. Sua especificação é baseada em dinâmica de sistemas dado que naturalmente modela as forças de mudança em um sistema complexo de modo que sua influência pode ser melhor compreendida.

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Palavras chave: Transformação digital, estratégia digital, Modelo das Cinco Forças Competitivas, Análise da Cadeia de Valor, Dinâmica dos Sistemas.

INTRODUCTION

The world is changing profoundly, and it has gone from the industrial age to the era of intelligent and connected products with consequences in both organizations and competition. Organizations are experiencing a transformation because of digital technologies (social, mobile, big data, cloud computing, Internet of Things). The impact of information technology is important even in sectors not intensives in information such as the agricultural or mining. The digital transformation presents challenges at several levels, namely in leadership, data governance, global supply chain processes, and in how to integrate technologies to transform the organization. These challenges may be of a magnitude and type not imaginable decades ago. This transformation puts to the test the sustainability of traditional business models. Weill & Woerner (2015) point out that organizations not only fail to take the opportunities given by the digitization but also fail to adapt their business models to reflect the economic characteristics and underlying mechanisms of digitization. At the same time, new companies such as Uber or Airbnb surprise with their ability to define a successful business model based on innovative use of new technologies. These changes in the globalized and digitized world raise the question if the principles derived from traditional theories continue to be sufficient to explain the performance of organizations.

This work is part of a research that aims to formulate a framework that explains resources, capabilities and management choices necessary to respond to the new environment. While some model's constructs and propositions may be valid for any organization, given the nature of the problem it is necessary to make exploratory regional studies to understand the local environment, barriers, and critical success factors to generate value from technology. Hence, the goal of this paper is to define a framework to assess organizational readiness for the new environment. The framework will allow a conceptualization pertinent to the phenomenon under study and it will be the baseline to conduct exploratory case studies.

The article organized as follows. Section 2 describes the methodology. Section 3 provides a literature review that motivates and gives some of the foundations to the paper proposed model. Section 4 discusses relevant dimensions derived from the literature, a specification of the framework using a Causal Loop diagram, and a discussion of an instrument derived from the proposal. Finally, ongoing and future research described. The article organized as follows. Next section describes the methodology. Then a literature review that motivates and gives some of the foundations to the paper proposed model is provided. After that, there is a section aimed to present relevant dimensions derived from the literature, a specification of the framework using a Causal Loop diagram, and a discussion of an instrument derived from the proposal. Finally, ongoing and future research described.

METHODOLOGY

To review the readiness of an organization for adapting to the digital transformation, it is necessary to consider research about key elements for successful product development. Hence, the methodology includes a literature review and analysis based on the Five Competitive Forces Model, the Value Chain Analysis, and contributions of Resource-based view of the firm.

The proposed framework is specified using a Causal Loop diagram. Causal Loop diagram is a modeling tool used in System Dynamics methodology. System Dynamics modeling was developed by Jay W. Forrester and has gained relevance in recent years because of the need to model complex systems. System Dynamics is a methodology to model the forces of change in a complex system so that their influences can be better understood. There is a tradition

in the use of dynamic simulation to study problems in the social sciences. Currently, it is used in business dynamics (Sterman, Henderson, Beinhocker, & Newman, 2007), (Morecroft, 2007), (Kunc, 2010), public health (Horner & Hirsch, 2006), (Thompson & Duintjer Tebbens, 2008), social welfare (Zagonel, Rohrbaugh, & Andersen, 2004), sustainable development (Dudley, 2008), security (Bontkes, 1993), among many others. The methodology is iterative, it allows various stakeholders to combine their knowledge of a problem in a dynamic hypothesis and then, using computer simulation, formally compare various scenarios on how to lead change (Andersen, Richardson, & Vennix, 1997). The emphasis of system dynamics is not to forecast the future, but in learning how the actions in the present can trigger reactions in the future (Senge, 1990). Even though it is not possible to determine with some degree of certainty the value of constants or change rates, the model is used as a learning tool to determine causal paths and relevant factors.

LITERATURE REVIEW

Digital transformation

In the past, most information technologies adopted by organizations were a means to lower operational costs and increase productivity. Hence, the broad strategic view was that Information Technology (IT) strategy must be aligned with the firm's business strategy (Henderson & Venkatraman, 1993). In the last years, the digital infrastructure of organizations and society has radically changed and both researchers and managers have acknowledged that the role of IT has undergone a transformation (Oestreicher-Singer & Zalmanson, 2013). El Sawy was one of the first to refer to the IT fusion model in which technology is fused in the business environment.

