

Information Management and Digital Transformations: Uses and Impacts of Technologies

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Abstract: The article presents managers perceptions about the transformations promoted by various information and communication technologies, such as mobile computing, internet of things, cognitive technologies, e-commerce, social networks cloud computing, artificial intelligence and big data in their companies. The objectives of the research were to investigate the opinions and expectations of the participants relative to a) the impacts of information and communication technologies in their companies; b) the levels at which technologies will transform their economic sectors; c) the levels of preparedness of their companies to deal with the changes brought about by digital technologies and d) the barriers to adaptation to digital technologies. More than three quarters (78%) of the 73 study participants are associated with Brazilian private companies and 13.7% operate in international markets. As for the areas of activity of the companies, they are concentrated in the services sectors, such as banks, insurance or financial services, education or training, consultancy, transportation and information technology, healthcare, commerce and public services. The companies operate in the first, second and third sectors of the economy and work in several segments. Collectively, these companies represent 69.86% of the study participants. According to the participants, the most positive impacts of ICTs are on cost reduction and customer relationships, while the expectations for transformations are higher in mobile computing and instant communication. The results suggest that companies are well prepared to deal with digital transformations, although there is much doubt about the potential transformations promoted by blockchain, robotics, and analytics/ big data. As for the barriers to organizational adaptation to ICTs, factors related to human resources stand out. The study highlights challenges and opportunities in the context of digital transformations for Chief Information Officers (CIOs).

Keywords: Information management. Information technologies. Digital transformations. Organizational change.

1. Introduction

Since the middle of the last century, the introduction and dissemination of digital computers have led to profound changes in society and in organizations. These changes have been analyzed by many of scholars and from several perspectives.

One of the first comprehensive studies on the economic impacts of computers was Fritz Machlup (1962). In his research on the production and distribution of knowledge in the United States, he argues that electronic data processing, considered by many as a way to reduce personnel expenses at operational levels, not only modifies the method of processing information, but also the speed and even the precision with which this processing happened. The author also highlights the benefits that the use of digital technologies in the organizational decision making process itself.

In addition to Machlup, Drucker (1969) also highlights the changes brought about by digital technologies in the economy. This author sums up this change by stating that "... the important thing is that knowledge has already become the central factor of production in an advanced and developed economy" (p.264). One of the results of the transition pointed out by Drucker is the awareness that information, as well as financial, material and human resources, must also be managed in a way that promotes organizational competitiveness and performance (Bergeron, 1996).

According to Daniel Bell (1973), the so-called post-industrial society is characterized by the transition from the production of goods to the production of services, whose consequences are the reduction of manual labor and the growth of technical and professional occupations in the areas of computing, engineering and financial services. Still from a sociological perspective, Castells (2001) investigates the process by which companies adopt the Internet as a new way of expanding the use of communication networks in the management of human resources and in the provision of services to clients.

The recognition that information, as well as other resources, should be managed from a strategic perspective, contributed to the introduction, in the late 1970s and early 1980s, to the concept of Information Resource Management (IRM). From then on, the concept of IRM gained great evidence due to the Paperwork Reduction Act, a decree of the American Government whose purpose was to rationalize the use of information by US government agencies. According to Shapiro (2013), the objective of IRM initiatives has not been fully realized. However, this did not prevent the increasing popularity of such concept as a new approach to managing information, which embraces aspects related to computing, management and information science (Trauth, 1989; Roberts, 1987).

Since the first studies of the adoption and use of digital equipment, technological developments in this area reached extremely high levels of sophistication, and one of the main characteristics of today's world is the exponential dissemination of networked devices (Misra et al., 2016). As a

consequence, both individuals and organizations are heavily impacted by this informational explosion. These impacts are manifested in many ways, either in the introduction of new products and services by companies and government agencies (Cooper, Zmud, 1990), in the loss of the privacy of people (Conger et al., 2012) or even in malicious invasions of organizational information systems (Hota et al., 2015).

Due to its volume and complexity, the development of ICTs has required the creation of managerial approaches that can guarantee its use in an effective way. In this sense, authors such as Strassman (1985) and Davenport (1997) have already been warning of the need to adopt integrative perspectives in the analysis of phenomena and informational processes in organizations. More recently, Marchand, Kettinger and Rollins (2001) have explored, through an extensive study, the relationships between IT management, information and the way people behave in relation to information.

