The Impact of COVID-19 on Government Digital Transformation from a Resource-based Perspective - The case of the Greek Ministry of Education

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The COVID-19 pandemic necessitated a drastic limitation of physical contact in order to minimize its spread, so organizations (both private and public ones) had to rapidly modify their operational model in this direction, with respect to both their internal processes and their interactions with customers, suppliers and partners, and this included the extensive use of digital technologies for the above purposes. So, COVID-19 put pressure on organizations to advance their digital transformation. However, the magnitude of the positive impact that COVID-19 had on the use of digital technologies and the digital transformation differs among organizations, depending on the nature of their activities, their processes, their human resources, as well as their digital maturity and the availability of financial resources. So, it is important to analyze the real impact that COVID-19 had on the use of digital technologies and the digital transformation of different kinds of private and public organizations based on sound theoretical foundations. This study makes a contribution in this direction by conducting a multi-dimensional analysis of the impact of COVID-19 on government digital transformation. For this purpose, a comprehensive multi-dimensional research model has been developed, having as theoretical foundation the resource-based view of the firm, which includes the analysis of the impact of COVID-19: i) on the ICT-related resources; ii) on the ICT-related capabilities; and iii) on the digital transformation outcomes. Our study has been conducted in one of the largest and most important and costly Ministries of Greece: The Ministry of Education. Data has been collected through a combination of qualitative and quantitative techniques: a focus group discussion and a questionnaire filled in by its participants. It has been concluded that the COVID-19 led to a large increase of the available financial resources for ICT-related investments and operating expenses, a significant improvement of the ICT-related processes/capabilities, and also acted as a strong driver of digital transformation of this Ministry, which consists of two components: one component that was temporary, as it concerned the support of schools' operation during the special circumstances of the COVID-19 period, including both the initial online synchronous e-learning, and the subsequent classroom-based learning in the COVID-19 conditions that followed, so it was discontinued afterwards; and another significant component that is permanent, and was continued beyond the COVID-19 period

CCS CONCEPTS • Applied computing~Computers in other domains~Computing in government

Additional Keywords and Phrases: digital transformation, e-government, Education, covid-19

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1 Introduction

The health crisis caused by the COVID-19 pandemic has been a defining moment in recent history, revealing the impact that a global crisis can have on the economy and society [1], [2]. Economic crises in general (caused by various factors, such as financial turmoil, health crises, wars, poor fiscal policy, or structural problems in the economy) lead to contraction of economic activity of organizations, as well as of their operating expenses and investments; however, they can act as a driver for rationalizations, enhancing efficiency and better utilization of available resources of organizations [3], [4], [5], [6]. The COVID-19 pandemic also necessitated a drastic limitation of physical contact in order to minimize its spread, so organizations (both private and public ones) had to rapidly modify their operational model in this direction, with respect to both their internal processes and their interactions with customers, suppliers and partners, and this included the extensive use of information and communication technologies (ICT) for the above purposes; so, COVID-19 put pressure on organizations to advance their digital transformation [7]. The COVID-19 pandemic was a crisis that highlighted the need for digital transformation, as organizations and businesses focused to adapt quickly to new operating conditions exploiting the capabilities provided by the ICT. COVID-19 was not just a health crisis, it was a catalyst for a rethinking of traditional working methods and service delivery, addressing the problems caused to the economic systems through adaptability and innovation.

However, the magnitude of the positive impact that COVID-19 had on the use of digital technologies and the digital transformation differs among organizations, depending on the nature of their activities, their processes, their human resources, as well as their digital maturity and the availability of financial resources. On the one hand, it led to a recession, and therefore to a reduction in the financial resources and the activities of many organizations, but on the other hand, it required increased use of digital technologies for the operations and digital transactions of organizations, in order to reduce personal contacts and transmission of the virus. So, it is important to analyze the real impact that COVID-19 had on the use of digital technologies and the digital transformation of different kinds of private and public organizations based on sound theoretical foundations. Some research has been conducted on this topic, however most of it is dealing with private sector firms (e.g. [7], [8], [9], [10], [11], [12], [13], [14]) and much less with public sector organizations (see section 2.1). While there is growing interest in how crises affect public organizations, the scope of research remains limited compared to other sectors and even more so in the impact of economic crises on the digitalization and digital transformation of public organizations.

