Big Data and IoT applications: the use of Information and Communication Technologies to obtain a competitive advantage

Maria Thereza Miranda de Camargo
Scientific Initiation, National Council for Scientific and Technological Development (CNPq), and Pontifical Catholic University of Campinas, Brazil;

Orandi Mina Falsarella
Teacher and researcher, Pontifical Catholic University of Campinas (PUC-Campinas), Center for Economy and Administration, Sustainability Postgraduate Program, Brazil;

Cibele Roberta Sugahara
Teacher and researcher, Pontifical Catholic University of Campinas (PUC-Campinas), Center for Economy and Administration, Sustainability Postgraduate Program, Brazil;

Celeste Aída Sirotheau Corrêa Jannuzzi
Teacher and researcher, Pontifical Catholic University of Campinas (PUC-Campinas), Center for Economy and Administration, Sustainability Postgraduate Program, Brazil

Duarcides Ferreira Mariosa
Teacher and researcher, Pontifical Catholic University of Campinas (PUC-Campinas), Center for Economy and Administration, Sustainability Postgraduate Program, Brazil.

Abstract

Currently, the search for a competitive advantage is a reality in all business sectors. While several reports in the literature that address this theme, only a few discuss the relationship between competitive advantages and the implementation of Information and Communication Technologies. Thus, in the present study, we sought to investigate how the application of emerging ICTs, such as the IoT and Big Data, can provide a competitive advantage to organizations. To achieve this goal, we conducted a qualitative bibliographic survey of the literature, to identify and analyze the presently available publications on the subject of ICTs and organizational management. Additionally, we defined the elements that corroborated the conceptual construction of the results. Based on the literature, we were able to demonstrate that organizations that utilize Big Data and IoT applications can gain a competitive advantage over their competitors.

Keywords: Competitive advantage, Information and Communication Technologies, Big Data, Internet of Things.

1. Introduction

With the systematic and increasing competition among organizations, whether by the entry of new companies that operate in the same segment of institutions that are already established in the market or of existing companies that start to operate in segments that they did not previously operate, strategies that can afford a competitive advantage are in constant demand. According to Thompson et al. (2008), a competitive strategy is a plan implemented by a company that allows it to successfully compete against and gain a competitive advantage over the competitors in a specific industry [34].

While there is a plethora of factors that can contribute to the achievement of a competitive advantage, the deployment of existing or emerging Information and Communication Technologies (ICT) has been gaining recognition. Existing ICTs include different types of information systems such as Transaction Processing Systems, Management Information Systems, Decision Support Systems, Executive Support Systems, Enterprise Resource Planning, among others [16]. On the other hand, notable examples of emerging technologies include Big Data and the Internet of Things (IoT). The rapid rise of Big Data and the IoT is primarily due to the resulting increase in connectivity among people and objects, enhancements in sensor and hardware technologies and rise in internet availability. As a consequence of the applications and technologies, anyone or anything can be accessed or monitored anywhere at any time.

The concept of Big Data, in recent years, is largely due to the enormous amounts of data that is generated from a variety sources such as social networks, social media, mobile devices, scientific activities, simulations, experiments, sensors as well as from other devices and activities and traditional sources [5]. Thus, the term Big Data refers to a set of data that grows exponentially and whose dimension is beyond the ability of typical tools to capture, manage and analyze [19]. It is for this reason that Manyika et al. (2011) previously suggested that the use of cloud computing would be necessary for managing these incalculable amounts of generated data [19].

It should be pointed out that with Big Data it is not only the volume that needs to be taken into consideration but also the variety of information and the speed of accessing and processing it [23]. Indeed, by paying attention to these important aspects, Big Data facilitates the best use of this information and allows the user(s) to achieve a specific goal(s). During this process, it is extremely important to point out that only useful information should be extracted and analyzed.

