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IMPROVING ORGANIZATION DYNAMIC CAPABILITIES USING ARTIFICIAL INTELLIGENCE

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ABSTRACT

Artificial Intelligence is diffusing through organizational environments, having become one of the pillars of the so-called the Fourth Industrial Revolution. This exploratory research investigates how the diffusion of Artificial Intelligence affects three Dynamic Capabilities of organizations: Sensing, Seizing and Reconfiguring. Using an interpretive approach and qualitative methods (13 semi-structure interviews with experts in the field of Artificial Intelligence), the paper suggests areas in which Artificial Intelligence is contributing to organizational Dynamic Capabilities. The findings show alignment with the academic and industry literature, pointing out implications for organizations, practitioners and researchers.

JEL: M100

KEYWORDS: Artificial Intelligence, AI, Dynamic Capabilities, Sensing, Seizing, Reconfiguring

INTRODUCTION

The diffusion of Artificial Intelligence (AI) for businesses is going fast. Experts consider that AI is today one of the pillars of the so-called Fourth Industrial Revolution (Schwab, 2017). The forecast is that by 2035, AI is going to improve labor productivity by 40%, doubling the economic growth of the most developed countries (Purdy and Daugherty, 2016). The expectations are that humanity will reach intellectual levels that would not be possible without AI (Accenture, 2018). The scope for AI applications is broad: from autonomous cars and drones, to assistant robots, personal assistants and intelligent machines such as IBM Watson and Google DeepMind. From the simple optimization of operations to the more sophisticated application in scientific discovery, AI is diffusing everywhere (McAfee and Brynjolfsson, 2017). Such a technological revolution has a significant impact on businesses. Academic research points out that most professionals and industries are expected to be affected by the diffusion of AI (McAfee and Brynjolfsson, 2017). AI is going to substitute labor in tasks that digital technology can do better than humans do (McAfee and Brynjolfsson, 2017). It is also going to be integrated into human activities, as part of workforce systems (Accenture, 2018). On the one hand, machine-learning techniques are going to allow AI to learn from humans and human behavior.

On the other hand, humans are going to discover new ways of working, through interactions with intelligent machines: there is a new language and a new way of thinking which is proper of AI solutions, and we need to learn to communicate with and understand these interfaces to get the best from technology (McAfee and Brynjolfsson, 2017, Tegmark, 2018). In this era of radical innovation, businesses need to rethink their practice to incorporate AI technologies, in such a way that they can preserve or enhance their competitive advantage in an environment in which technology and economic contexts change continuously (McAfee and Brynjolfsson, 2017, Schwab, 2017). For AI solutions to bring better results, organizations need to have the right resources in place, and to adapt these resources across time. Considering the nature of the stated problem – use of resources for sustaining competitive advantage –, this paper draws upon the theory of Dynamic Capabilities to investigate the impact of AI. This paper focuses particularly on how organizations

may prepare themselves to develop Dynamic Capabilities in an economic environment in which the adoption of AI solutions become more pervasive.

This paper is organized as follows. Firstly, it introduces a literature review on the topic of AI and some examples of its impact on organizations, using academic and industry papers. Secondly, it introduces the theoretical framework of Dynamic Capabilities. Thirdly, it presents the methodology used to collect and analyze data. Fourthly, it presents the key findings, linking them back to the literature and theory. The final sections bring conclusions, limitations and opportunities for future research, followed by a brief discussion on the path forward for academic and industry professionals considering the research conclusions.

LITERATURE REVIEW

Digital technology innovation and diffusion across organizations and societies are driving the Fourth Industrial Revolution (Mendonça and Andrade, 2018a, Paschek, Luminosu and Draghici, 2017, Schwab, 2017). Technologies such as IoT (Internet of Things), Big Data Analytics and Cloud Computing are combined with Artificial Intelligence (AI), allowing organizations to speed up innovation (Khin and Ho, 2019, Mendonça and Andrade, 2018a, Mendonça and Andrade, 2018b). Digital technology is transforming organizations, from their operations to their business models, strategies and organizational structures (Hess et al., 2016). The impact of digital technologies in the transformation of organizations has increased in the last decades, with AI leading the current waves of changes (Fabre, 2018, Gerbert, Mohr and Spira, 2019).

