10-2022

A model to understand digital capabilities, shadow IT and individual performance in the context of remote work

Pietro Cunha Dolci

Antonio Carlos Maçada

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Pietro Cunha Dolci
PPGA / UNISC
pcdolci@unisc.br

Antonio Carlos Gastaud Maçada
PPGA / EA / UFRGS
acgmacada@ea.ufrgs.br

Abstract

In recent years, remote work has grown enormously, as has the adoption of digital technologies and shadow IT. There has never been a situation where workers could choose to use their own devices and cloud-based applications. Due to the Covid-19 pandemic, large numbers of workers suddenly found themselves at home. Understanding how this shift to remote working has impacted digital resources, the use of shadow IT and individual performance is of great importance to academics and professionals. This study seeks to analyze the relationship between digital capabilities and shadow IT usage on the one hand and individual performance on the other in the context of remote working. To do so, a survey was carried out among a sample of 188 IT and non-IT executives from Brazil working remotely. The resulting data were analyzed using IBM-SPSS 24 exploratory analysis and PLS-SEM software to test the measurement and structural model. In the study we identified that shadow IT usage is positively related both to digital capabilities and individual performance. The main findings reveal that to understand the behavior of employees and how these systems are being used is essential for the individual performance of company employees to be maintained or even improved.

Key-words: Digital capabilities, Shadow IT usage, Individual performance, Remote working.

1. Introduction

Digital technologies have been penetrating all aspects of our lives, economy, living security and society, profoundly changing social productivity, human relationship, and production relations (Zhu, Dai & Wan, 2022). These technologies have brought many contributions, profound effects on organizational processes and opportunities for companies to improve their performance. Digital technologies can determine what kind of resources actors can provide as inputs and how these resources are transformed into and provided as outputs (Von Briel, Davidsson & Recker, 2018). The achievement of this transformation, according to Zhen et. al. (2021), is tricky and a complex task needing to establish digital organizational culture and digital capabilities. The concept of digital capabilities is still in its early stages of development and not present a uniform definition neither there are consolidated elements nor dimension. According to Zhu, Dai and Wan (2022) is the ability to integrate, allocate internal and external resources, and utilize the potential of digital technology.

According to Gartner (2021), global expenditure on Information Technology (IT) is expected to total US$ 4.2 trillion in 2021, equivalent to an increase of 8.6% compared to 2020. These investments will be directed towards digital transformation, cloud computing, mobile technologies and internet of things, which are capable of helping organizations in the search for greater performance and productivity of their employees at work and their relationship with their stakeholders. At the same time bringing implications for the potential use of alternative solutions and technologies, such as the use of shadow IT. Additionally, Gartner has estimated worldwide enterprise software spending at $600 billion in 2021, and forecasts spending to rise to $1 trillion by 2030, and specifically with SaaS (Software as a Service). KPMG & Beamy released a survey in early 2022 that 85% of applications should be managed by business units and individuals by 2031, which will represent greater engagement with IT and

governance teams in managing the following risks: unplanned spending and waste; and compliance with unauthorized use of applications in controlled environments and remote work.

According to Dulipovici and Vieru (2016) the new IT management policy highlights the concern with the use of unauthorized Information Systems (IS) and Mobile Technologies (TM) in the business environment, called Shadow IT. Rentrop and Zimmermann (2012) define this as the adoption of systems developed by areas without the support of the IT department. These systems are implemented autonomously, without the organization's knowledge, therefore, these technologies are not included in the organization's IT service management (Zimmermann, Rentrop & Felden, 2014). Thus, Silic and Back (2014) revealed that organizations face enormous difficulties in controlling security risks because of unauthorized alternative technologies (shadow IT). From the users' point of view, the use of shadow IT associated with digital and IT capabilities allow overcoming the restrictions found in the IS of organizations and allow the work to be performed in a complete and effective way (Tallon et al., 2013).