Previously, it was proposed by Mayer-Schönberger and Cukier (2013) that Big Data can be characterized by the five V's: volume, variety, velocity, veracity and value [20]. In this context, volume refers to the amount of data, which can be structured as with texts and files or unstructured as with photos, videos, social media posts, etc., that Big Data deals with; variety comes from the fact that the obtained data or information originates from different sources; velocity has to do with the speed and agility required for handling and managing the data, which is sometimes utilized for decision-making processes; veracity relates to the authenticity of the data; and value concerns how the acquired information benefits the user(s) and, thus, symbolizes how useful it is.

The other emerging ICT is the IoT. Simply put, the IoT is a system of devices connected to the internet. According to Pacheco, Klein and Righi (2016), the IoT is both an opportunity and a challenge for companies in different industries or sectors, since it provides a digital capacity that is embedded in products

and objects, including cars, televisions, refrigerators, books and other products, consequently offering new functions and applications and enhancing their utility [26]. It has been reported that about 55% of IoT applications are related to public services and smart cities and that the other 45% are embedded in appliances and vehicles [32]. Due to the growing prevalence of this technology, Atzori, Iera and Morabito (2010) stated that the IoT will influence various aspects of daily life, including the behavior of users both at home and work [2]. For example, possible applications of this new paradigm are related to assisted living, e-health, industrial automation and manufacturing, logistics, business and process management, intelligent transportation of people and goods, among others.

Since IoT applications can connect people with people, people with objects and objects with objects, and because Big Data can collect, organize and analyze data with the speed necessary for decision-making processes, these emerging ICTs could revolutionize our society. Indeed, through the development of products and services, based on these emerging ICTs, it is plausible that organizations could gain a competitive advantage over their competitors. Therefore, the present study sought to evaluate how IoT and BIG Data are related to organizations achieving a competitive advantage.

Towards this goal, we conducted a bibliographic survey, understood as a formal procedure with reflective thinking that allows researchers to identify new facts and relationships in any area of knowledge [15]. Herein, the bibliographic survey was of a qualitative character [38], that sought to identify and analyze the currently available literature, in the field of ICTs and organizational management, and to define the elements that corroborate the conceptual construction of the results.

2. Theoretical foundation

2.1 Competitive advantage

A competitive advantage can be achieved when is a company implements a generic strategy to obtain and sustain an advantage in its market segment [27]. Previous studies have shown that this advantage occurs when an organization utilizes a value creation strategy that cannot be simultaneously launched by other current or potential competitors [4, 13]. Additionally, Porter stated that a competitive advantage arises from the value a company creates for its buyers, and when that value exceeds the cost of manufacturing the product or delivering the service [27]. In other words, value is the amount that consumers are willing to pay for a product or service, and value is created when the purchase price exceeds the cost of any generic strategy [13]. A competitive advantage also occurs when the strategies adopted by the companies lead to levels of economic performance that are above the market average, which can be explained by different currents of thought about strategy [17].

For example, Vasconcelos and Cyrino (2000) state that the issue of a competitive advantage can be divided into four major models, further segmented into two explanatory currents of thought: external factors and internal factors [36]. Concerning external factors, the model of Michael Porter stands out because he analyzed the industrial structure. In this model, Porter considers five competitive forces present in the business environment that must be studied to determine an efficient business strategy [27].

The first competitive force has to do with the threat of new entrants, that is, new competitors. This force is related to how easy or difficult it is for a new competitor to enter a sector. Typically, there is an inverse

relationship between ease of entry and competition, with more complex levels of entry resulting in less competition. The second and third forces are the bargaining power of buyers and suppliers. These two forces are similar since both are related to the power each party has. On the one hand, buyers use it to reduce prices, while on the other hand suppliers use it to affirm dependency since their products are essential to the buyer. The fourth force is substitute products and has to do with how simple or complicated it is for a buyer to replace one product or service with another that is similar or perhaps better. Finally, the fifth force is industry competitors or the degree of competitiveness within the industry.