Although there is a variety of AI technologies, we can define AI as digital systems which use reasoning to solve complex problems and achieve objectives in a way of mimicking patterns of human intelligence (Cisco, 2018, KPMG, 2019, Paschek, Luminosu and Draghici, 2017). Within the broad spectrum of AI, Machine Learning is defined as mathematical techniques which, when applied to big data and knowledge repositories, can generate insights and knowledge without programming specific functions for this activity (Accenture, 2018, Fabre, 2018, KPMG, 2019, Loucks, Davenport and Scatsky, 2018, Paschek, Luminosu and Draghici, 2017, Ustundag and Cevikcan, 2018). Natural Language Processing (NLP) (used in chat bots and virtual assistants), and computer vision (used in facial recognition and driverless cars) are examples of Machine Learning solutions (Fabre, 2018, Loucks, Davenport and Schatsky, 2018). Academics and industry professionals agree that AI is today able to execute complex tasks, which before were thought to be manageable exclusively by humans (Cisco, 2018, Mendonça and Andrade, 2018a, Mendonça and Andrade, 2018b, McAfee and Brynjolfsson, 2017, Schwab, 2017).

Despite not being yet as developed as other digital technologies such as IoT and Big Data Analytics, AI solutions are expected to have greater importance in the future (Mendonça and Andrade, 2018b). At the current stage, AI has enabled optimized operations, more agile process to adapt to market needs and changes, and new business models (Cisco, 2018, Loucks, Davenport and Schatsky, 2018, Rao and Verweij, 2017, Shook and Knickrehm, 2018). Industry research relates AI to business efficiency, productivity, agility, scalability, capacity of adapting to new environments, and competitiveness (Cisco, 2018). Some examples demonstrate the scope of AI applications. In manufacturing, AI maximizes the use of assets through earlier identification of underutilized or faulty machinery (Charalambous et al., 2019, Purdy and Daugherty, 2017). AI allows insights in large datasets of unstructured data, finding patterns that are difficult to be identified by humans alone (Gerbert, Mohr and Spira, 2019, Purdy and Daugherty, 2017, Shook and Knickrehm, 2018). AI enables better personalization of products and services through analyzing customer insights (Accenture, 2018, Cisco, 2018, Khin and Ho, 2019, Rao and Verweij, 2017, Wilson and Daugherty, 2018). Machine Learning can develop mathematical models that allow AI to explore solutions to problems and develop predictive analytics in an autonomous fashion (Cisco, 2018, Government Office of Science, 2016). AI may support decision-making processes, tailoring information for the right governance levels (Accenture, 2018, Rao and Verweij, 2017, Shook and Knickrehm, 2018, Wilson and Daugherty, 2018).

Dynamic Capabilities

This research draws upon the theoretical framework of Dynamic Capabilities, which explores how organizations may develop high-performance routines to obtain competitive advantages (Teece and Pisano, 1994). Dynamic capabilities are defined as the firm's "ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece, Pisano and Shuen, 1997: 516). Dynamic capabilities draw upon the resource-based view of the firm (Harreld, O'Reilly and Tushman, 2007), adding the capability to adapt the use of resources in order to obtain sustainable competitive advantage in face of environmental changes (Breznik, Lahovnik and Dimovski, 2019). Reaching dynamic capabilities requires organizations to change processes to get the best from resources (Teece and Pisano, 1994, Teece, Pisano and Shuen, 1997). Those organizations which have dynamic capabilities are able to *sense* relevant changes in the environment, *seize* opportunities (and avoid threats), and *reconfigure* the use of assets and resources (Breznik, Lahovnik and Dimovski, 2019, Day and Schoemaker, 2016, Harreld, O'Reilly and Tushman, 2007, Mendoca and Andrade, 2018a, Teece, 2007).