Organizational changes promoted by the new ICTs also require the use of information from a strategic perspective that, according to Choo (2006), involve: a) the decision-making process, b) the production of meanings, and c) organizational learning. As for the decision-making process, organizations seek and evaluate sources of information to support strategic decisions by identifying options and their possible outcomes. The production of meanings through information occurs when the organization is faced with events and tendencies of the external organizational environment whose meaning is often nebulous. The use of information in learning refers to the creation of new knowledge that can contribute to the innovation of products and services.

In an exponential and non-linear rhythm, the digital revolution is based and combines several technologies, with economic, social and individual changes, that cause systemic impacts, with transformation of whole systems, in countries, companies, institutions and in the whole society. There is a need to understand the speed, breadth and potential of change by nations, institutions, companies, managers, professionals to explain, collaborate and share information and knowledge.

According to Schwab (2016), the so-called Fourth Industrial Revolution is characterized by the fusion of the physical, digital and biological worlds, whose impacts are felt in all human activities and industrial sectors. Such changes, according to the author, promise to connect billions of people through digital networks and dramatically increase the efficiency of organizations. On the other hand, he emphasizes the importance of adaptability of companies and governments so that the benefits of transformations can be earned.

The current innovations in ICTs are derived from transdisciplinary knowledge that generate impacts on the productive processes, on business models (Andal-Ancion, A.; Cartwright, P., Yip, G. S, 2003), on health (Herrmann, M., et al.,

2018), in the organizational culture; in the professions, in the skills of the people; and for mankind in general (Kane, G. C. et al, 2016). And, in particular, the ongoing digital transformations create new digital workspaces for people and radically change business value chains. In this new context, the role of information and knowledge management acquires special relevance (Bongiorno, G., Rizzo, D., Giovanni, V., 2018).

In addition to this introduction, the present work will address the changes brought about by digital technologies in organizations, the technologies that promote such transformations, as well as the effects, impacts and processes of adaptation to such technologies. The specific objectives are: a) to identify the impacts of different types of digital technologies on the decision-process, organizational learning and sensemaking; b) identify the expectations of the respondents regarding possible organizational changes caused by information technologies; c) identify the level of preparation of companies to deal with digital transformations and d) identify factors that act as barriers to the adaptation to new digital technologies. In the sequence, methodological procedures and the research will be presented.

2. Digital transformations and organizational practices

The adoption of new information and communication technologies promote radical changes in processes, products and in the business models themselves. As a result, the progress and survival of enterprises in the context of the fourth industrial revolution depend on their ability to properly incorporate new digital technologies into their operations and to use such resources in order to gain competitive advantage (Schwab, 2016). According to Stief, Eidhoff and Voeth (2016), the phenomenon of digital transformations can be understood as a business development strategy. In this sense, the challenges relate to investment costs; changes in organizational culture; adaptations to customer demands and resistance on the part of managers and employees. Digital transformations can also be conceptualized as the use of digital technologies to enable significant business improvements (Fitzgerald, Kruschwitz, Bonnet and Welch, 2013); (Iansiti and Lakhani, 2014) that interconnect activities, people and companies (Berman, 2012).

The strategic uses of information have been defined by Choo (2006) as those in decision-making, learning and sensemaking. In fact, the creation of meanings and organizational learning are strengthened by information technologies in creativity and idea generation (Boland et al., 1994), monitoring of technological trends (Chen et al., 2009), and in the sharing of information and knowledge (Kim; Lee, 2006).

Organizational practices related to ICTs were analyzed by Marchand, Kettinger and Rollins (2001). These practices, which involve hardware, software, network and technical knowledge applications, have been adapted to the present study and focus on the nature of the effects or impacts of ICTs related to: a) cost

reduction, b) clients, d) relationships with suppliers, e) effectiveness of institutional information systems, f) data and information security, g) introduction of new products and services, h) effectiveness of the decision-making process, i) creativity and generation of ideas, j) monitoring of technological trends in the external organizational environment, (k) assessing possible risks or threats, (l) employee performance and (m) sharing of information and knowledge among employees through social networks.