According to Global Workplace Analytics (2021) during the pandemic, 95% of U.S. office workers worked from home three or more days a week. A full 82% said they wanted to continue working remotely at least weekly when the threat of the pandemic was over. Five million people in the US work at least 50% of their hours remotely, a number that has increased 173% over last year. During the initial phase of pandemic Microsoft reported a 500% increase in Microsoft Teams meetings, calls and conferences. Video conferencing software operator Zoom, meanwhile, added more users in the first six weeks of 2020 than it had in all of 2019, according to CNBC (2020). To Evangelakos (2020), as remote work sees extraordinary growth, however, shadow IT concerns grow in tandem for individual performance. To this author, never in history have we seen a situation where the temptation to use your own device, or use your preferred cloud-based consumer application, is so appealing to vast numbers of suddenly homebound workers. Even prior to Covid-19, shadow IT risks were underappreciated. Research from Gartner estimates that shadow IT represents up to 40% of overall IT spending in large enterprises (Evangelakos, 2020).

Thus, the research question of this study is how digital capabilities are related to shadow IT usage and individual performance in the context of remote working? To answer this question our study aims to analyze digital capabilities and shadow IT usage impacts on individual performance in the context of remote working.

2. Digital capabilities, shadow IT usage and individual performance

Digital capability is the ability to (1) integrate digital technology with organizational business process activities, (2) utilize the potential of digital technology and stimulate the utility of data resources and (3) allocate internal and external resources, enhance organizational practices, and drive organizational change driven by digital technology enablement and data resources (Zhu, Dai & Wan, 2022).

Digital capabilities have become important in the last decade for organizations to improve organizational responsiveness (Lavie, 2006). According to Tams et. al. (2014), with this responsiveness, firms can achieve greater performance and competitive advantage, even sustainable competitive advantage (Lavie, 2006). Moreover, to Pavlou and El Sawy (2011) sensing capability also is related with digital capabilities. To these authors sensing capability is defined as the ability to spot, interpret, and pursue opportunities in the environment.

Digital platforms and business models need well defined processes for digitization (Täuscher and Laudien, 2017). Digital capabilities are necessary to gain visibility into company's work processes and react to changes as quickly as possible. To Markus and Loebbecke (2013) to understand this change and the process of business is necessary an ecosystem orchestration. In this sense, in this study digital capabilities are understood (Table 1) by sensing capability (Pavlou & El Sawy, 2011), process digitization (Täuscher & Laudien, 2017), responsiveness (Tams et. al., 2014) and ecosystem

orchestration (Markus & Loebbecke, 2013). All variables related to the dimension digital capabilities are at Table 1.

People and organizations increasingly want to use easy, fast, flexible, and ubiquitous access to software, platform, or infrastructure services from any device at low costs or even for free using internet (Haag, 2015). However, according to Haag e Eckhardt (2014), a challenge that occurs is that by taking advantage of the conveniences and benefits the services offered by public or private cloud services from third party providers are used independently of the IT department and without the approval of the organization sometimes. These authors define shadow IT usage as the voluntary usage of any IT resource violating injunctive IT norms at the workplace as reaction to perceived situational constraints with the intent to enhance the work performance, but not to harm the organization.

Mobile and cloud-based infrastructures enable users to take advantage of the flexible and convenient value propositions new IT services such as Dropbox, WhatsApp, or Google Docs propose, not only in private but also in work-life (Haag, Eckhardt, & Schwarz, 2019). These advantages enable collaboration among co-workers, customers, and partners, and thus, improve job performance. Moreover, it could be used as a collaborative tool, used for communication and to develop shared solutions (Rentrop and Zimmermann, 2012; Silic and Back, 2014).

According to Mallmann, Maçada and Oliveira (2018) another possibility of IT shadow usage is employees using at work equipment purchased (notebooks, servers, routers, printers, or other peripherals) directly from retail rather than being ordered through the official catalog of the IT department. It includes the use of applications in the employee's personal devices at the workplace. Other Shadow IT usage is the software installed by employees to perform their work tasks, on the company's computers (Mallmann, Maçada, & Oliveira, 2018). All variables related to the dimension Shadow IT Usage are at Table 1.

To Furstenau, Rothe and Sandner (2017), we must understand shadow IT usage as sociotechnical phenomena, which individuals are key for establishing a shadow system. Shadow systems can help employees to work around the restrictions of existing IT or organization processes (Alter, 2014). Workers tend to individualize systems based on business needs if they meet their individual requirements and social context conditions to adopt new or adapt existing IT (Furstenau, Rothe & Sandner, 2017). Thus, it is important to understand the individual performance related to Shadow IT.