The second model that deals with a competitive advantage, presented within the current of external factors, is market process theory, which originally came from the Austrian school. This theory primarily refers to the understanding of the market phenomenon by reformulating and reconstructing fundamental neoclassical ideas and secondarily by studying the processes through which the markets reach equilibrium. Put another way the Austrians prioritize the market process as an object of study and relegate the analysis of the equilibrium conditions to a plane that is nothing more than instrumental [12]. Previously, the market was seen as a force that keeps economic agents in balance, and any economic phenomenon that shifts this equilibrium was categorized as a transient event. However, with the recent constant waves of change, innovation and new competitors, these above-average economic performance phenomena are now desired. In fact, according to market process theory, a permanent process of discoveries that generates information and knowledge will increase the occurrence of above-average performance phenomena and create competitive advantages. Indeed, it is this vision that leads to the constant search for innovations that competitors are unable to imitate or supplant. However, these innovations are difficult to produce, because the role of the entrepreneur is not only to make discoveries but also to imitate competitors in an agile way. Notably, four fundamental aspects of market process theory have been identified and include competition, knowledge and discovery, incentives and rewards and market prices [14, 36].

The third model presented within the current of external factors is the theory of resources and capabilities. According to this theory, obtaining a competitive advantage is linked to endogenous factors organizations employ, and the maintenance of this advantage is defined by the present and future endowment of its resources and capabilities and their nature in the face of income generation [24]. This theory follows the assumption that organizations, even ones that operate in the same segment, are not identical in terms of resources and capabilities. It is this heterogeneity that defines the organization and becomes its identity. Notably, organizations that adapt to the external environment, because their internal resources can develop competencies above their competitors, consequently create a competitive advantage.

Another model that deals with competitive advantages is the resource-based view [4]. This model describes how organizations can obtain a competitive advantage using its distinctive resources and competencies and is primarily based on four types of internal resources: financial, physical, human and organizational, which can be characterized as tangible or intangible. Financial, physical and human resources are considered tangible since they can be “touched” and/or easily measured. On the other hand, human and organizational resources are considered intangible, because they do not have a physical form. Concerning competitive advantages, it is the intangible resources that lead to the generation of strategic competitiveness, since they are based on information and knowledge and can expand without limits [24]. It should be pointed out that

in the resource-based view, the external environment is an important source of resources that can be acquired and used to complement the existing internal resources of the organization.

The fourth and final model is the dynamic capability theory, which can be understood as the integration of internal and external factors in constantly changing environments [33]. This theory addresses the aforementioned market process and resources and capabilities theories and the conceptual structure is largely based on the elements of the resource-based view [3]. Additionally, in the dynamic capabilities theory, the identification of changes in the external environment are considered because these changes are the generators of resource reconfigurations that the organization already possesses [18]. Moreover, this theory can be viewed as the ability an organization has to promote strategies that give them a competitive advantage in a dynamic environment [25] and seeks to relate this competitive advantage with how it reconfigures its resource base using evolution and external renewal, thus determining its competence.

Table 1 - Characteristics of competitive advantage models

INTERNAL FACTORS	EXTERNAL FACTORS
Resources and Capabilities • Resources and capabilities of organizations. • Heterogeneity of internal resources and capabilities. • Resource-based view [4]. • Tangible and intangible resources.	Industrial Vision • Competitive Forces [27]. • Generic Strategies [27].
Dynamic Capabilities • Interaction between internal and external factors (market + resources and capabilities) • "Inventory" of resources to supply constant market changes. • Knowledge and innovation.	Market Process • Views the market as a continuous process of discoveries. • Generates above-average performances (competitive advantage).

As shown in Table 1, the main characteristics of the competitive advantage models are summarized. It should be pointed out that, to obtain a competitive advantage, companies must take into account the analysis of how they can gain an advantage over the competition. Moreover, because of the aspects observed, the term competitive advantage stands out as a basis for the business context and is key to the positioning of a company within its business environment.