This study makes a contribution to filling this important research gap by conducting a multi-dimensional analysis of the impact of COVID-19 on government digital transformation based on sound theoretical foundations. For this purpose, a comprehensive research model has been developed, based on the resource-based view of the firm (see section 2.2) as theoretical foundation, which includes the analysis of the impact of COVID-19 not only on the outcome (digital transformation), on which most previous relevant studies focus, but also on its main determinants (ICT-related resources and ICT-related capabilities) as well, in order to provide a deeper understanding of this complex phenomenon. In this direction we are using a combination of qualitative and quantitative techniques in order to investigate the impact of COVID-19: i) on the ICT-related resources; ii) on the ICT-related capabilities; and iii) on the digital transformation outcomes.

Our study has been conducted in one of the largest and most important and costly Ministries of Greece: The Ministry of Education. It has to be mentioned that there has been some previous research about the impact of the preceding recessionary crisis that hit Greece between 2010 and 2018 on the digital transformation of this Ministry [15], which has found that despite the reduction in the available financial resources for ICT-related investments and operating costs during this period, there has been an improvement and rationalization of its ICT-related processes and capabilities, as well as a significant increase in its digital transformation developments; however, there has been limited renewal and enrichment of their digital infrastructures (e.g. ICT hardware) during this period, which has led to their obsolescence and overutilization of their capacity. So, it is interesting to investigate the 'digital response' of this Ministry to the COVID-19 under these challenging initial conditions of weak and obsolete digital infrastructure.

The findings of our study can be quite interesting and useful for both political and administrative directors of public organizations, as well as consultants offering services to such organizations, in order to develop effective strategies to

manage their digitization and digital transformation activities in such difficult times. The new knowledge created in our study is expected to be particularly useful for optimizing the behavior of public organizations in future similar crises.
This paper consists of five sections. This introductory section is followed by section 2 outlining the background of our study, and then section 3 describing our method and data. The results are presented in section 4, and finally the conclusions are summarized in section 5.

2 BACKGROUND

2.1 The Impact of the Covid-19 on Public Organizations

As mentioned in the Introduction most of the research that has been conducted on the impact of COVID-19 on the use of digital technologies and the digital transformation of organizations has focused on private sector firms (e.g. [7], [8], [9], [10], [11], [12], [13], [14]), while much less has dealt with public organizations [16], [17], [18], [19].
In [16] is investigated the impact of COVID-19 on four important dimensions of digital transformation concerning the tasks and processes, the individual duties and required competences, the resources and structures, and also the culture in ten organizations of the Austrian federal administration. Similarly, [17] examines the impact of COVID-19 on the digital transformation of the public administration in the European Union. In [18] is investigated the influence of the approaches that have been adopted to governance and multi-stakeholder cooperation on the success of the digital transformation initiatives of three countries (Austria, Denmark and Republic of Korea) they undertook during the COVID-19 crisis period. [19] proceeds to an analysis of how digital transformation processes have influenced the attitude of local governments toward the COVID-19 pandemic and their effect on achieving the United Nations' Sustainable Development Goals.
Furthermore, there are some studies that analyze important aspects of the digital transformation driven by the COVID-19, such as the telework [20], [21]. In particular, the study described in [20]examines the effects of the teleworking by public servants that occurred during the COVID-19 period on their job satisfaction, organizational commitment, burnout, and productivity. Similarly, the study presented in [21] examines how employees in public sector organizations experienced the implementation of telework during the COVID-19 pandemic.
However, the above research has a limited scope: it investigates the impact of COVID-19 only on the digital transformation related outcomes in public organizations, but not on their main determinants, such as the ICT-related resources and ICT-related capabilities proposed by the Resource-based View of the Firm theory (see following section 2.2). Our study contributes to addressing this weakness by proposing a research model enabling a wider scope in investigating the impact of COVID-19 on the digital transformation (of both public and private organizations) based on the above theory.