The individual performance using informal systems can be measured in several ways, being related to productivity increase using informal systems at work, performing tasks faster using an informal system, exchanging information more effectively using an informal system, being able to solve problems faster using an informal system and controlling tasks using an informal system (Rentrop & Zimmermann, 2012; Silic & Back, 2014, Haag & Eckhardt, 2014). All variables related to the dimension individual performance are at Table 1.

3. Hypothesis development and proposed research model

As remote work has seen extraordinary growth in recent years, adoptions of digital technologies and the use of shadow IT grow together (Evangelakos, 2020). Never in history has there been a situation where the temptation to bring your own device, or use your preferred cloud-based consumer app, is so appealing to many workers suddenly stuck at home. Thus, in this context of remote work, digital capabilities (DC), the use of shadow IT (SITU) and individual performance (IP) have increased their importance for both academia and practice. It is important to understand the relationship and impacts of these variables. Based on these arguments and considerations, the research model proposed in Figure 1 was created. The formulation of the hypotheses is presented below.

Variable	Author(s) (year)
Digital capabilities	
Sensing	Pavlou & El Sawy (2011)
Process digitization	Täuscher & Laudien (2017)
Responsiveness	Tams, Grover & Thatcher (2014)
Ecosystem orchestration	Markus & Loebbecke (2013)
Shadow IT Usage	
Information sharing	Rentrop & Zimmermann (2012); Silic & Back (2014)
Communication	Rentrop & Zimmermann (2012); Silic & Back (2014)
Systems installation	Mallmann, Maçada & Oliveira (2018)
Use of own devices	Mallmann, Maçada & Oliveira (2018)
Solution development	Rentrop & Zimmermann (2012); Silic & Back (2014); Mallmann, Maçada & Oliveira (2018)
Individual performance	
Productivity increase	Rentrop & Zimmermann (2012); Silic & Back (2014); Haag & Eckhardt (2014)
Performing tasks faster	
Exchanging information more effectively	
Solve problems faster	
Control tasks	

Table 1: Dimensions and variables

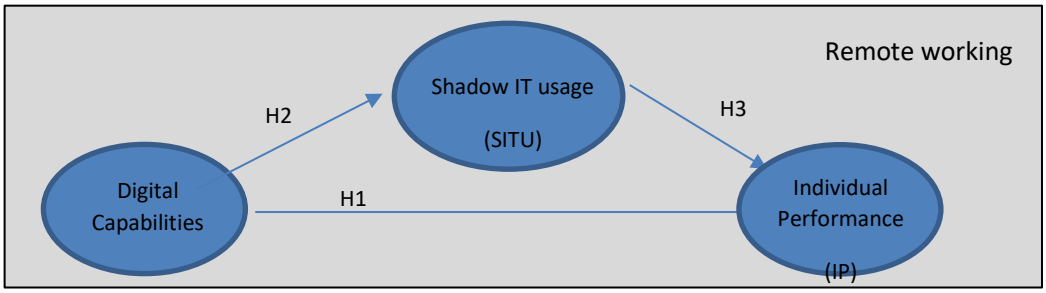

Figure 1: Research Model

(Source: Elaborated by authors.)

To Furstenau, Cleophas and Kliewer (2020) digital capabilities can improve performance by supporting complex decision-making processes. According to Tams et. al. (2014), organizations can achieve greater performance and competitive advantage, from digital capabilities enabled by different technologies. From this, we found a relationship between digital capabilities (DC) and individual performance (IP). Hence, we hypothesize that:

H1: Digital capabilities are positive related with individual performance

The company's digital capabilities (DC) are embedded in the people and relationships within the company, so their effectiveness depends on those people's interactions with available technologies (Tams et. al., 2014). More digitized the company or use digital solutions, employees have more

tendency to provide their own technological solutions within organizations such as smartphones, tablets or cloud applications, within organizations, which have facilitated the adoption and use of technologies by the user, which are not authorized by the IT department (Goodwin, 2014). From this, we hypothesize that:

H2: Digital capabilities are positive related with shadow IT usage

Some research pointed out that Shadow IT usage could improve productivity and performance. Employees could use shadow IT to increase productivity, perform tasks faster, exchange information more effectively, solve problems faster and control their tasks (Rentrop & Zimmermann, 2012; Silic & Back, 2014; Haag & Eckhardt, 2014). Moreover, shadow IT usage enables the work to be carried out completely and efficiently (Tallon et. al., 2013) associated with individual performance. To Haag, Eckhardt and Bozoyan (2015) shadow system users were significantly more motivated and enthusiastic about coming up with new ideas for existing technology and processes to solve the most task in a better way. Similarly, Haag and Eckhardt (2014), Silic and Back (2014), Mallmann and Maçada (2017) point out in their research that the study of shadow IT, at an individual level, is related with individual performance. From this, we hypothesize that:

H3: Shadow IT usage is positive related with individual performance

4. Method

This is a descriptive and explanatory study (Pinsonneault & Kraemer, 1993). It is descriptive because we tried to find out opinions are occurring in a sample of population. It is explanatory because the instrument was to understand how and why the variables ought to be related. Also, we proposed cause and effect in the model not only assuming the existence of relations among variables but assumes directions.

This research was carried out using a survey. To operationalize the Survey collection, a questionnaire was prepared. The variables were operationalized using a seven-point Likert scale of agreement, aiming to measure the effects of the relationships between the variables studied. This questionnaire was developed with scales adapted from the literature and from interactions with experts. There is 3 dimensions and 19 items. The dimension Digital Capabilities is formed by Sensing (DC1 and DC2), Process digitization (DC3 and DC4), Responsiveness (DC5 and DC6), and Ecosystem orchestration (DC7 and DC8). The dimension Shadow IT Usage is composed by SITU 1, SITU2, SITU3, SITU4 and SITU5. Finally, the dimension Individual Performance is composed by IP1, IP2, IP3, IP4, IP5 and IP6. All the dimensions and variables are presented at Table 2.

Data collection was carried out during December 2020 to March 2021. Data collected from 188 IT and non-IT executives through an electronic questionnaire were analyzed. The largest group of participants in the survey are managers (13%), analysts (11%) and professors (11%), followed by directors (9%), business auxiliary (8%) and business assistants (6%). We received from different positions and functions such as, CTO, CEO, doctors, developers, consultants. The most of the responses are from employees working in a private company (63%), followed by public company (26%), self-employed (7%) and family business (3%). The respondents have between 31-43 years (37%), 18-30 years (33%), 44-60 years (26%) and 60 or more (3%) with on average 3.4 years in the company.

To simultaneously examine the dependence relationships between the variables studied, a structural equation modeling (SEM) were used (Hair & Hult, 2016). The minimum sample was calculated using the G*Power software, which is based on the dependent variable with the largest number of predictors.

To assess the validity and reliability of the sample, the procedures indicated in the literature for this type of research were followed. Convergent and discriminant validity analyzes were performed, exploratory and confirmatory factor analysis were also performed. Confirmatory factor analysis is

important in the examination of structural equation modeling in the process of model refinement and research instrument (Koufteros, 1999).

Confirmatory Factor Analysis (CFA) is required as a refinement stage of the research model when verification is performed through structural equation modeling (Koufteros, 1999). The CFA was operationalized with the support of the PLS-SEM statistical software due to the saturation of the relationships between the variables (Hair & Hult, 2016). For the validation of the measurement model, at this stage, the individual validity of the factors was analyzed using Cronbach's Alpha and Composite Reliability (CR), which are more appropriate.

The convergent and discriminant validity of the constructs were also appreciated. The convergent validity was evaluated through the Average Variance Extracted (AVE – Average Variance Extracted). Fornell and Lacker's criterion is used, looking for values greater than 0.5, so that the model can converge to a satisfactory result (Fornell & Larcker, 1981). Discriminant validity was analyzed both by cross-loading analysis and by the Fornell and Larcker criterion. The models that make up this research were evaluated and tested using structural equation modeling techniques, with the help of IBM SPSS 24 and PLS-SEM software. The final phase of the research was developed from the evaluation of the quantitative stage and final analysis of the research with the crossing of inferences from the Survey results and the discussion of the proposed model.