Porter & Heppelmann (2014) provide an historic view to the analysis of the influence of technology, and describe three "waves" as follows:

- The first wave of IT (1960s – 1970s) automated individual activities in the value chain. The productivity of activities increased because huge amounts of new data could be captured and analyzed in each activity.
- The second wave (1980s – 1990s) given by the rise of Internet with its inexpensive and ubiquitous connectivity. This enabled coordination and integration across individual activities, with outside suppliers, channels, and customers; and across geography.
- The third wave (now) of IT is becoming an integral part of the product itself. Embedded sensors, processor, software, and connectivity in products, coupled with a product cloud in which product data is stored and analyzed and some applications are run, are driven dramatic improvements in product functionality and performance

Porter & Heppelmann (2014) argue that although the Internet of Things (IoT) shows a new set of technological opportunities, the rules of competence and competitive advantage remain the same. The authors analyze IoT impact on industry structure and the limits of industry to understand the effects of intelligent and connected products. They also describe some strategic options. In a more recent article, the authors analyze the internal implications, such as how the nature of intelligent and connected products redefines the work in each function (product development, IT, manufacturing, logistics, marketing, sales and post-sales service) (Porter & Heppelmann, 2015).

Loebbecke & Picot (2015) use the term "digitization" to refer to changes of established patterns caused by the digital transformation and complementary innovations in economy and society. Digitization penetrates all areas of life and creates new ways of working, communicating and cooperating. Shirky (as cited in (Loebbecke & Picot, 2015)

mentions that connecting individuals, enterprises, devices and governments enables easier transactions, collaboration and social interaction and results in enormous accessible data sources. The interaction between objects adds a multitude of data sources throughout organizations and society. The focus on connected sensors and appliances defines challenges to data flow management. More connections are required with a broad spectrum of organizations and this depends on an adequate management of new relations with stakeholders such as customers, suppliers and rivals.

The improvements in business models that derive from digitization aim to optimize existing processes to increase global efficiency and services and products quality. Digitization enables and makes easier data collection, communication and control activities and in that way, reduces transaction costs. However, the standardization and massive adoption of these solutions are not sufficient to get a sustainable competitive advantage (Markus & Loebbecke, 2013).

The MIT Sloan Management Review and Deloitte conducted a research and the authors highlight that strategy, not technology, drives digital transformation. Maturing digital businesses are focused on integrating digital technologies, such as social, mobile, analytics and cloud, in the service of transforming how their businesses work (Kane, Palmer, Phillips, Kiron, & Buckley, 2015). The findings of this research show that organizations where digital has transformed processes, talent engagement and business models have a clear and coherent digital strategy. Also, digitally maturing organizations are more comfortable taking risks than their less digitally mature peers.

More recently, a research on designing digital organizations also emphasizes the importance of developing a business strategy that takes advantage of digital technologies (Ross, Sebastian, & Beath, 2016). The authors distinguish two kinds of strategies: a customer engagement strategy which targets to superior, personalized experiences that engender customer loyalty; and a digitized solutions strategy aimed at information enriched products and services that deliver new value for customers. In addition, the research observes that operational excellence is the minimum requirement for doing business digitally.

Firm success

The aim of the work is to understand barriers and required conditions to generate value from technology, to understand why some organizations are successful in generating value from technology and others do not. In fact, this question may be framed within the central question in strategy: the reason why firms succeed or fail. Therefore, it is necessary to consider seminal works that address this research question. To explain firm success the early literature on strategy defined three essential conditions (Porter, 1991). The first is that a company develop and implement an internally consistent set of goals and functional policies that collectively defined its position in the market. The second condition for success is that this internally consistent set of goals and policies aligns the firm's strengths and weaknesses with the external opportunities and threats. And the third condition is that firm's strategy been centrally concerned with the creation and exploitation of its so-called distinctive competences.

According to the resource-based view of the firm the origins of competitive advantage are valuable resources (or competences) that firms possess, which are often intangible assets such as skills or reputation (Penrose, 1959). However, the theory does not explain the decision-making process that managers follow to develop their resources. Instead, resource-based strategy researchers have embedded decision-making processes into the concepts of dynamic capabilities which are the capabilities with which managers build, integrate, and reconfigure organizational resources and competencies (Teece, Pisano, & Shuen, 1997), (Adner & Helfat, Corporate effects and dynamics managerial capabilities, 2003) as cited in (Kunc, 2010)). Hence, it is difficult to identify which resources account for

firm success; the interdependencies among resources, and how competitive advantage arise and evolve over time (Gary, Kunc, Morecroft & Rockart, 2008).