A number relationships can be established between the TICs and the strategic uses of information proposed by Choo (2006). In fact, uses of information in decision-making, sensemaking, and organizational learning are associated with the effects of ICTs on decision-making, creativity and the generation of ideas, monitoring of technological trends, risk assessment, performance of employees and the sharing of information and knowledge.

Each class of digital technology promotes different types and levels of organizational effects and, due to their potential impacts, the following technologies were selected for the present research:

- Mobile computing: mobile devices such as phones, TVs, tablets, clocks, vehicle-based devices, networked computers.
- Messaging / instant messaging tools: software and platforms that enable instant messaging between users.
- Internet of Things: connectivity of physical devices, vehicles, buildings and others through sensors that allow the collection and exchange of data.
- Corporate social platform: software platforms for multidirectional communication, through sequential or interventional posts. Ex: bases of resumes on LinkedIn, posts on Facebook.
- Cognitive technologies: systems capable of performing human tasks such as artificial vision, speech recognition, machine learning, problem solving, biometrics, etc.
- E-commerce: sale and purchase of products and services; customer service and making payments through the Internet.
- Social networks: resources for expanding the number of social and/or business contacts.
- Cloud computing: access and storage of data on the Internet.
- Chatbots: software designed to simulate conversation with humans.
- Analytics/Big data: large sets of data that are analyzed using statistical techniques to identify patterns, trends, and associations.
- Artificial intelligence: development of computer systems capable of performing tasks such as identification of visual patterns, speech recognition, machine learning, deep learning and automatic translation.
- Virtual /augmented reality: while virtual reality technology creates artificial environments, augmented reality overlaps information with a real environment.

- Robotics: discipline related to the design, construction, use and fields of application of robots.
- Blockchain: open and decentralized platform of transaction logs outside formal systems.

Next, the methodological procedures adopted in the present investigation will be presented.

3. Methodological procedures and results

The research involved managers and professionals from 73 companies of various sizes, sectors and segments of activity, located in Brazil. Data were collected through an online questionnaire that could be accessed through links in WhatsApp, Messenger, Email, LinkedIn, and Facebook.

The companies represented in the study are Brazilian private companies (78%), while 13.7% operate in international markets. The areas of activity of the companies are concentrated in services sectors such as banks, insurance or financial services, education or training, consultancy, transportation and information technology, healthcare, commerce and public services. The sample consisted of 19.2% micro enterprises, 16.4% small companies, 13.7% medium-sized companies and 50.7% large companies.

Regarding the age of the participants, 54.8% are 35 and 54 years old. Collectively, the study participants work in many different areas, especially in the areas of general management (26.0%), marketing/sales (15.1%) and human resources (11.0%). As for their hierarchical levels, 17% are the top executives of their companies, while the others rank one or more levels below the main executives of their companies.

Respondents' opinions about the nature of the impacts of ICTs on their companies are presented in Table 1, below. The response options for this question were: a) very positive impacts, b) positive impacts, c) without impacts, and d) I do not know how to estimate. The frequencies of the very positive impacts and positive impacts were summed and these aggregate values were ordered according to the results of such addition. The results show that "very positive" and "positive" impacts are related to business performance, as they were attributed to the reduction of costs (97.3%), customer relationships (93.2%) and effectiveness of organizational information systems (91.8%). On the other hand, the positive or very positive effects of ICTs on the increase in revenues were registered by 78.1% of the respondents. On the whole, the data are compatible with Mendonça, Freitas and Souza (2009), which confirm the positive effects of information technology on the performance of Brazilian companies.

In addition to the reduction of costs, customer relationships and effectiveness of organizational information systems, the frequency of responses regarding the

positive and very positive effects of ICTs on the relationship with suppliers was 76.7%. And while the impact of technologies on the effectiveness of organizational information systems was one of the items most strongly considered, such effects on data and information security were not considered positive and very positive by 80.8% of the respondents. This data, when associated with the fact that 13.2% of the respondents recognized their difficulties in estimating such impacts, reveal a level of insecurity of the executives in this regard.