5. Results

All constructs in this study are based on a reflective measurement model, as the items of each construct are associated and interchangeable (Hair & Hult, 2016). To evaluate the measurement model, the metrics proposed by Hair et. al. (2019) were used.

The first step in evaluating the model is to examine the loads of each item that make up the construct, which must be above 0.708 to indicate that the construct explains more than 50% of the item's variation, thus being able to attest to its reliability (Hair & Hult, 2016). Values below 0.708 were evaluated, the literature recommends that the item should be excluded if there is a significant increase in composite reliability, if not, it should be maintained (Hair, Ringle & Sarstedt, 2011). Items DC5, DC6, DC7 and SITU3 presented values of 0.525 and 0.581, respectively, and were excluded from the model because their exclusion increased the value of composite reliability. Items DC1, DC4 and SITU5 were kept in the model, as their exclusion would not lead to an increase in composite reliability (Hair et al., 2019). The other items have their loads above the established minimum parameter.

The second step was to assess internal consistency, using Cronbach's Alpha and Composite Reliability. The alpha must present values above 0.70, while the composite reliability must present values between 0.70 and 0.90, given that values above 0.95 indicate reliability problems (Diamantopoulos et al., 2012). Even though all values are between 0.70 and 0.90, it is noteworthy that the literature points to composite reliability as a more reliable criterion than Cronbach's alpha, as the items are weighted based on the individual loads of their respective constructs (Hair et al., 2019).

The third step was to analyze the convergent validity, which is the measure in which each construct converges to explain the variation of its items, using the Average Variance Extracted (AVE), which must present values above 0.50 to indicate that the construct explains at least 50% of the variation of its items (Hair et al., 2017). All constructs have convergent validity according to the established criteria. Table 2 presents the Descriptive analysis of each variable, Convergent Validity and Reliability Analysis.

The fourth step was to assess discriminant validity, which is the extent to which the construct is different from other constructs in the structural model. (Hair et al., 2019). Two criteria were used, as the HTMT is more reliable than the Fornell-Larcker criterion, which can generate inaccurate results in some cases,

and which is widely used in studies that use the PLS-SEM as the only criterion to assess discriminant validity (Hair et al., 2019).

Construct	Variables		n	Mean	Standard deviation	Variance	Factor loading	AC	CR	AVE
Digital Capabilities	DC1	identify new opportunities for the development of my work	188	4,32	0,96	0,92	0.665	0.778	0.840	0.513
	DC2	interpret the information in the environment for the development of my work	188	4,27	0,89	0,78	0.769			
	DC3	gain visibility into my company's work processes	188	4,22	0,89	0,78	0.709			
	DC4	react to changes as quickly as possible	188	4,35	0,99	0,99	0.667			
	DC5	create strategies to improve my activities and the activities of my colleagues	excluded							
	DC6	respond quickly to the problems I encounter when performing my activities	excluded							
	DC7	acquire and exchange more information with co-workers	excluded							
	DC8	acquire and exchange more information with external stakeholders	188	4,13	1,06	1,13	0.747			
Shadow IT Usage	SITU1	I share work information using informal systems)	188	3,25	1,56	2,42	0.868	0.963	0.970	0.843
	SITU2	I communicate with my co-workers through informal systems	188	3,71	1,43	2,04	0.863			
	SITU3	I install informal systems on the company computer to carry out my work tasks	excluded							
	SITU4	I use my own devices to carry out my work tasks	188	3,63	1,54	2,37	0.735			
	SITU5	I develop technological solutions using informal systems to carry out my work tasks	188	2,80	1,47	2,16	0.678			
Individual Performance	IP1	My productivity increases by using informal systems in remote work	188	3,27	1,31	1,73	0.929	0.798	0.868	0.624
	IP2	I can accomplish my remote work tasks faster using an informal system	188	3,27	1,39	1,94	0.920			
	IP3	I exchange information with my colleagues more effectively using an informal system in remote work	188	3,51	1,48	2,18	0.891			
	IP4	I can solve problems in my work more quickly using an informal system	188	3,36	1,41	2,00	0.924			
	IP5	I better control the tasks in my work using an informal system	188	3,13	1,40	1,97	0.912			
	IP6	In general, the use of informal systems improves my performance in remote work	188	3,23	1,42	2,02	0.933			

Table 2: Descriptive analysis, Convergent Validity and Reliability Analysis.