2.2 Big Data and IoT and their applications

Within the context of Big Data, there are two other important terms, Business Intelligence (BI) and Big Data Analytics (BDA). To meet business-related goals and solve problems, BI tools, including software and services, are used to extract data that is important to the company and then arrange the information into hierarchical levels. After this phase of data processing, BDA is employed to analyze the information and generate value that can be used to justify potential investments and achieve a competitive advantage. Concerning a competitive advantage, McAfee and Brynjolfsson (2015) demonstrated that organizations

that effectively utilized Big Data were 5% more productive and 6% more profitable than their competitors [21]. Moreover, Hoppen and Baptista (2015) generated generic industry sectors data sets and identified banks/credit and insurance, security, health, oil, gas and electricity, retail, production, representative organizations, marketing, education, financial/economic, logistics, e-commerce, games, social networks and platforms and recruitment as the types of businesses that can use Big Data to obtain business opportunities [11]. The same authors also point out that analyzing lists of assets and values and transaction history data can identify the optimal purchase value of complex assets, determine trends in asset values and discover opportunities [11].

In the retail sector, Big Data must first consider consumers that are not recognized channels, but rather people that can discriminate brands, value proposals and shopping experiences [31]. In this sense, Big Data makes it possible to monitor and track consumption trends in the retail market.

Another sector that can take advantage of Big Data is in the transport sector. This sector produces large amounts of data that Big Data could use to improve cargo handling and optimize delivery times, ultimately providing a competitive advantage.

In the marketing sector, Big Data contributes to achieving business objectives, by analyzing large volumes of data and predicting behaviors, segmenting campaigns and offering personalized products and services [9].

In the human resources sector, Big Data creates business opportunities. by using registration information, social networks, histories and professional curricula. In this sense, the employer can carry out a more detailed assessment of the prospective job applicants and/or improve the allocation of existing personnel and resources [11].

It has also been demonstrated that Big Data also benefits information security, which happens to be a major concern of organizations [10]. Here, by aligning the tool with information security, it is possible to detect threats and suspicious activities, log attempted intrusions and monitor the spread of viruses in real-time with precision and responsiveness.

Concerning the medical sector, the health portal Saúde Business (2017) mentioned that data analytics could be used as a facilitator in scientific evidence, by making diagnoses and recommending treatments; predicting patient health events based on medical records and artificial intelligence algorithms and resources; and assisting in hospital administrative decision-making [30].

According to Bronson and Knezevic (2016), the agri-food sector could benefit from using Big Data collection and analytics tools. For example, the Monsanto Corporation has developed a suite of digital tools (Integrated Field Systems platform) that allows farmers to collect information about soil conditions, weed varieties and weather [8].

In the legal sector, there is an increase in the use of Big Data by law professionals and firms. In fact, some applications can assist in the analysis of the probability of gain, decision-making, creating scenarios and verifying the results [6].

With regard to the IoT, the term “Internet of Things” was first introduced in 1999 by Kevin Ashton, a researcher at the Massachusetts Institute of Technology (MIT) Auto-ID Lab, who used the term during his presentation on the use of Radio-Frequency IDentification (RFID) in the supply chain of a large company [1, 35]. However, it was not until 2001, when the term was officially presented by Brock, also a researcher

at the Auto-ID Lab [7]. Since its conception, the IoT uses objects that are equipped with the ability to communicate and process data. In most cases, the objects are embedded with sensors that can collect and share data over a network.

Due to its inherent versatility, the IoT can be and has been used in a variety of different settings. Notably, in the industrial sector, IoT technologies have facilitated the new industrial revolution, through the establishment of the Industry 4.0 era and integration of technology into production and logistics lines. As exemplified by Xu, Xu and Li (2018), IoT applications in the manufacturing industry, such as Product Lifecycle Management (PLM), allow for the collection and management of data that can be used to monitor and optimize processes and decisions throughout the entire product development stage [37]. In this sense, unique identifiers for products or parts are essential for PLM applications during the predefined lifecycle, since products in PLM are disposed of in a distributed, mobile and collaborative environment at both the intra- and inter-organizational levels [37]. Romeder (2016) mentions IoT applications that can be used in PLM, using mainly RFID sensors and tags [28]. Broadly speaking, from a manufacturing process perspective, IoT solutions can be employed to define and use suitable production equipment, monitor production, detect problems and decision-making activities. When successfully deployed IoT can increase the uptime of the machines and improve manufacturing efficiency.