Then Porter incorporated ideas from industrial organization economics and industry level factors became the centre of attention (Porter, 1980). To explain the competitive success of firms, Porter proposes the “Five Forces” and the “Value Chain” frameworks which link environmental circumstances and firm behaviour to market outcomes. The “Five Forces” aims to explain the sustainability of profits against bargaining and against direct and indirect competitors. To understand sustainable competitive advantage vis-a-vis its rivals Porter differentiates lower cost than its rivals, or the ability to differentiate and command a premium price that exceeds the extra cost of doing so. Porter also states that an attractive relative position results from possessing competitive advantage within some scope (including the array of products and buy segments served, the geographic locations in which the firm competes, its degree of vertical integration, and the extent of related business in which the firm has coordinated strategy). Hence, the “Value Chain” framework provides a detailed look at what firms do.

This set of frameworks allows systematically evaluating and understanding a firm’s industry structure, positioning, value chain, resources and capabilities.

PROPOSED FRAMEWORK

While theoretical and managerial implications of Porter’s frameworks and resource-based view of the firm’s contributions may remain the same in the context of digital transformation, it is necessary to assess whether new drivers emerge.

Based on the literature review a framework is proposed which aims to assess organizational readiness for sustaining a competitive advantage within the new environment. The framework abstract complexity to isolate a few key variables derived from existing literature. The aim is to highlight relevant conditions, resources and capabilities and use the proposal as a starting point for future case study research.

Dimensions derived from organizational theories and frameworks

Porter and Heppelman (2014), (2015) provide a detailed analysis of the transformative effect of smart and connected products on industry structure and the value chain. Based and inspired on these analyses, some dimensions that should be assessed to understand the significance of digital transformation within an organization are derived.

Five Forces Model Analysis

Smart, connected products capture usage data that allows segmenting customers, customizing products, setting prices to better capture value, and extending value-added services (Porter & Heppelmann, 2014). Organizations that focus on customer success and experience are more prepared to enhance differentiation and this serves to mitigate buyers’ bargaining power. Also, the creation of new value with data requires data capabilities.

The high fixed costs of more complex product design and embedded technology can raise barriers to entrants. The capability of an organization to develop in house or build a partnership with technology experts may give the advantage of first-mover by collecting and accumulating product data.

In many industries smart, connected products create new types of substitution threats. To understand how digitization is affecting an organization, Weill & Woerner (2015) proposes to assess the digital threat by thinking in terms of one of the best-selling product or service and evaluate to what extent it is delivered digitally or can be augmented with valuable information.

Smart, connected products often introduce powerful new suppliers such as providers of sensors, software, connectivity, embedded operating systems, and data storage, analytics (Porter & Heppelmann, 2014). The bargaining power of these new suppliers may be reduced by creating relationships with other providers that offer complimentary services.

Value Chain and Value System Analysis

Holding industry structure constant, a successful firm is one with an attractive relative position (Porter, 1991). An attractive relative position is a consequence of choices about the array of product and buyer segments served, the geographic locations in which the firm competes, its degree of vertical integration, and the extent of related businesses in which the firm has a coordinated strategy. However, as Porter (1991) states to understand why some firms gain an attractive relative position within some scope it is necessary to analyze which firms do. Competitive advantage results from a firm's ability to perform the required activities at a collectively lower cost than rivals, or perform some activities in unique ways that create buyer value. Since digital technologies may have a significant impact on both cost and differentiation it is necessary to understand the conditions for this to happen.

Non-technology firms should develop the necessary partnerships (it is more cost effective than develop in-house) and work to integrate the manufacturing team with the internet team (Slama, Puhlmann, Morrish, & Bhatnagar, 2015). It is not always feasible for a single player to specialize in all the aspects of a smart product value chain (hardware, electronics, software, operating system, connectivity components, and analytics).

Social networks, mobile and IoT products generate huge amount of data that may be used to improve product or services design and support a differentiation strategy. Hence, organizations must add talent in data analytics area. The management, governance, analysis, and security of data are developing into a major new business function. Porter describes a new organizational structure including a new functional unit focused on data management (Porter & Heppelmann, 2015). For the case of Big Data, Davenport (2012) describes several ways it can be used to enhance a business, such as making routine business decisions faster, supporting new decisions and developing new product and services. Any of these applications may contribute to cost savings of improve differentiation.