Sensing Capability is the ability an organization has to identify opportunities and threats which emerge from changes in the environment and uncertainty (Breznik, Lahovnik and Dimovski, 2019, Day and Schoemaker 2016, Mikalef and Pateli, 2016, Pavlou and El Sawy, 2011, Shafia et al., 2016). Taking into consideration the environmental change, Sensing Capability is related to gathering market intelligence, knowledge creation, and product development (Day and Schoemaker, 2016, Kindström, Kowalkowski and Sandberg, 2013, Mikalef and Pateli, 2016, Pavlou and El Sawy, 2011, Teece, 2007). *Seizing Capability* is the ability to mobilize resources in order to take advantages of opportunities (Birkinshaw, Zimmermann and Raisch, 2016, Mendonça and Andrade, 2018a). Meanwhile Sensing focuses on finding opportunities, Seizing aims exploiting them (Birkinshaw, Zimmermann and Raisch, 2016). Seizing implies making right decisions to deliver better products, services, processes and business models to achieve sustainable competitive advantage (Agwunobi and Osborne, 2016, Mendonça and Andrade, 2018a, Teece, 2007, Kindström, Kowalkowski and Sandberg, 2013, O'Reilly III and Tushman, 2008).

Reconfiguring Capability is the ability an organization has to recombine and transform its assets and organizational structure, to obtain sustainable competitive advantage (Agwunobi and Osborne, 2016, Birkinshaw, Zimmermann and Raisch, 2016, Teece, 2007). Focusing on technological and market trends, through the strategic lenses, Reconfiguring Capabilities allow companies to be better than competitors (Pavlou and El Sawy, 2011). Reconfiguring is also related to innovation in business models (Kindström, Kowalkowski and Sandberg, 2013), timely and rapid changes to operational capabilities (Mikalef and Pateli, 2016), and asset and process management (Shafia et al., 2016).

METHODOLOGY

This research adopts an exploratory approach (Gray, 2016, Saunders, Lewis and Thornhill, 2009), taking into consideration the lack of literature on Artificial Intelligence (AI) and Dynamic Capabilities (with a few exceptions, e.g. Mendonça and Andrade, 2018a, and Mendonça and Andrade, 2018b). The paper follows an interpretive perspective (Mason, 2002), to understand the meaning AI experts attribute to the impact of this technology on organizational dynamic capabilities. Through semi-structured interviews (qualitative approach) (Flick, 2002, Mason, 2002), the paper aims to explore whether the theoretical perspective on Dynamic Capabilities resonates with AI professionals, and, if so, to explore key social constructs that bridge the discussions about the impact of AI in building competitive advantage through better use of resources. Therefore, the research aims to answer the following research question: How do AI technologies affect organizational Dynamic Capabilities of Sensing, Seizing and Reconfiguring?

Using a purposive and convenience sample strategy (Gray, 2016, Saunders, Lewis and Thornhill, 2009), respondents were chosen because of their relevant background knowledge of AI and the access the

researchers had to these professionals. The final sample is small (13 interviews, identified by codes from RA to RM in the presentation of findings), but representative for getting a first glance in the domain, and answering the research question. The sample includes academic scholars, AI thought leaders and experts, start-up entrepreneurs, and management professionals. Respondents are based in the United Kingdom, the United States and France, and were interviewed in 2019. Respondents were asked about the impact of AI in organizations from the perspective of building competitive advantages, considering the theoretical propositions that the technology would support sensing, seizing and reconfiguring capabilities. Respondents were mainly asked to discuss the impact of AI for information and knowledge management, monitoring of the environment, decision making and asset management. Interviews have been anonymized. Transcripts have been coded using NVivo software. The coding process has been informed by the theory on Dynamic Capabilities (Flick, 2002). Drawing from the theory, constructs have been proposed; then interviews were analyzed using the proposed code book. The constructs in the code book are as follow:

Constructs related to Sensing Capabilities: the ability to identify opportunities and threats by exploring environmental changes (e.g. Breznik, Lahovnik and Dimovski, 2019, Shafia et.al, 2016); and the ability to capture information that feeds into market intelligence and knowledge management (e. g. Day and Schoemaker, 2016, Mikalef and Pateli, 2016).