The increasing digitization of organizational data and information represents, at the same time, great opportunities for process rationalization, cost reduction and decision-making agility at operational levels. On the other hand, the weaknesses created by the digitization of organizational collections require comprehensive approaches to the management of information and knowledge security (Araujo; Amaral, 2010). In fact, according to Soomro et al. (2016), the development of explicit security policies, employee awareness and capacity building, as well as the alignment of ICTs with human resource management, make a decisive contribution to the quality of information security management.

Table 1 - Opinions concerning information technology impacts

What is your opinion about the effects or impacts of information technology on:	Very positive impacts		Positive impacts		Positive or very positive impacts		No impacts		I don't know how to estimate	
	%	n	%	n	%	n	%	n	%	n
... cost reduction	50.7%	37	46.6%	34	97.3%	71	0.0%	0	2.7%	2
... increase in revenues	34.2%	25	43.8%	32	78.1%	57	16.4%	12	6.6%	4
... customer relationships	42.5%	31	50.7%	37	93.2%	68	2.7%	2	4.2%	3
... supplier relationships	21.9%	16	54.8%	40	76.7%	56	11.0%	8	13.8%	9
... effectiveness of institutional information systems	38.4%	28	53.4%	39	91.8%	67	4.1%	3	4.3%	3
... data and information security	39.7%	29	41.1%	30	80.8%	59	6.8%	5	13.2%	9
... introduction of new products and services	37.0%	27	39.7%	29	76.7%	56	20.5%	15	3.4%	2

... effectiveness of the decision-making process	41.1%	30	47.9%	35	89.0%	65	9.6%	7	1.5%	1
... creativity and generation of new ideas	38.4%	28	46.6%	34	84.9%	62	11.0%	8	4.6%	3
... monitoring of technological and economic trends (among others) of the external organizational environment	26.0%	19	50.7%	37	76.7%	56	12.3%	9	12.5%	8
... assessment of possible risks or threats	27.4%	20	46.6%	34	74.0%	54	6.8%	5	20.6%	14
... performance of employees	28.8%	21	56.2%	41	84.9%	62	6.8%	5	8.8%	6
... sharing information and knowledge among employees through social networks	28.8%	21	43.8%	32	72.6%	53	19.2%	14	10.2%	6

Source: survey data

The data above also demonstrate respondents difficulties in estimating the impacts of ICTs on their ability to assess possible risks and threats (20.6%), supplier relationships (13.8%) and monitoring of technological and economic trends (12.5%).

Results considering the impact of information technology on internal or external aspects indicate that three of the four highest frequencies focus on internal effects such as operational processes (98.6%), cost reduction (97.3%) and effectiveness of organizational information systems (91.8%). On the other hand, three of the four least impact factors concern external aspects, which are the monitoring of external technological and economic trends (76.7%), supplier relationships (76.7%) and evaluation of possible risks and threats (74%). These data indicate that the potential of the Internet for competitive intelligence is not yet adequately exploited by the companies studied. In fact, according to Teo and Choo (2001), the marketing sector can obtain information about consumer

preferences, as well as the strategic decision-making process can benefit from technological and economic identification and analysis.

Respondents expectations about the levels at which information technologies will transform their companies performance are presented in Table 2, below.