Even digital technologies pose some opportunities, there are uncertainties about the market needs and hence which is the right value proposition to develop. There are no clear rules about how to proceed. Slama & others (2015) suggest building a minimum viable product and get to market fast. Hence, firms have first-mover advantages by collecting and accumulating product data and using it to improve product and services. A first-mover strategy may imply shorter development cycles and some requirement to optimize development is adopting agile methodologies. General Electric relies on agile methodologies to transition for 20th century conglomerate to 21st century digital industrial company (Rigby, Sutherland, & Takeuchi, 2016). There are many other cases that support the benefits of agile and suggest that organizations which master agile project management techniques have an advantage. However, agile requires training, behavioral change and is not adequate for all innovation types or organizations (Nuottila, Aaltonen, & Kujala, 2016), (Conforto, Salum, Amaral, da Silva, & Magnanini de Almeida, 2014).

Digital ecosystem research

As mentioned in the previous section non-technology firms should develop the necessary partnerships and work to integrate manufacturing team with internet team. The transition to a successful digital enterprise requires expertise in using digital technologies such as cloud, social, mobile and analytics. In the case of smart products building software related characteristics is not usually part of the traditional product engineering process. According to Slama & others (2015), the Internet of Things involves a clash between two worlds in which those in the machine camp and those in the Internet camp will require to work together to create products.

The role of partnerships has also been addressed more thoroughly by digital ecosystem research (Iansiti & Levien, 2004), (Iansiti & Levien, 2004a). The digital ecosystem theory is adequate to analyse the role of IT in organizations that operate in complex networks and has its origins in complexity theory (Stacey, 1995) and organizational ecology (Hannan & Freeman, 1977). Business ecosystems are networks of organizations that are held together through formal contracting and mutual dependency. The entities of a business ecosystem are structured around core firms, whose centrality is established based on control over the dominant technological architecture or brand that structures value in the ecosystem, or other factors such as product characteristics or geography (Teece, 2007). Stakeholder refers to any group or individual who can affect or is affected by the achievement of the organization's objectives (Freeman, 1983). Addressing the needs of internal and external stakeholders has been identified as a key element of successful product development (Majava, Harkonen, & Haapasalo, 2015). Considering that to develop innovative products or services, organization may not have relevant expertise, and then stakeholder's role may become more critical. Also, the concept of digital ecosystem is used for understanding how companies can co-create business with people. Co-creation refers to the scenario in which individuals or consumer communities produce marketable value in voluntary activities conducted independently of any established organization, although they may be using platforms provides by such organizations (Karhu, Botero, Vihavainen, Tang, & Hämäläinen, 2011).

Resources and dynamic capabilities to adopt a digital strategy

The lack of some resources or dynamic capabilities may impede an organization to adopt or develop digital technologies. Many of them may be discovered by doing a Five Forces or Value Chain Analysis. Additionally, other may arise within the organization (for example, collaborative culture, leadership understanding, a well-defined digital strategy) and a case analysis with an organization as a unit of study is required. In what follows, resources and necessary capabilities already discussed in the literature and that may be used as a starting point for a particular case study are described.

Progress in data storage and processing technology led to more data-driven decision making. Brynjolfsson found that between 2005 and 2010, the share of manufacturing plants that adopted data-driven decision-making early tripled to 30 percent, but the rapid diffusion is uneven (Brynjolfsson & Mcelheran, 2016). McAfee and Brynjolfsson describe five management challenges related with Big Data that are related with leadership, talent management, technology, decision making and culture (McAfee & Brynjolfsson, 2012). Companies need leaders who can spot a great opportunity, understand how a market is developing, think creatively and propose truly novel offerings, articulate a compelling vision, persuade people to embrace it and work hard to realize it, and deal effectively with all stake holders. Organizations require expertise at working with large volume of data and capability of helping leaders reformulate their challenges in ways that big data can tackle. It is also necessary to increase cooperation between the people who understand the problems and the ones who master problem-solving techniques and can generate value from data. Successful information technology organization will train and recruit people with a new set of skills who can integrate analytic capabilities into their production environments (Davenport, Barth, & Bean, 2012). Finally, a

data-driven decision-making poses managerial challenges related with how decisions are made and who gets to make them (Klotz, 2016).

Regarding leadership, Bennis (2013) argues that information-driven transparency will change the way that power is delivered by top leaders, and that leaders need to embrace that transparency.

Ross & others (2016) findings include the importance of developing a digital strategy and the need of an operational backbone that ensures efficient, reliable transactions and customer interactions. Berman (2012) also mentions that leading companies focus on reshaping customer value propositions and transforming their operations using digital technologies for greater customer interaction and collaboration. Reshaping the operating model requires integrating all business activities and optimizing how data related to those activities are managed and tracked.