2.2 Resource-Based View of the Firm

The theory of the Resource-based View of the Firm (RBV) is one of the most 'classical' and widely recognized and used theories in management science [22], [23], [24], [25]. According to it the output and performance of an organization depend on the resources it possesses and on its capabilities to use them. As resources of an organization are meant all the assets it controls (such as equipment, ICT hardware and software, buildings, human resources, various kinds of intangible resources, etc.) that can be used to carry out its main activities. The main capabilities of an organization include: organizational capabilities (for the proper management of resources to achieve its goals), innovation capabilities (meant as abilities to develop new ideas, products, or processes, and to adapt to market changes, maintaining its competitiveness), and managerial capabilities (that refer to the efficient and effective use of its human and physical resources to maximize the value it generates). So, the success of an organization does not depend exclusively on the external environment, but also on the internal resources and capabilities it possesses for responding to it, both to its positive aspects (generating opportunities) as well as its negative ones (giving rise to threats). The RBV theory, though initially developed for private sector firms, has been subsequently used successfully for public sector organizations as well [24], [25].

The RBV holds both for the whole organization, and also for each of its individual activities, including the ICT-related activities. There has been extensive relevant research in the information systems domain, which has identified the main kinds of ICT-related resources (e.g. ICT hardware, ICT software, ICT personnel, etc.) of an organization, as well as the main ICT-related capabilities (e.g. for developing ICT plans, managing ICT projects, procuring ICT hardware and

software, developing/modifying/integrating software, conducting ICT operations, supporting ICT users, etc.), and also revealed the significant impact of both on the ICT-related output (development and operation of information systems for supporting the activities of the organization), as well as on the overall organizational output and performance [26], [27], [28], [29], [30], [31], [32]. Therefore, the RBV is an appropriate theoretical foundation for a comprehensive multi-dimensional analysis of the impact of the COVID-19 on the digital transformation of both public and private organizations.

3 Method and Data

So, based on the RBV we developed the research model shown in Fig.1 for the comprehensive multi-dimensional analysis the impact of the COVID-19 pandemic on the digital transformation of government organizations, which includes assessment of the impact of COVID-19 on:

(a) the financial resources spent on ICT by the government organization, on the one hand on ICT-related investments and, on the other hand on ICT-related operational expenses;

(b) on its ICT-related processes and therefore its corresponding ICT-related capabilities;

(c) on the digital transformation of the government organization, meant as the development of information systems for the support and digital transformation of the main activities of it.

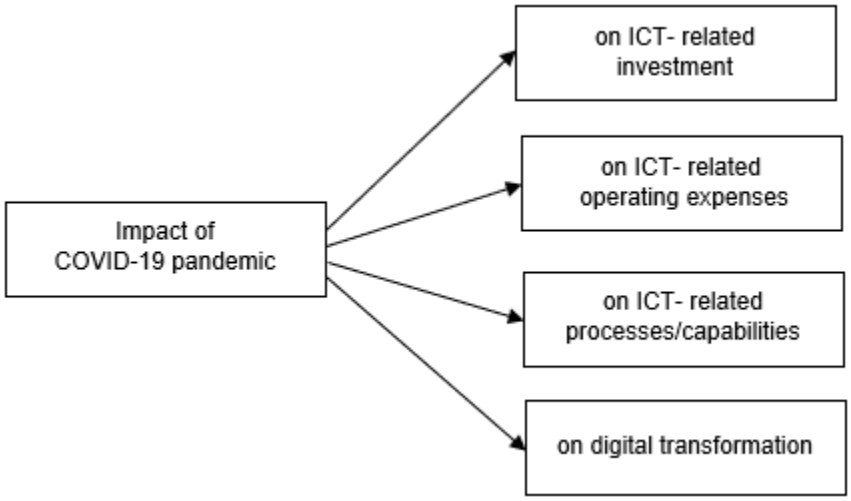

Figure 1: Research Model

Data were collected from a focus group, in which participated the ICT Director of the Ministry of Education, as well as four experienced personnel of the ICT Directorate, through a combination of quantitative and qualitative techniques. The quantitative part includes collaborative filling of a questionnaire by the focus group, which included four questions corresponding to the above four components of our research model. The qualitative part included filling of one box after each question with free text that justifies and explains in more detail the corresponding answer in the preceding question; also, it included a free discussion after the end of questionnaire filling, concerning these four components of our research model.

4 Results

The answers to the four questions of the questionnaire are shown in Table 1. We can see that COVID-19 led to a large increase of both ICT-related investments and operating costs (ICT-related resources); also, it acted as to a large extent as

a driver for the improvement and rationalization of ICT-related processes/capabilities of the Ministry, as well as an advancement of the digital transformation of it.