Other sectors that can take advantage of IoT technologies include design and marketing, in which sensors report exactly where, when and how a product is used and/or assist in design and marketing processes [28]. Additionally, in the retail sector, components connected to products allow companies to predict when consumers will need replacement parts, thus encouraging proactive sales. In healthcare, doctors and hospitals can collect and organize data from connected medical devices, that are worn by the patient or installed in their homes. In agriculture, sensors can monitor humidity and temperature, automatically activate irrigation systems and increase productivity in the field, and it has also been proposed that sensors could be employed to monitor the amount of feed available to farm animals, automatically replenishing when it is low.

3. Relationship between IoT and Big data and competitive advantage

Based on the previously discussed competitive advantage models and the segmentation of the various application sectors, we were able to observe that each of the models has different approaches for each area of activity of the companies (see Table 1). In Table 2, a summary of the relationships between each competitive advantage model and Big Data and IoT technologies are presented. Interestingly, it was possible to observe that in all of the models, there are applications that can be employed in various market sectors that help organizations achieve a competitive advantage. Importantly, the information in Table 2 demonstrates that a new relationship can be applied to the four models of competitive advantage and their respective areas of greater focus in conjunction with the applications of Big Data and IoT.

For example, when applying the Resources and Capabilities Model to the area of human resources, Big Data can be used to improve the hiring process of prospective employees, by automating the collection and extraction of information from registration information and resumes. As a result, applicants can be screened and only the ones that meet the characteristics the vacancy offered would be selected, thus reducing the

waiting and response time. Moreover, in the security sector, the use of IoT technologies, such as sensors, make it possible to monitor access to physical locations like data centers, control environments, identify risks and prevent human errors, ultimately protecting the information of the organization.

In the Dynamic Capabilities Model, the marketing sector can use Big Data to monitor consumer trends and identify target audiences, by sending out personalized surveys and using services that forward ads and promotions to potential consumers interested in the company. Concerning IoT in the marketing sector, it can create solutions that spike the interest of consumers, such as connecting customers with the nearest store. Additionally, in the design sector, IoT applications could report where, when and how a product is used, assisting in design and marketing processes.

Table 2. Relationships between competitive advantage models and Big Data and IoT applications.

MODELS	APPLICATIONS	
	BIG DATA	IoT
RESOURCES AND CAPABILITIES	• Use *Analytics*, transforming information into value; • Contribute to justify investments better; • Discover market trends; • Improve the process of hiring human resources; • Discover patterns of consumption trends; • Analyze price statistics, create consumer profiles; • Improve the profile assessment for the position; • Efficiently allocate resources; • Improve information security	• Use RFID tags in products for smart inventory • Connect customers with the nearest store; • Use sensors and RFID tags to monitor production; • Use access sensors to obtain total control of the environment, identifying failures, threats.
DYNAMIC CAPACITIES/ MARKET PROCESS	• Use Analytics, transforming information into value; • Contribute to justify investments better; • Discover market trends; • Discover patterns of consumption trends; • Analyze price statistics, create consumer profiles; • Improved profile assessment for a position; • Efficient allocation of resources; • Information security; • Database protection and encryption.	• Use RFID tags on products for smart inventory; • Connect customers with the nearest store; • Use access sensors, obtaining total control of the environment, identifying failures, threats. • Collect and organize data from connected medical devices. • Report where, when, and how a product is used to assist with design and marketing processes.

INDUSTRIAL VISION	• Use Analytics, transforming information into value; • Use machine learning for decision making • Seek efficiency in route planning to save fuel and time; • Improve the allocation of the logistics fleet; • Contribute to justify investments better; • Determine trends in asset values; •Analyze price statistics, create consumer profiles; • Improve the profile assessment for the position to be filled; • Efficiently allocate resources; • Generate information for information security.	Detect problems with machinery; Use RFID tags in products for smart inventory; Use access sensors, obtaining total control of the environment, identifying failures, threats; Use real-time monitoring sensors to generate transport and production data such as location, handling frequency, speed, mileage, and vehicle problems.