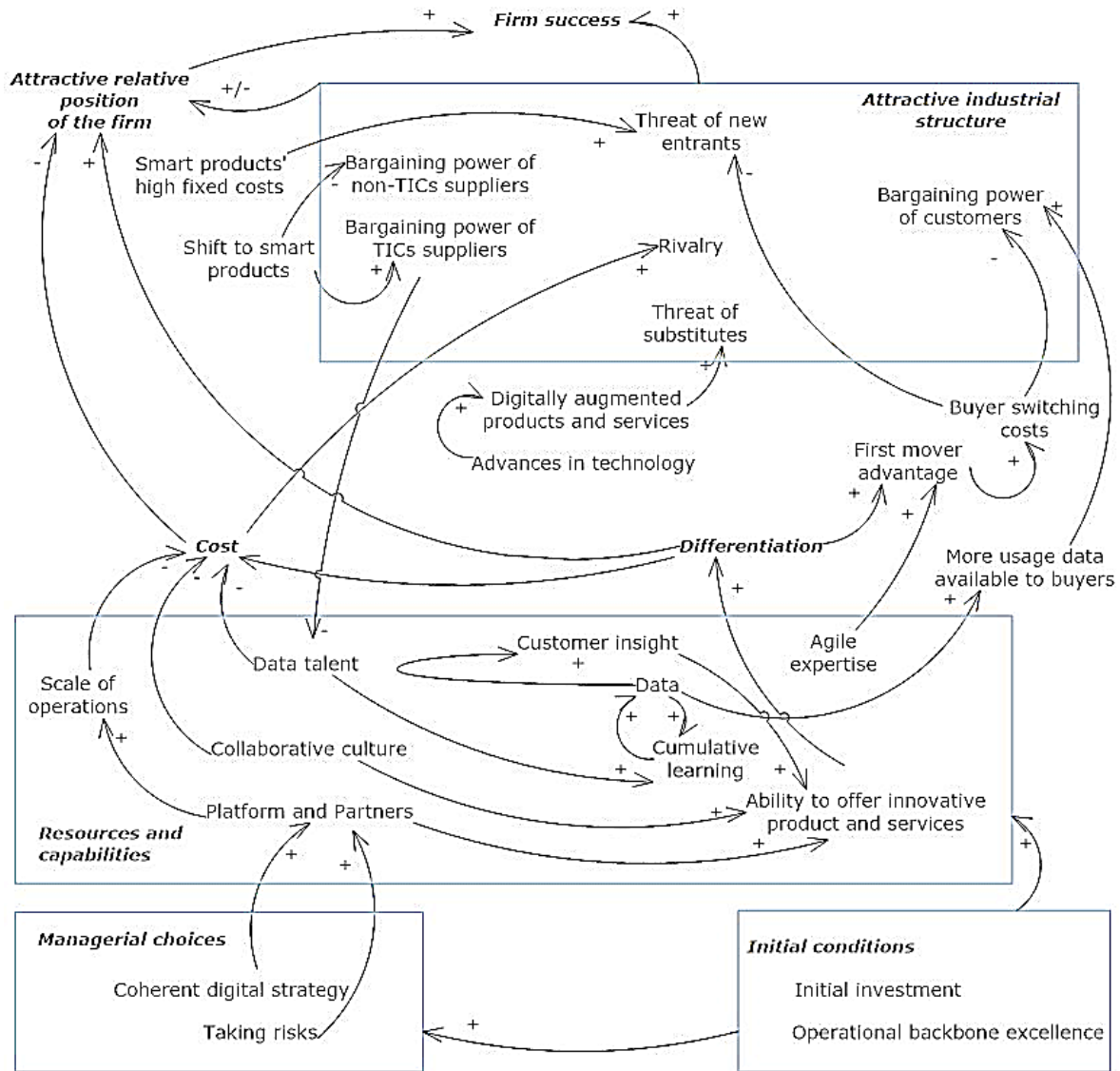
Conceptual framework

The framework in Figure 1 is based on the analysis included in the previous section and the chain of causality to explain the competitive success of firms elaborated by Porter (1991). The framework is presented using a Causal Loop diagram. It shows the interactions between the states of resources, capabilities, environment forces, firm position, the impact of firms' actions, and environment conditions such as advances in technology or shift to smart products. The model consists of causal relationships. The causal relationship $x \rightarrow y$ means that the input variable x has some causal influence on the output variable y . A positive influence means "a change in x , being the rest of variables unchanged, causes y to change in the same direction". The symbol $+$ indicates a positive causality. On the other hand, a negative influence means "a change in x , being the rest of variables unchanged, causes y to change in the opposite direction".

Based on the conceptual framework (Figure 1) it is possible to define a model using a system of differential equations and perform simulations. However, the simulation is out of the scope of this work.