Table 1:Impact of COVID-19 pandemic

Impact of COVID-19 pandemic	
on ICT-related investments	1 (large increase)
on ICT-related operating expenses	1 (large increase)
on the improvement/rationalization of ICT-related processes/capabilities	4 (to a large extent)
on the advancement of the digital transformation	4 (to a large extent)

The first and second questions are assessed in a 7-points Likert scale (1 = large increase, 2 = moderate increase, 3 = small increase, 4 = no effect, 5 = small decrease, 6 = moderate decrease, 7 = large decrease); the third and fourth questions is assessed in a 5-points Likert scale (1 = not at all, 2 = to a small extent, 3 = to a moderate extent, 4 = to a large extent, 5 = to a very large extent)

The above were further elaborated and explained by the more detailed qualitative information that was provided by the participants in the focus group, both in the free text boxes of the questionnaire, and in the discussion that followed. It was mentioned that the COVID-19 pandemic on the one hand caused a recession (= a serious decline in economic activity), which reduced the state revenue from taxation, and therefore the financial resources of the state; this became even worse because at the same time the pandemic necessitated spending significant financial resources in order to support firms that had to temporarily close, and citizens who had become unemployed, due to the pandemic. However, on the other hand COVID-19 made it necessary to reduce physical contacts between civil servants, as well as with citizens, and this was possible only through then extensive digitalization of both internal processes and transactions with citizens, which required substantial ICT investments as well ICT operating expenses; so, despite the abovementioned scarcity of financial resources, significant additional financial support was provided for these purposes by the Ministry of Finance to all government organizations. The Ministry of Education used it in order to enrich and upgrade its digital infrastructure (both for its central administration and the numerous schools throughout Greece), which as mentioned in the Introduction had become quite weak and obsolete during the preceding economic crisis in the 2010-2018 period due to the reduced financing of all government organizations implemented as part of austerity programs [15]; so, we had a large increase of the ICT-related investments in the COVID-19 period in order to address these pre-existing digital infrastructure deficiencies. This was facilitated also by the national and European legislation that was passed at the outset of the COVID-19 pandemic, which simplified and expedited the procurement procedures for ICT hardware (laptops, servers, networks, etc.). Based on this enhanced and stronger infrastructure several new information systems were developed and quickly put into operation in a short time, which transformed radically:

i) The teaching and learning procedures in the schools, enabling synchronous distance e-learning from students' homes, complemented by asynchronous e-learning. This was of critical importance, as COVID-19 pandemic impacted educational systems worldwide, leading to the closure of schools; so, the Greek government decided to close schools in order to curb the spread of COVID-19, and adopt distance e-learning programs (mainly synchronous and secondarily asynchronous ones) in order to ensure that the educational process could continue in these adverse COVID-19 conditions.

ii) The transactions of the Ministry with students, parents and contract teachers (enabling their easy and quick conduct through the Internet).

iii) The internal processes of the Ministry.

These three aspects of the COVID-19 driven digital transformation of the Ministry of Education are shown in Fig.2.

However, the focus group participants mentioned that the above were not easy, given the complexity of these new information systems and the limited time available, so it required major improvements and rationalizations of most ICT-related processes and practices, especially the ones concerning information systems planning, project management, development, operation as well as users support, leading increasing relevant ICT-related capabilities of the Ministry.

We can distinguish two components in the above COVID-19 driven digital transformation of the Ministry. A first component that was temporary, as it concerned the support of schools' operation during the special circumstances of the COVID-19 period, including both the initial online synchronous e-learning (which was complemented asynchronous e-

learning as well), and the subsequent classroom-based learning in the COVID-19 conditions that followed, so it was discontinued after the end of it. However, it was emphasized that this has led to substantial improvements of the digital skills of both students and teachers, as well as familiarity with synchronous e-learning procedures, which will be very useful in the long run, so they constitute a 'permanent soft digital transformation'; furthermore, it has developed a synchronous and asynchronous e-learning infrastructure, which can be utilized in the future in case of various emergencies that make classroom-based learning impossible, such as severe weather conditions, etc. Furthermore, we can distinguish a second component of this COVID-19 driven digital transformation, which concerns the transactions with students, teachers and contract teachers, as well as the internal processes of the Ministry, that is permanent, as it was continued beyond the COVID-19 period. The focus group participants in the qualitative discussion we held after questionnaire filling provided valuable insights about these two parts of the COVID-19 driven digital transformation of the Ministry of Education, which are outlined below.