Constructs related to Seizing Capabilities: the ability to draw new insights from the information captured (e.g. Birkinshaw, Zimmermann and Raisch, 2016, Day and Schoemaker, 2016); and the ability to respond to insights with informed decision making (e.g. Agwunobi and Osborne, 2016, Heger and Boman, 2015, Kindström, Kowalkowski and Sandberg, 2013, Teece, 2007).

Constructs related to Reconfiguring Capabilities: the ability to reconfigure the asset base (e.g. Agwunobi and Osborne, 2016, Birkinshaw, Zimmermann and Raisch, 2016, Shafia et.al, 2016); and the ability to reconfigure operational capabilities (e.g. Mikalef and Pateli, 2016).

FINDINGS AND ANALYSIS

Sensing

From the perspective of identifying opportunities and threats, respondents reveal that Artificial Intelligence (AI) can contribute to Sensing Capabilities in organizations through better building insights from the data (RE, RD). When improving the deployment of resources, data quality is more important than data quantity (RJ). AI adds new capabilities to data collection processes; for instance, vision image recognition allows data collection in real-time in a scale and speed which cannot be done otherwise (RD). AI can help organizations to understand trends and use-cases, and to develop capabilities for predicting market changes; thus, businesses are better equipped to adjust their strategies to complex environmental changes (RA, RE, RF, RI). AI supports organization competitiveness through helping businesses to overcome the lack of human resources dedicated to Big Data Analytics (e.g. lack of data scientists) (RE, RD). AI helps companies to improve products and services observing behavior patterns (RC). Retail and travel companies, for instance, use AI to recommend products and services based on expected individual preferences (RK). BMW uses AI to inform insurance companies about the behavior of drivers (RL). UberEats' freelancer workers can contract cost-effective insurance proportional to the actual number of hours they work (instead of paying the full premium) (RD). In financial services, AI compares communication exchanges between trades in order to evaluate the risk of collusion (RB).

The literature confirms that AI is changing data gathering and allowing organizations to get new insights from unstructured data (Gerbert, Mohr and Spira, 2019, Purdy and Daugherty, 2017, Shook and Knickrehm, 2018). AI deployment for recognizing patterns and predicting future market behavior is discussed in the literature. AI use modelling to predict trends (Cisco, 2018, Government Office of Science, 2016), and

studies behavior patterns for aligning offerings with customers' expectations (Cisco, 2018, Khin and Ho, 2019). AI helps organizations to identify environmental changes and to find trends and opportunities from unsupervised exploration of data (Day and Schoemaker, 2016).

From the perspective of market intelligence and knowledge management, respondents recognize AI is changing how companies manage intangible assets. In a high-level application, AI contribution may generate knowledge from unstructured data, without need of specific functions being programmed into code, such as the case of IBM Watson and Google DeepMind (RH, RK). AI integrated with CRM (Customer Relationship Management) software helps sale teams to understand which leads are promising and when to chase leads (RI). In an operational level, AI improves the way people, processes and practices work towards producing knowledge (RL). For instance, AI solutions collect data about how employees work in order to make explicit the tacit knowledge embedded into processes, protecting the organization from losing its expertise when contributors leave the business (RM). The literature links AI to how organizations are capturing and using knowledge in their businesses (Loucks, Davenport and Schatsky, 2018, Cisco, 2018). In this direction, a key capability is the potential of machine learning technologies to look for optimizing solutions using learning mechanisms (instead of depending on specific programming) (Accenture, 2018, Fabre, 2018, KPMG, 2019, Paschek, Luminosu and Draghici, 2017, Loucks, Davenport and Scatsky, 2018, Ustundag and Cevikcan, 2018).