The framework includes environmental circumstances and firm-level dynamics. As observed by Porter (1991), industry structure is partly exogenous, and partly subject to influence by firm actions. Hence structure and firm position ultimately interrelate, which makes separating them a simplification (Porter, 1991). At the broadest level, firm success is feed by the attractiveness of the industry in which the firm competes and its relative position in that industry. An attractive relative position is the result of a competitive sustainable advantage. This advantage can arise from commanding lower cost than rivals, or the ability to differentiate. Some resources and dynamic capabilities have a positive effect on the value chain activities contributing to reduce cost or increase differentiation. At the same time, organizational expertise in agile methodologies facilitates delivering the most valuable innovations earliest and support a first mover strategy. A cycle of positive feedback is given by the increase of data and cumulative learning about customers' experience. This cycle model depicts the ability of firms to improve products and services based on data. The selection of the resources that account for firm success depends on the presence of a coherent digital strategy and easiness to take risks (Ross, Sebastian, & Beath, 2016). In addition, some initial conditions (operational excellence and investment) may have a positive influence on managerial choices and available resources.

Figure 1. Firm and environmental dynamics of digital transformation.



Source: Own elaboration.

Resources and capabilities influence the bargaining power of customers and through their link to cost may increase the rivalry among existing competitors. An increase in the bargaining power of TICs suppliers may reduce the availability of data talent. Environmental events such as the smart products' high fixed cost of development, solution operation and maintenance, the shift to smart products and advances in technology change industry circumstances.

Instrument derived from the model

As mentioned at the beginning of this section a framework is proposed which aims to assess organizational readiness for sustaining a competitive advantage within the new environment. It allows a conceptualization pertinent to the phenomenon under study and is the baseline to define a questionnaire. The questionnaire (see Appendix for details) augmented with information about the relative position and performance of an organization will serve as one of the instruments to conduct deep case study research. The indicators are based on the framework and previous research. Some questions are adapted from (Davenport, 2014) (data management), (Weill & Woerner, 2015) (digital products

or services), and (Conforto, Salum, Amaral, da Silva, & Magnanini de Almeida, 2014) (project management and agile methodologies).

CONCLUSIONS AND FUTURE RESEARCH

Digital transformation emerges as a topic of interest and this is reflected by the many research papers and empirical works. These works indicate that digital transformation becomes the basis of the organizational strategy. While there is a growing number of research that consider digital innovations and their implications in management, given the nature of the problem it is necessary to make an exploratory regional study to understand the local environment, barriers, and required conditions to generate value from technology. But to address these studies it is necessary to develop a preliminary conceptualization of the phenomenon of interest and this is the main contribution of this paper.

The rationale of the proposed framework follows works of Porter since they allow causal chain thinking. Additionally, more recent empiric research findings guided in the selection of relevant issues. While there are many theories that illuminate about topics related with digital transformation (innovation, entrepreneurship, leadership, knowledge management), the initial proposal describes a minimal set of variables. Hence, the resulting framework is tractable in practice. Its specification is based on system dynamics because it naturally models forces of change in a complex system so that their influences can be better understood. The framework is aimed to be a starting point and it will be extended, and updated because of exploratory research.

The questionnaire derived from the framework guides empiric research and it is currently being used in case studies with organizations as unit of analysis. In the future, more cases will be considered, and the insight will be used to improve the framework.

REFERENCES

- Adner, R., & Helfat, C. (2003). Corporate effects and dynamics managerial capabilities. *Strategic Management Journal*, 24, 1011-1025.
- Andersen, D., Richardson, G., & Vennix, J. (1997). Group model building: adding more science to the craft. *System Dynamics Review*, 13(2), 187-201.
- Bennis, W. (2013). Leadership in a Digital World: Embracing Transparency and Adaptive Capacity. *MIS Quarterly*, 37(2), 635-636.
- Berman, S. (2012). Digital transformation: opportunities to create new business models. *Strategy & Leadership*, 40(2), 16-24.
- Bontkes, T. E. (1993). Dynamics of rural development in southern Sudan. *System Dynamics Review*, 9(1), 1-21.
- Brynjolfsson, E., & Mcelheran, K. (2016). The Rapid adoption of Data-Driven Decision Making. *American Economic Review*, 106(5), 133-139.
- Conforto, E., Salum, F., Amaral, D., da Silva, S., & Magnanini de Almeida, L. (2014). Can Agile Project Management be Adopted by Industries Other than Software Development? *Project Management Journal*, 45(3), 21-34.
- Davenport, T. (2014). *Big Data at Work. Dispelling the Myths, Uncovering the Opportunities*. Boston: Harvard Business Review Press.
- Davenport, T., Barth, P., & Bean, R. (2012). How "Big Data" Is Different. *MIT Sloan Management Review*, 22-24.
- Dudley, R. (2008). A basis for understanding fishery management dynamics. *System Dynamics Review*, 24(1), 1-29.
- Freeman, R. (1983). Stockholders and stakeholders: a new perspective on corporate governance. *California Management Review*, 25(3), 88-106.
- Gary, M., Kunc, M., Morecroft, J., & Rockart, S. (2008). System dynamics and strategy. *Syst. Dyn. Rev.*, 24, 407-429.