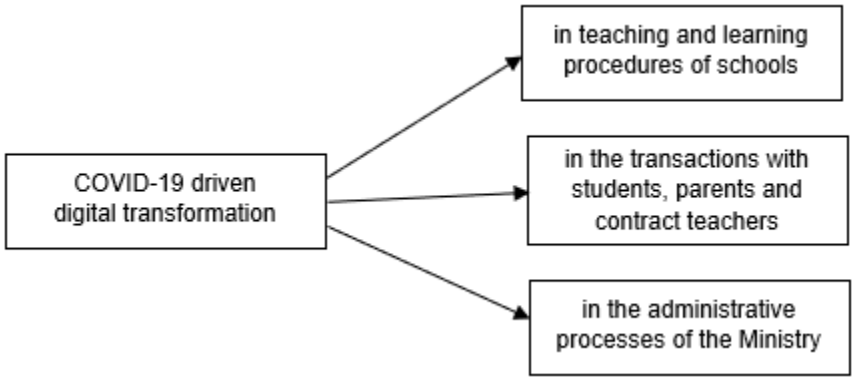

Figure 2: Aspects of the COVID-19 driven digital transformation of the Ministry of Education

4.1 Resource-Based View of the Firm

Initially needs were identified for ICT equipment in order to support the new distance e-learning methods that had to be adopted during the COVID-19 period, as well as for digital infrastructures that were necessary, and relevant procurements were conducted rapidly (taking advantage of the abovementioned new national and European legislation that simplified and expedited the procurement procedures for ICT hardware). Also, online connections of all schools were upgraded. The Ministry, responding to the need for suspension of face-to-face teaching in schools, in order to halt the transmission of COVID-19, activated all required digital tools. Indicatively, it was mentioned that during the period between 13/03/2020 and 04/04/2020, the total enrolments in the list of the Panhellenic School Network approached one million five hundred thousand (1,500,00). In eclass.sch.gr, 312,500 lessons were created by 106,000 teachers, and attended by 587,000 students. In meeting.sch.gr, 26,700 new members were registered, and 5,820 synchronous e-learning sessions were conducted, while in lessons.sch.gr 25200 new members were registered and 5,010 sessions were held. The total number of e-learning conferences was as high as 10.830. Also, email addresses were provided to more than 1,100,000 mailboxes of schools, teachers and students. The helpdesk served more than 70,000 support requests, mostly student registration and teacher password retrieval.

Furthermore, throughout the period of distance e-learning, teleconferences were held between the teams responsible for it at the schools and the Central Distance Learning Team of the Ministry of Education. Also, in collaboration with the Ministry of Education, the Ministry of State, the Ministry of Digital Governance, and mobile network providers, access to the platforms used by the Ministry of Education for distance e-learning was provided free of charge (zero-rating) via mobile networks. With intensive efforts by both teachers and students as well as families, a great leap was made in the cultivation of digital skills. It was noted that the period of the COVID-19 pandemic highlighted the need for training teachers in synchronous/asynchronous teaching online platforms as well as methodologies. Almost in absolute majority, teachers

recognized the need for their upskilling, aiming to become in the future more efficient in their roles, by becoming accustomed with the tools offered by the digital technologies for distance learning.

During the COVID-19 period initially lessons were conducted online using synchronous and asynchronous e-learning methods; later they shifted to classroom face-to-face learning, but for classes with big numbers of COVID-19 cases this face-to-face learning was temporarily suspended. This created a high complexity, and also had to be monitored centrally; for this purpose the following functionalities were added to Myschool (a shared information system operated in the central headquarters of the Ministry of Education, and is remotely accessed by all schools in Greece enabling then to support all their administrative functions):

• Recording by all schools of COVID-19 confirmed cases (both students and teachers), enabling a central monitoring by the Ministries of Education and Health.

• Development of a mechanism for weekly recording of the suspension of operation of face-to-face classes due to big numbers of COVID-19 cases (with the simultaneous implementation of a digital approval workflow for these suspensions by the regional education directorates), and further automated dissemination of this information to parents (via email) as well as on the website of the Ministry of Education (www.minedu.gov.gr).