Seizing

From the perspective of drawing insights from information, AI monitors historical data trends to evaluate which strategy is adequate for a context and time (RA, RK), and how markets are likely to evolve (RB). AI proposes hypotheses and relationship between variables, improving the accuracy of insights across time (RA, RF, RI). Companies (e.g. Netflix and Google) and industries (e.g. fashion) use AI to monitor markets trends (RE, RL). Based on data about individuals, AI can personalize the customer value proposition, more efficiently than mass marketing strategies (RL). The infamous case of Cambridge Analytica demonstrates how AI can be used to target personalized advertisements to individuals in accordance with their personality types (RH). This knowledge of markets in the level of individuals was not possible before (RK). The literature on AI agrees that the technology can create valuable insights from evaluating patterns (Paschek, Luminosu and Draghici, 2017, Loucks, Davenport and Scatsky, 2018, Fabre, 2018, KPMG, 2019, Ustundag and Cevikcan, 2018). These insights improve the capacity of an organization of seizing opportunities and avoiding threats. A good example of AI supporting new insights is the way organizations can personalize solutions to customers, gaining competitive advantage and markets (Rao and Verweij, 2017, Wilson and Daugherty, 2018, Accenture, 2018, Cisco, 2018, Khin and Ho, 2019).

From the perspective of having better decision making, AI can improve the quality, speed and efficiency of processes through gaining insights from information (RA, RL, RJ). AI solutions propose to use unbiased data to bring more accuracy for decision making (RE, RF). AI is used, for instance, for automating trades in stock market and decision-making in commodity markets (RF, RM), and for generating reports automatically (RC). However, respondents also think human intervention is required in decision making, as people may have understandings superior to AI solutions so far (RI, RG). The literature relates improved decision making to having seizing capabilities (Agwunobi and Osborne, 2016, Heger and Boman, 2015, O'Reilly III and Tushman, 2008, Mendonça and Andrade, 2018a, Teece, 2007, Kindström, Kowalkowski and Sandberg, 2013). The Government Office for Science (2016) relates deep learning techniques to the capacity of fostering better decision making based on finding relevant data patterns. The literature also does not advocate that AI is to exclude humans from the decision making; rather, AI is expected to support humans to make better decisions (Rao and Verweij, 2017, Wilson and Daugherty, 2018, Shook and Knickrehm, 2018, Accenture, 2018).

Reconfiguring

Respondents associate AI with the optimization of asset usage (reconfiguration of assets) (RF). For instance, analyzing data generated by digital technologies such as RFID (radio-frequency identification), AI can both maximize asset utilization and minimize asset inventory and scope (RD, RG). AI may use predictive analytics for planning maintenance and investment in infrastructures, allowing organizations to reengineer their assets considering market changes (RH, RI). In the literature, Charalambous et al. (2019) and Purdy and Daugherty (2017) explore the same idea that AI plays a role when companies are optimizing the use of assets, from selecting the adequate configuration of assets (minimizing investments on assets), quickly detecting defects in assets, and helping the organization to maximize the use of its assets.

Respondents say AI influences how organizations remodel operations (RA, RM). Collecting data on behavior, AI may create automation rules for tasks, thus improving the effectiveness of processes, while personalized approaches become viable (RA, RM). AI has been added to workflows, increasing speed, accuracy and productivity in complex process (RB, RE, RG, RL). Process which are repetitive and clearly defined, such as working monitoring and work allocation, can be automated (RB, RL, RM), optimizing resource allocation and cost savings (RE). For instance, AI solutions support doctors improving the quality and speed of diagnosis (RD). AI can use insights on customer's emotions to create disruptive impact on marketing and customer relationship (RC, RH, RJ). In automating processes, organizations may reallocate human resources to tasks better handled by people (RM). The literature supports the idea that companies are using AI to optimize internal operations (Cisco, 2018, Khin and Ho, 2019, Loucks, Davenport and Schatsky, 2018). Academic and industry researches explain that automation is changing processes, substituting repetitive tasks, at the same time that human resources are transferred to more complex activities which cannot be done by automated solutions (McAfee and Brynjolfsson, 2017, Rao and Verweij, 2017, Purdy and Daugherty, 2017, Accenture, 2018).