- Hannan, M., & Freeman, J. (1977). The population ecology of organizations. *American Journal of Sociology*, 82(5), 929-964.
- Henderson, J., & Venkatraman, N. (1993). Strategic Alignment: Levering Information Technology for Transforming Organizations. *IBM Systems Journal*, 32(1), 4-16.
- Horner, J., & Hirsch, G. (2006, March). *American Journal of Public Health*(96), 452-458.
- Iansiti, M., & Levien, R. (2004). *The keystone advantage: what the new dynamics of business ecosystems mean for strategy, innovation and sustainability*. Boston: Harvard Business School Press.
- Iansiti, M., & Levien, R. (2004a). Strategy as ecology. *Harvard Business Review*, 82, 68-78.
- Kane, G., Palmer, D., Phillips, A., Kiron, D., & Buckley, N. (2015). *Strategy, not technology, drives digital transformation*. MIT Sloan Management Review, Massachusetts.
- Karhu, K., Botero, A., Vihavainen, S., Tang, T., & Hämläinen, M. (2011). A Digital Ecosystem for Co-Creating Business with People. *Journal of Emerging Technologies in Web Intelligence*, 3(3), 197-205.
- Klotz, F. (August de 2016). Navigating the Leadership Challenges of Innovation Ecosystems. *MIT SMR Frontiers*, 1-5.
- Kunc, M. (2010). Managerial Decision Making and Firm Performance Under a Resource-based Paradigm. *Strategic Management Journal*, 31, 11-64-1182.
- Loebbecke, C., & Picot, A. (2015). Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda. *Journal of Strategic Information Systems*, 24, 149-157.
- Majava, J., Harkonen, J., & Haapasalo, H. (2015). The relations between stakeholders and product development drivers: practitioners' perspectives. *Int. J. Onnovation and Learning*, 17(1), 59-78.
- Markus, L., & Loebbecke, C. (2013). Compositized digital processes and business community platforms: new opportunities and challenges for digital business strategies. *MIS Quarterly*, 37(2), 649-653.
- McAfee, A., & Brynjolfsson, E. (2012). Big Data: The Management Revolution. *Harvard Business Review*, 10, 60-79.
- Morecroft, J. (2007). *Strategic Modelling and Business Dynamics*. Chichester: Wiley.
- Nuottila, J., Aaltonen, K., & Kujala, J. (2016). Challenges of adopting agile methods in a public organization. *International Journal of Information Systems and Project Management*, 4(3), 65-85.
- Oestreicher-Singer, G., & Zalmanson, L. (2013). Content or Community? A Digital Business Strategy for Content Providers in the Social Age. *MIS Quarterly*, 37(2), 591-616.
- Penrose, E. (1959). *The Theory of the Growth of the Firm*. New York: Wiley.
- Porter, M. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: Free Press.
- Porter, M. (1991). Towards a Dynamic Theory of Strategy. *Strategic Management Journal*, 12, 95-117.
- Porter, M., & Heppelmann, J. (2014). How Smart, Connected Products Are Transforming Competition. *Harvard Business Review*, 4-23.
- Porter, M., & Heppelmann, J. (2015). How Smart, Connected Products are Transforming Companies. *Harvard Business Review*, 1-19.
- Rigby, D., Sutherland, J., & Takeuchi, H. (May de 2016). Embracing Agile. *Harvard Business Review*.
- Ross, J., Sebastian, I., & Beath, C. (2016). How to Develop a Great Digital Strategy. *MIT Sloan Management Review*.
- Senge, P. (1990). *The fifth discipline: the art and practice of the learning organization*. New York: Doubleday/Currency.
- Slama, D., Puhlmann, F., Morrish, J., & Bhatnagar, R. (2015). *Enterprise IoT*. O'Reilly Media.
- Stacey, R. (1995). The science of compelxity: an alternative perspective for strategic change processes. *Strategic Management Journal*, 16(6), 477-495.
- Sterman, J., Henderson, R., Beinhocker, E., & Newman, L. (2007). Getting big Too Fast: Strategic Dynamics with Increasing Returns and Bounded Rationality. *Management Science*, 53(4), 683-696.
- Teece, D. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28(13), 1319-1350.
- Teece, D., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533.
- Thompson, K., & Duintjer Tebbens, R. (2008). Using system dynamics to develop policies that matter: global management of poliomyelitis and beyond. *System Dynamics Review*, 24(4), 433-449.
- Weill, P., & Woerner, S. (2015). Thriving in an increasingly digital ecosystem. *MIT Sloan Management Review*, 56(4), 27-34.
- Zagonel, A., Rohrbaugh, J., & Andersen, D. (2004). Using simulation models to address "What if" questions about welfare reform. *Journal of Policy analysis and Management*, 23(4), 890-901.