Table 2: Transformation Expectations

At what level will the digital technologies below transform the performance of your organization?	Radical transformations		Many transformations		Many or radical transformations		Few transformations		No transformations		I don't know how to estimate	
	%	n	%	n	%	n	%	n	%	n	%	n
Mobile Computing	31.5 %	23	57.5 %	42	89.0 %	65	8.2 %	6	1.4 %	1	1.4 %	1
Messaging/instant messaging tools	24.7 %	18	54.8 %	40	79.5 %	58	13.7 %	10	4.1 %	3	2.7 %	2
Internet of things	27.4 %	20	35.6 %	26	63.0 %	46	11.0 %	8	4.1 %	3	21.9 %	16
Corporate social platform	23.3 %	17	34.2 %	25	57.5 %	42	27.4 %	20	6.8 %	5	8.2 %	6
Cognitive technologies	31.5 %	23	26.0 %	19	57.5 %	42	12.3 %	9	6.8 %	5	23.3 %	17
E-commerce	19.2 %	14	37.0 %	27	56.2 %	41	20.5 %	15	15.1 %	11	8.2 %	6
Social networks	9.6 %	7	43.8 %	32	53.4 %	39	38.4 %	28	6.8 %	5	1.4 %	1
Cloud computing	24.7 %	18	28.8 %	21	53.4 %	39	27.4 %	20	4.1 %	3	15.1 %	11
Artificial Intelligence	28.8 %	21	24.7 %	18	53.4 %	39	17.8 %	13	8.2 %	6	20.5 %	15
Chatbots	19.2 %	14	32.9 %	24	52.1 %	38	24.7 %	18	6.8 %	5	16.4 %	12
Analytics/big data	27.4 %	20	23.3 %	17	50.7 %	37	16.4 %	12	4.1 %	3	28.8 %	21
Robotics	23.3 %	17	16.4 %	12	39.7 %	29	16.4 %	12	16.4 %	12	27.4 %	20
Blockchain	6.8 %	5	19.2 %	14	26.0 %	19	16.4 %	12	2.7 %	2	54.8 %	40

Source: survey data

The results presented in Table 2 show that expectations for higher radical transformations refer to mobile computing and cognitive technologies (both with 31.5%). Radical transformations are also expected as result of artificial intelligence (28.8%), internet of things and analytics / big data (both with 27.4%).

The responses indicative of radical transformations and many transformations highlight the expectation of large transformations caused by mobile computing (89.0%) and instant messaging and communication tools (79.5%). Regarding the transformations caused by these two types of technologies, the respondents appear to have no doubts. On the other hand, results show a great difficulty in estimating the possible impacts of blockchain (54.8%), analytics/big data (28.8%), robotics (27.4%), cognitive technologies, internet of things (21.9%) and artificial intelligence (20.5%). Taken together, the results show a significant level of uncertainty about the possible changes being promoted by the latest technologies, such as blockchain, analytics / big data, robotics and the internet of things. The growth of systems that use principles of artificial intelligence also lead to expressive levels of doubts in the respondents.

The evaluations of the study participants regarding the degrees in which their companies are prepared to deal with the digital transformations provoked by the TICs are presented in Table 3.

Table 3 - Level of preparation to deal with changes caused by digital transformations

The extent to which companies are prepared to deal with the changes brought about by digital technologies	%	n
Very well prepared	13.7%	10
Well prepared	23.3%	17
Reasonably well prepared	49.3%	36
Unprepared	13.7%	10
I can't estimate	0.0%	0
Total	100%	73

Source: survey data

As can be observed, according to the respondents, their companies are reasonably well prepared (49.3%) or well prepared (23.3%) to deal with digital transformations. These results, which add up to the opinions of 72.6% of the study participants, are apparently contradictory with other results of this study. This apparent contradiction, on the other hand, may be indicative of the uncertainties naturally provoked by the set of digital transformations studied. That is, the difficulties revealed by the study participants in estimating the transformations brought about by advances in cognitive technologies and robotics indicate that levels of company training were overestimated by the respondents. The relationships between expectations of changes brought about

by digital technologies and the levels of preparation assigned by professionals and managers to their companies deserve to be investigated in future studies. These relationships can be mediated by factors such as the size of the company, the levels of economic and/or technological instability in the sectors in which companies operate or even in the areas of performance and hierarchical levels of professionals.

The possible barriers to adaptation to digital technologies, adapted from (Kane et al., 2016), were classified in a) human resource factors, involving training of professionals and users; b) market factors; c) internal factors such as lack of agility, inflexible culture and resistance to change; d) security factors related to data and information and e) factors related to competition. These factors were estimated for their importance on a scale that was irrelevant to extremely important. The results recorded on this five-point scale were aggregated in order to produce an importance index. Respondents also had the opportunity to indicate their difficulty in estimating the importance of these factors. The survey results are presented in the table below.