CONCLUSIONS

The goal of this exploratory research is to investigate how the diffusion of Artificial Intelligence (AI) affects the Dynamic Capabilities of organizations. Drawing upon the literature and theory, the paper establishes three Dynamic Capabilities to be investigated: Sensing, Seizing and Reconfiguring. Based on the propositions from the literature, this research has conducted 13 semi-structure interviews with AI experts, to verify whether their perception of the phenomenon was aligned with the theoretical propositions. This research concludes that there is a good match between the perspective of respondents, AI experts, and the academic and industry literature on the impact of AI in organizations' Dynamic Capabilities. The findings suggest that AI technologies affect Sensing Capabilities through building the ability to quickly identify opportunities and threats in face of environmental changes, allowing companies to better understand customers and develop predictive analytics. AI contributes to knowledge management capabilities, through capturing information which feeds into market intelligence and knowledge generation and distribution. These findings point out opportunities for organizations to embed AI in data collection and processing, to find new patterns. AI may be applied to capture and document human workflow, pointing out activities which can be automated, thus avoiding loss of knowledge when employees leave the business.

The findings suggest that AI technologies affect Seizing Capabilities through drawing new insights from information (understanding patterns) and moving towards a more efficient data-driven decision making. Organizations may use AI for better understanding their data on business operations and customers, and to support humans in their process of decision making through new insights. However, automated decision-making is yet in the horizon: the best approach is for AI to be integrated into processes lead by professionals. The findings suggest that AI technologies affect Reconfiguring Capabilities through supporting asset optimization in accordance with the changes in context, on the one hand preventing overuse of assets and on the other hand ensuring the right level of investments in infrastructure and maintenance. AI also is

applied to transform operational capabilities in order to gain more accuracy, efficiency and productivity. In this function, AI can support automation of repetitive activities, freeing human resources for more complex tasks. Considering these capabilities, organizations may use AI to oversee operations, for identifying automation opportunities, improving workflows, and complementing human capabilities. The main limitation of this research is the number of interviews. Although the interviews have provided enough data for the analysis, future research can benefit from adding more interviews and triangulate the findings through other methods. Future research may also present the perspective of scholars and industry professionals separately, in order to grasp whether there are differences between the perceptions of the two expert groups. Finally, future research may explore further implications for organizations' Dynamic Capabilities in a scenario of more pervasive diffusion of AI technologies.

A Path Forward

These conclusions are promising from two perspectives. In a pragmatic level, this research points out how organizations can use Artificial Intelligence (AI) for enhancing their Dynamic Capabilities, thus getting better chances of developing sustainable competitive advantages. Organizations are urged to evaluate the impact of AI diffusion in their industries, to prepare their Dynamic Capabilities in accordance with the needs of the environment, as there is not one solution which fits all organizations. In a theoretical level, this research demonstrates the framework on Dynamic Capabilities provides a robust perspective to investigate the impact of AI on the way organizations use their resources to sustain competitive advantage. Academic research needs to prepare a robust theoretical framework to support organizations in the transformation driven by AI diffusion. The perspective of Dynamic Capabilities emerges as a promising framework.

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BIOGRAPHY

Dr Magda Hercheui is a Principal Teaching Fellow in Project Management and Innovation at University College London, School of Management (corresponding author). Mr. Rishikesh Ranjith is an alumnus of UCL School of Management (MSc Management 2018-2019). This paper draws upon Mr. Ranjith's dissertation for the MSc Management, under the supervision of Dr Hercheui. The original work has been synthetized and further literature and analysis have been added to the presented research. Authors are in alphabetical order.