APPENDIX

Table 1. Suggested questions to guide an interview to assess organizational readiness for the digital transformation.

Indicator	Measurement
Strategy definition	
<p>To what extent do you agree that the following are part of your organization's strategy?</p> <ul style="list-style-type: none"> - Improve customer experience - Innovation - Decision making - Efficiency 	Four-point Likert scale (strongly agree – strongly disagree)
Platform and partners	
To what extent your value proposition depends on new ways of collaboration with stakeholders (e.g. partners, suppliers, consumers, competitors)?	Four-point Likert scale (great extent – not at all)
To what extent your organization is vertically integrated with suppliers and customers?	Four-point Likert scale (great extent – not at all)
To what extent does your company know about their end customer's goals?	Four-point Likert scale (sells through another company – owns customer relationship)
Digital products or services	
<p>Consider one of your bestselling product or service. To what extent is this product or service ...</p> <ul style="list-style-type: none"> - Electronically specifiable and searchable? - Ordered digitally? - Delivered digitally? - Augmented (or can be) with valuable information? - Threatened by enterprises in other industries that have relationships with your customers –offering competitive services to yours and disrupting our business? - At risk of being replaced with an alternative digital offering? (classroom education vs. Online learning) - Going to be delivered digitally in five years? 	Four-point Likert scale (low extent – high extent)
Resources and capabilities	
<p>My organization ...</p> <ul style="list-style-type: none"> - Is using digital technologies (social networks, mobile, analytics and cloud computing). - Is working in integrating digital technologies (social networks, mobile, analytics and cloud computing). - Monitors customer needs and behaviour. - Is able to respond to threats and opportunities better than our competitors. 	Select one option and use a four-point Likert scale (strongly agree – strongly disagree)
<p>(Data management) In my organization ...</p> <ul style="list-style-type: none"> - Our senior executives regularly consider the opportunities that data analytics (data mining, OLAP, Big Data) might bring to our business. - We integrate data from multiple internal sources into a data warehouse for easy access. - We integrate external data with internal to facilitate high-value analysis of our business environment. We collaborate with channel partners, customers, and other members of our business ecosystem to share big data and applications. 	Four-point Likert scale (strongly agree – strongly disagree)

Indicator	Measurement
<ul style="list-style-type: none"> - We identify internal opportunities for big data and analytics by evaluating our processes, strategies, and marketplace. - We have explored or adopted tools to process unstructured data such as text, video, or images. - Our data scientists, quantitative analysts, and data management professionals operate effectively in teams to address big data and analytics projects. 	
<p>(Project management and agile expertise) How project success is defined?</p> <ul style="list-style-type: none"> - Project success depends on traditional iron triangle criteria on time, within budget, and to specification. - Project success depends on high quality design, and effective functioning of the project team. - Project success depends on solution use, user satisfaction, and user benefits. 	Four-point Likert scale (strongly agree – strongly disagree)
<p>(Project management and agile expertise) Stakeholder involvement: Not involved, involved without influence, involved with influence.</p>	Select an option
<p>(Project management and agile expertise) Multidisciplinary project teams: Not multi-functional, some key departments, most departments.</p>	Select an option
<p>(Project management and agile expertise) Project management responsibility: Created by a department or Project Management Office, created by the project manager, created collaboratively.</p>	Select an option
Barriers to adopt digital technologies	
<p>Which barriers are impeding your organization to adopt or develop digital technologies?</p> <p>Lack of organizational strategy. Lack of ecosystem strategy. Lack of collaborative culture. Lack of leadership/CEO level understanding. CEO-level satisfaction with status quo. Employees lack of ability to use digital technologies (cloud, social, mobile, and analytics). Legal/regulations restrictions. Bestselling product/service dependency on current commercial context.</p>	Multiple selection

Fuente: Own elaboration