Table 4 – Barriers to adaptation to digital technologies

How important are the factors or questions below as potential barriers to your organization's adaptation to new digital Technologies?	Irrelevant		Little important		Important		Very important		Extremely important		Index		I do not know how to estimate	
	%	n	%	n	%	n	%	n	%	n			%	n
Human resources factors: lack of qualified professionals, users not prepared.	27%	2	9.6%	7	30.1%	22	34.2%	25	20.5%	15	3.52		2.7%	2
Market factors: loss of clients, low brand or image visibility.	82%	6	13.7%	10	24.7%	18	27.4%	20	20.5%	15	3.22		5.5%	4
Internal factors: lack of agility, rigid	68%	5	12.3%	9	41.1%	30	23.3%	17	13.7%	10	3.16		2.7%	2

culture, resistance to change.	%												
Security factors: security breaches, hacking, intellectual property theft.	68%	5	9.6%	7	34.2%	25	19.2%	14	21.9%	16	3.15	8.2%	6
Competitive factors: intense competition, increased number of competitors.	68%	5	13.7%	10	37.0%	27	23.3%	17	15.1%	11	3.14	4.1%	3

Source: survey data

The data above demonstrate that human resources factors constitute, according to the respondents, the main barriers to the adaptation of their companies to the new digital technologies. The index of importance of this set of factors (3.52) is higher than the index calculated for market factors (3.22). Another way to analyze these data is by adding the percentages assigned to the categories "important", "very important" and "extremely important". Viewed in this way, the values attributed to human factors totaled 84.8%, while the same sum of market factors corresponded to 72.6%. Barriers due to internal factors such as lack of agility, inflexible culture and resistance to change correspond to 78.1%. Seen as a whole, and according to respondents perceptions, the main barriers to digital transformations are the lack of qualified personnel, unprepared information technology users, inflexible culture and resistance to change. And when one adds to these elements the fact that the weaknesses of information security are strongly related to human factors, one can conclude that the barriers analyzed are strongly associated with human behavior.

Alignment of organizations to the digital age does not correspond strictly to the adoption of digital technologies or process automation, but changes in business models and mental models of people (Taurion, 2017) with leaders and people imbued with a transformative purpose (Salin et al, 2016). Some drivers of digital transformation are also pointed out by Eidhoff and Voeth (2016). They involve collaboration between IT professionals and general management to achieve profitability gains, employee collaboration and greater transparency. Support of strategic levels of organizations with strategic guiding projects; technological capability; human resources and knowledge are also considered relevant the analysis of the status quo, digital capabilities, infrastructure, people skills and leadership style.

4. Conclusions

The main objective of the present research was to identify the perceptions of professionals and managers of business companies regarding the organizational transformations provoked by several types of digital technologies. The most significant impacts were those related to operational processes and cost reduction, and the least significant to the sharing of information among employees. As far as expectations are concerned, the ICT related issues related to corporate mobility, artificial intelligence, internet of things and big data analysis tools stand out. As a whole, the level of preparedness of companies to deal with change is medium, suggesting the need to incorporate to the strategic decision-making process of companies the analysis of scenarios regarding opportunities and threats resulting from the development of digital technologies. These results corroborate the estimates of barriers to the adaptation of companies to new technologies, among which the human factors, with respect to the strategic alignment, cultural adaptation, leadership and employee qualification stand out.

The results reinforces the relevance of new digital technologies for the strategic management of organizational information and knowledge. In particular, the study emphasizes the importance of the Chief Information Officers (CIOs) to follow trends, promote creative uses of emerging technologies and establish partnerships within the company itself and in external sectors (Holland, T., 2018). The questions pointed out in this research represent challenges for the academic world and for organizations in general. New studies, for example, may investigate how organizational size and the sector of activity affect the dynamics of the digital transformations in companies. Other questions that are worth pursuing are which barriers to digital transformations occur in companies of different types of companies. In addition to quantitative research, case studies can reveal in depth the dynamics of the adoption and assimilation of new ICTs in various business contexts.

In summary, the present study represents a contribution to the understanding of the effects of transformations created with the adoption new digital technologies in organizational contexts. The results also highlight new challenges for the management of organizational information and knowledge. Many other issues need to be addressed through both quantitative and qualitative studies. Further research, with other methodological procedures, can contribute to the continuous improvement of the processes of digital transformations in organizations, strategic management of information and organizational knowledge

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