In the Market Process Model, Big Data can be used to discover insights that can guide the strategies of an organization. For example, using software to extract information from employee documents or informational assets could predict patterns and trends and consequently transform this information into value. In the retail sector, IoT technologies such as sensors or RFID tags can more intelligently control and monitor inventories and monitor sales, both made and lost, in real-time.

In the Industrial Vision Model, one of the main relationships between Big Data and IoT applications is incorporated in the production and logistics sectors. In the production sector, both Big Data and IoT contribute to the so-called Industry 4.0. Big Data guarantees that all the data coming from the machinery is collected and uses machine learning for making decisions without the need for human intervention. On the other hand, the IoT provides the hardware that is attached or embedded into Industry 4.0 machines, facilitating connectivity and integrating production chains and systems, which allows for the automation of all the manufacturing processes. Additionally, in the logistics sector, Big Data can optimize the allocation of transport resources to determine the most efficient transport routes and identify unnecessary expenses. IoT uses sensors and GPS to monitor transport data in real-time, recording data such as location and mileage traveled. Moreover, this ICT allows companies to monitor the status of the transported products and in cases of theft can be used to quickly pinpoint the location of the cargo, consequently minimizing losses.

Based on the observed relationships between the different competitive advantage models and Big Data and IoT applications and technologies, the examples discussed above demonstrate that, in most cases, the use of these ICTs can benefit numerous business sectors. This is primarily because these technologies facilitate the automation of a variety of processes, enhance control and perform real-time monitoring. As they increase efficiency and reduce unnecessary expenses, these technologies provide organizations with greater

sustainability, the ability to perform above the market average and reinforce the idea that Big Data and the IoT provide a competitive advantage to the organizations over their competitors,

4. Conclusion

In the context of ICTs, such as Big Data and the IoT, academic studies and publications, as well as the practical use of applications by organizations are still relatively new; however, the adoption of these technologies by organizations, academic and research institutions is rapidly increasing. This result is driven by the fact that the use of these technologies progressively please an increasingly innovative and competitive market. In the present study, we listed and discussed specific competitive advantage models and Big Data and IoT applications and demonstrated that the use of these emerging ICTs helps organizations achieve a competitive advantage.

In addition to process automation, these technologies are a driving force for promoting relevant changes in the competitive market as a whole. Moreover, we were able to show that relationships between competitive advantage models and ICT applications exist, regardless of the characteristics of the competitive advantage model. In conclusion, we affirm that Big Data and IoT provide a competitive advantage to the organizations that use them by making each organization technologically updated, identifying new business opportunities and reducing costs.

5. Acknowledgment

The authors would like to thank the Pontifícia Universidade Católica de Campinas and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for the finanical support needed to conduct this research project.

6. Bibliographic references

[1] K. Ashton, That ‘internet of things’ thing, RFID Journal, 2009. Disponível em: < https://www.rfidjournal.com/that-internet-of-things-thing >. Acesso em: 12 jan. 2020.

[2] Atzori, L., A. Iera, and G. Morabito, The Internet of Things: A survey, Computer Networks, Elsevier, v. 54, 2010, pp. 2787-2805.

[3] Augier, M. and D.J. Teece, Strategy as evolution with design: The foundations of dynamic capabilities and the role of managers in the economic system, Organization Studies, v. 29, 2008, pp.1187-1208.

[4] J. Barney, Firm Resources, and Sustained Competitive Advantage, Journal of Management, v. 17, 1991, pp. 99-120. Disponível em: < https://journals.sagepub.com/doi/10.1177/014920639101700108 >. Acesso em: 12 dec. 2019.

[5] Begoli, E. and J. Horey, Design Principles for Effective Knowledge Discovery from Big Data, Joint 10th Working IEEE/IFIP Conference on Software Architecture and European Conference on Software Architecture, IEEE Computer Society, Helsinki, 2012, pp. 215-218.

[6] P. Borges, Data Analytics e Big Data para advogados, Gestão Jurídica Empresarial, 2017.

[7] Brock, D.L., The Electronic Product Code (EPC) – A naming Scheme for Physical Objects, Auto-ID Center White Paper WH-002 MIT, Cambridge, 2001, pp.290-307.