Note: Cronbach's Alpha (AC), Composite Reliability (CR), Mean Variance Extracted (AVE)

The Fornell-Larcker criterion points out that to assess the discriminant validity it is necessary that the square root of the AVE of each construct must be greater than the estimated correlations between it and

the other constructs (Fornell & Larcker, 1981). The heterotrait-monotrait ratio (HTMT) criterion indicates that the obtained values must be less than 0.85 for conceptually different constructs (Franke & Sarstedt, 2019). Both discriminant validity criteria are met. In order to evaluate the structural model, the hypothesis test of the model was performed, using the bootstrapping resampling technique, using 5000 samples, to ensure stability in the determination of standardized errors (Hair et al., 2019). In addition, the blindfolding function was used to assess the predictive relevance of the model.

The first step was to verify that there are no critical levels of collinearity between the proposed structural relationships, using the Variance Inflation Factor (VIF), which should present values below 3.3 (Diamantopoulos & Siguaw, 2006). The obtained results varied between 1.185 and 1.877, indicating that there were no collinearity problems. The second step was to analyze the Coefficient of Determination (R^2), which is a measure of the explained variance of the endogenous construct and is a measure of the explanatory power of the model (Hair, Ringle; Sarstedt, 2011). Values 0.26, 0.13 and 0.02 are considered substantial, moderate and weak in social and behavioral sciences (Cohen, 1988). The obtained R^2 values were 0.519 (IP) and 0.048 (SITU), both considered substantial.

The third step was to assess the predictive relevance of the model in the PLS through the Stone-Geisser value (Q^2), which must present values greater than 0, with values 0, 0, 25 and 0.50 representing low, medium and high predictive model relevance (Hair et al., 2019). The obtained Q^2 values were 0.431 (IP) and 0.027 (SITU), supporting the model's predictive relevance. Finally, the hypothesis test was performed for the relationships between the constructs, considering that for the hypotheses to be supported, the critical t values must be 1.96 ($p<0.05$) and 2.57 ($p<0.01$) (Hair et al., 2019). Additionally, the standardized root mean residual (SRMR) was analyzed as a measure to assess the model's fitting. The cutoff value of the SRMR is 0.08 for models that use the PLS-SEM (Henseler, Hubona & Ray, 2016). The SRMR value in this study was 0.069, so the model is a good fit. Table 3 presents the results of the model's hypothesis test.

Hypotheses	Path	VIF	Coefficient	Value *t* [a]	*p* value	Decision
H1	DC → IP	1.877	-0.219	0.157	0.876	Not supported
H2	DC → SITU	1.680	0.723	2.802*	0.005	Supported
H3	SITU → IP	1.575	0.013	16.244*	0.000	Supported

Table 3: Path Coefficient and Hypothesis Testing

Note. [a] t value for two-tailed test:* 2.57 ($p < 0.01$) **1.96 ($p < 0.05$) (HAIR et al., 2019).

Digital capabilities are positively related to Shadow IT usage ($\beta = 0.723$, $p < 0.005$), providing empirical support for hypothesis H2. H3 was also supported, showing that shadow IT usage is positively related to individual performance ($\beta = 0.013$, $p < 0.000$). H1 was not supported.