• Creation of a supervisory mechanism for the dynamic recording of the operating history of schools, and provision of relevant aggregate statistics through a business intelligence tool (MS Power BI)

• Modification of algorithmic students' attendance calculation mechanisms, in order to adapt them to the new regulatory framework (e.g. absences of students due to COVID-19 that are not counted in attendance).

4.2 Permanent Digital Transformation

Furthermore, the focus group participants mentioned that in the beginning of the COVID-19 period were developed several electronic transaction services for students, parents and contract teachers (who are numerous, as in Greece a significant part of the teachers are not permanent public servants, but are on annual contracts that can be renewed), e.g. electronic services for informing parents about the grades achieved by their children (through email), for electronic registrations, electronic baccalaureates, electronic undertaking of service and placement of contract teachers, electronic sending to students of the results of nationwide university entry examinations (through sms) (grades, department in which they are admitted), etc. These electronic transaction services are highly valued and popular, so they were continued after the end of the COVID-19 period, leading to a radical digital transformation of the communication and transaction of the Ministry with students, parents and contract teachers.

Also, it was emphasized that special efforts were made in order to develop interoperability between important information systems of the Ministry, such as the Integrated Information System for Personnel Management of Primary/Secondary Education and the abovementioned Myschool system. This enabled a radical digital transformation of the entire process for the recruitment of contract teachers, which included automation of some parts of them and optimization of the remaining ones, continuing after the COVID-19 period. The administrative bodies of the Ministry, the directorates of education as well as the candidate teachers were relieved of time-consuming procedures. For the first time, contract teachers were able to digitally register their preferences for schools, and then being placed with complete transparency, using algorithms developed in collaboration of the Ministry with the 'National Network of Infrastructures for Research and Technology' (a public sector technological institution that provides network and computing services to academic and research institutions, to educational institutions of all levels and to institutions of the public and private sector) and as well as the 'Computer Technology Institute and Publications Diophantos' (a public sector technological institution dealing with the utilization of digital technologies in the field of education). Also, it enables the digital conclusion of contract for the assumption of service of these numerous contract teachers, and in general reduces significantly the bureaucracy and the time required for these contracts. Through the simplification and digitalization of time-consuming and repetitive processes that had been adopted for long time, the new Integrated Information System for Personnel Management of Primary/Secondary Education enabled the timely teaching personnel planning for all school, leading to a drastic reduction of the extensive administrative work required for this purpose. For the first time, vacancies for schoolteachers started being registered in a single information system that interoperates with other existing information systems of the Ministry, aiming at timely planning and quick filling of vacancies.

5 Conclusions

In the previous sections a multi-dimensional empirical investigation has been presented of the impact of COVID-19 on government digital transformation. For this purpose, initially a comprehensive multi-dimensional research model has been developed, having as theoretical foundation the resource-based view of the firm, which includes the analysis of the impact of COVID-19 on the available financial resources for ICT (for ICT-related investments and for ICT-related operating expenses), on the organizational ICT-related capabilities as well as on the digital transformation outcomes. Our study has been conducted in a large, costly and highly important public organization: the Greek Ministry of Education.

It has been concluded that the COVID-19 led to a large increase of the available financial resources for ICT-related investments and operating expenses, a significant improvement of the ICT-related processes/capabilities, and also acted as a strong driver of digital transformation of this Ministry, concerning mainly the teaching and learning procedures of the schools (a temporary component of this digital transformation that was discontinued after the COVID-19 period), the transaction of the Ministry with students, parents and contract teachers, as well as the internal processes of the Ministry (a temporary component of it that was continued after the COVID-19 period). However, even the above temporary component provided significant benefits, such as substantial improvements of the digital skills of both students and teachers, as well as familiarity with synchronous e-learning procedures, which will be very useful in the long run, as well as valuable modern synchronous and asynchronous e-learning infrastructures. Furthermore, the increased availability of financial resources for ICT during the COVID-19 period allowed addressing the weaknesses and obsolescence of the digital infrastructure of the Ministry that had had been caused by the preceding recessionary crisis that had hit Greece between 2010 and 2018.

Further research is required on the impact of the COVID-19 pandemic on other government organizations, and possibly on private ones as well, using the research model we have developed, in order to identify similarities and differences. Also, would be useful to develop further this research model, with additional dimensions of analysis, based on various theoretical foundations from the information systems as well as management domains.

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