[8] K. Bronson and I. Knezevic, Big Data in food and agriculture, Big Data & Society, 2016. Disponível em: < https://journals.sagepub.com/doi/full/10.1177/2053951716648174 >. Acesso em: 10 jan. 2020.

[9] V. Duarte, Big data e aplicações, TIC em foco, 2017. Disponível em: < https://www.ticemfoco.com.br/big-data-e-aplicacoes/ >. Acesso em: 18 ago 2019.

[10] L. Guimaraes, Como o Big Data beneficia a segurança da informação?, Know Solutions, 2017. Disponível em: < https://www.knowsolution.com.br/como-o-big-data-beneficia-a-seguranca-da-informacao/ >. Acesso em: 05 out. 2019.

[11] J. Hoppen and M.A.F. Baptista, 14 setores para aplicação de Data Analytics, Aquarela. 2015. Disponível em: < https://www.aquare.la/14-setores-para-aplicacao-de-data-analytics/>. Acesso em: 05 set. 2019.

[12] J.U. Iorio, A Escola Austríaca, o processo de mercado e a função empresarial, Mises Brasil, 2013. Disponível em: < https://www.mises.org.br/article/1534/a-escola-austriaca-o-processo-de-mercado-e-a-funcao-empresarial-/>. Acesso em: 02 jan. 2020.

[13] Ito, N.C., P. Hayashi, F.A.P. Gimenez, and J.E. Fensterseifer, Valor e vantagem competitiva: buscando definições, relações e repercussões, Revista de Administração Contemporânea, Rio de Janeiro, v. 16, n. 2, 2012, pp.290-307.

[14] Kirzner, I. M., Discovery and the capitalist process, The University of Chicago Press, Chicago, 1985.

[15] Lakatos, E.M. and M.A. Marconi, A Metodologia do trabalho científico, 7º ed. Atlas, São Paulo, 2007.

[16] Laudon, K. and J. Laudon, Sistemas de informação gerenciais. 9th ed, Pearson Prentice Hall, São Paulo, 2010.

[17] Leite, J.B.D. and M.C.S. Porsse, Competição Baseada em Competências e Aprendizagem Organizacional: em Busca da Vantagem Competitiva. Revista de Administração Contemporânea, Curitiba, v. 7, 2003, pp.121-141. Disponível em: < https://www.scielo.br/scielo.php?script=sci_arttext&pid=S1415-65552003000500007/>. Acesso em: 28 ago. 2019.

[18] Makador, R., Toward a synthesis of the resource-based and dynamic-capability views of rent creation, Strategic Management Journal, 22, 2001, pp. 387–40.

[19] Manyika, J., M. Chui, B. Brown, J. Bughin, R. Dobbs, C. Roxburgh, and A.H. Byers, Big data: The next frontier for innovation, competition, and productivity, McKinsey & Co, 2011.

[20] Mayer-Schonberger and K. Cukier, Big Data: como extrair volume, variedade, velocidade e valor da avalanche de informação cotidiana, 1st ed, Elsevier, Rio de Janeiro, 2013.

[21] A. McAfee and E. Brynjolfsson, Big Data: The Management Revolution, Harvard Business Review. 2012.

[22] Meirelles, D.S. and A.A.B. Camargo, Capacidades Dinâmicas: O Que São e Como Identificá-las?, Revista de Administração Contemporânea, Rio de Janeiro, v. 18, n. 3, 2014, p.41-64. Disponível em: < https://www.scielo.br/pdf/rac/v18nspe/1415-6555-rac-18-spe-00041.pdf>. Acesso em: 02 jan. 2020.

[23] Mohanty, H., P. Bhuyan, and D. Chenthati, Big Data A Primer, 1st ed, Springer, India, 2015.

[24] Noriler, I.L.M. and A.R. Andrade, A gestão estratégica e a teoria dos recursos e capacidades no CRIEM – Centro de Referência em incubação e empreendedorismo de Blumenau: a opinião das empresas incubadas, Gestão & Regionalidade, São Caetano do Sul v.22, n.64, 2006 p.67-77. Disponível em: < file:///C:/Users/Administrador/Downloads/57-135-1-PB%20(1).pdf>. Acesso em: 22 de jun. 2019.