The main results indicate that for digital capacity to be related to individual performance, care must be taken with the use of shadow IT or informal systems. Sharing information using informal systems as well as communication (Rentrop & Zimmermann, 2012; Silic & Back, 2014) among colleagues proved to be very important for the relationship between digital capabilities and performance. In addition, the use of their own devices (Mallmann, Maçada & Oliveira, 2018) to carry out activities at work and the development of technological solutions were also evidenced in the research as relevant in this relationship. This demonstrates the importance of clear BOYD policies being extremely necessary for companies to understand the behavior of their employees that has influenced their performance. Another important point is the issue of information and systems security, especially in times of remote work. According to Abbas and Alghail (2021) the Shadow IT usage, mobile in this case, can lead to a security issue of the data privacy in organizations, that could disseminate inside the companies without the

organization fully knowing. Thus, the need for clear policies for the use of their own systems and devices must be on the companies' agenda to avoid the problems caused by the potential use of informal systems. The research showed that prohibition is not the way but understanding more about the phenomenon and the behavior of employees to extract the best from them in relation to the use of technologies within the company.

It was identified in the research that individual performance improves with the use of informal systems. This type of system improves productivity in remote work, facilitates tasks to perform them faster, the exchange of information is more effective through this type of system, problem solving, and task control are also better with the use of informal systems (Rentrop & Zimmermann, 2012); Silic & Back, 2014); Haag & Eckhardt, 2014). Thus, as mentioned before, individual performance is positive influenced by Shadow IT use, the prohibition is not the best way, but the best understanding of the use of informal systems, such as Whatsapp, tools from Google Tools (Drive, Sheets, Docs, Forms,…) and in the cloud such as Dropbox. Understanding the behavior of employees and how these systems are being used is essential for the individual performance of company employees to be maintained or even improved. Understanding the digital capabilities of these employees, such as identifying new opportunities for the development of work, interpreting information from the environment, more visibility of work processes and reacting to changes as quickly as possible are the capabilities that should be observed and encouraged by companies. An important point that drew attention was that the acquisition and exchange of information with colleagues was not confirmed, but with external stakeholders it was. This shows that an important capability is more related to external actors than to co-workers, and that this can create a differential for employees and their companies.

6. Conclusion

The objective of the study “analyze digital capabilities and shadow IT usage impacts on individual performance in the context of remote working” was accomplished. Findings pointed to the importance of the study of digital capabilities, shadow IT and individual performance. The investment in digital capabilities and enabling system users to engage in this challenge could improve the management of these resources. Also, policies about the usage of Shadow IT could help companies to understand this phenomenon and improve the task performance by employees. The literature does not answer all the questions about the usage of shadow IT and if companies should turn off all the devices used without formal acceptance of the IT department. Our study proposes a model and validates the scale to advance in this discussion.

Other contribution is the instrument construction relating digital capability, shadow TI usage and individual performance. The instrument was created and validated with IT and non-IT Brazilian managers through an electronic questionnaire. We propose a model to understand and measure Digital capability by elements Sensing, Process digitization, Responsiveness and Ecosystem orchestration. Shadow IT usage was measured by Information sharing, Communication, Systems installation, Use of own devices and Solution development. We validated the dimension Individual performance that can be measured by productivity using informal systems at work, performing tasks faster using an informal system, exchanging information more effectively using an informal system, being able to solve problems faster using an informal system and controlling tasks using an informal system.

We can highlight that digital capacity could be related to individual performance, using shadow IT. The direct relationship was not supported. We found that use of information systems or shadow IT could help the daily activities and should be studied and understand by organizations. In the results we infer that companies should not prohibit the use of these systems without permission and validation of organization. Instead of, organizations should identify these systems and create new forms of use and formalize the use.

The academic contribution is to propose and validated an instrument to measure digital capability, shadow IT and individual performance. In the remote work this contribution could help researchers to understand these phenomena and advance in the field. The managerial contribution is to create a model to companies to understand how analyze digital capability, shadow IT and individual performance generate ways to improve productivity and interaction with technology. Other contribution is to show that individual performance is influenced by digital capacity by using shadow IT or informal systems. Thus, organizations should understand why and how employees use this type of system and create new forms to use these technologies or create policies and rules to use.

For future study we indicated a survey with a bigger sample in different contexts and industries. Another suggestion is applying a qualitative study based on instrument validated in this study to understand the phenomena in more detail. Researchers could explore the results to propose tools to create a link between digital capability and individual performance using shadow IT. Finally, from the results of this study, BYOD policy could be articulated and discussed in companies from digital capabilities view that influence individual performance by Shadow IT usage.

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