[25] Ottoboni, C. and J.Y. Sugano, Compreendendo a capacidade para inovarem empresas de base tecnológica (EBTs) a partir da abordagem capacidades dinâmicas, In Anais do XXXIII Encontro da Associação Nacional de Pós-Graduação e Pesquisa em Administração. ANPAD, Rio de Janeiro, 2009. Disponível em: < http://www.anpad.org.br/diversos/down_zips/45/ESO1991.pdf>. Acesso em: 15 de set. 2019.

[26] Pacheco, F.B., A.Z. Klein, and R.R. Righi, Modelos de negócio para produtos e serviços baseados em internet das coisas: uma revisão da literatura e oportunidades de pesquisas futuras, REGE - Revista de Gestão, São Paulo, v. 23, 2016, p.41-51. Disponível em: < http://www.revistas.usp.br/rege/article/view/121064>. Acesso em: 14 de nov. 2019.

[27] Porter, M.E, Vantagem Competitiva: criando e sustentando um desempenho superior, 16th ed. Editora Campus, Rio de Janeiro, 1989.

[28] S. Romeder, Dez aplicações possíveis de Internet das Coisas em PMEs, Computerword, 2016. Disponível em: < https://computerworld.com.br/2016/07/20/dez-aplicacoes-possiveis-do-conceito-de-internet-das-coisas-em-pmes/>. Acesso em: 14 de jan. 2020.

[29] Santos, I.B., A. Sandman, B.E. Souza, C.A.P. Schmidt, P.L. Paula, A.I. Melges, and J.F. Marcolin, Internet das coisas (IoT) aplicada ao agronegócio: Projeto e implementação de um gateway de IoT sobre a plataforma Arduino para simplificar a automatização da agricultura, Brazilian Journal of Development, Curitiba, v. 5, n. 11, novembro de 2019.

[30] Saúde Business, 5 aplicações de Big Data e AI na medicina, 2017. Disponível em: < https://saudebusiness.com/ti-e-inovacao/5-aplicacoes-de-big-data-e-ai-na-medicina/>. Acesso em: 15 de set. 2019.

[31] A. Serrentino, Varejo omnichannel. Mercado e Consumo, São Paulo, n. 5, fev./mar. 2014 p. 42. Disponível em: < https://www.mundodomarketing.com.br/artigos/alberto-serrentino/30036/varejo-omnichannel.html>. Acesso em: 22 de jan 2020.

[32] J. Tan, A internet das coisas e a sustentabilidade dos negócios, CIO, 2016. Disponível em: < https://cio.com.br/a-internet-das-coisas-e-a-sustentabilidade-do-negocio>. Acesso em: 15 de mar 2020.

[33] Teece, D.J., G. Pisano, and A. Schuen, Dynamic capabilities and strategic management, Strategic Management Journal, v. 18, n. 7, 1997 p. 509-533.

[34] Thompson, A.A., A. Strickland III, and J.E. Gamble, Administração Estratégica, 15th ed. McGraw-Hill, São Paulo, 2008.

[35] Uckelmann, D., M. Harrison, and F. Michahelles, Architecting the Internet of Things, 1st ed. Springer, Berlin, 2011.

[36] Vasconcelos, F.C. and A.B. Cyrino, Vantagem competitiva: os modelos teóricos atuais e a convergência entre estratégia e teoria organizacional, Organização, Recursos Humanos e Planejamento, São Paulo, v. 27, n. 1, 2000 p. 20-37.

[37] L.D. Xu, E.L. Xu, and L. LI, Industry 4.0: state of the art and future trends, International Journal of Production Research, 2018. Disponível em: < https://www.tandfonline.com/doi/full/10.1080/00207543.2018.1444806>. Acesso em: 24 de jan 2020.

[38] R.K. Yin, Pesquisa qualitativa do início ao fim, Tradução Daniel Bueno. Porto Alegre: Penso, 2016.