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Etude de terrain sur les interactions entre la transformation numérique et la résilience en contexte de crise

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Résumé :

Cette étude étend la recherche sur la transformation numérique et la résilience d'une description séparée à une compréhension de l'interaction mutuelle. Pour cette étude, nous avons réalisé 40 entretiens avec différents experts (managers et middle managers) de différents domaines (industrie aéronautique, industrie urbaine et transport, industrie maritime, industrie ferroviaire, gestion de la chaîne d'approvisionnement, commerce électronique, assurance médicale et télécommunication). Dans une perspective partitionnelle, nous avons bien distingué les différentes dimensions de la transformation numérique et de la résilience et les différentes interactions entre elles dans un contexte de crise. Ce document présentera quelques incitations pour toute personne intéressée par les interactions mutuelles entre la transformation numérique et résilience en temps de crise du point de vue des praticiens.

Mots clés : Transformation numérique ; résilience ; causalité ; dimensions ; interactions ;

Field study about the interactions between digital transformation and resilience in a crisis context

Abstract :

This study extends the Digital transformation and resilience assimilation research from separate definitions and descriptions to a mutual interaction comprehension. For this study, we did 40 interviews with different experts (managers and middle managers) from different fields (Aero industry, urban industry and transportation, maritime industry, train industry, supply chain management, E-commerce, medical insurance, and telecommunication). From a partitional perspective, we did distinguish the different digital transformation and resilience dimensions and the different interactions between them in a context of crisis. This document will present some incites for anyone interested in the mutual interactions between digital transformation and resilience in a time of crisis from a practitioners' perspective.

Keywords : Digital transformation; resilience; causality; dimensions; interactions;

1. Introduction

“During COVID-19 crisis, many of the nice-to-have IS functionalities have become must-haves” (Floetgen et al., 2021). Similar comments have been repeated in many journals that focus on digital transformation and resilience. Pee et al., 2021 also cited that in response to the pandemic, technology has raised privacy and resilience concerns.

We can notice that the accumulation of multiple crises since the year 2020 (COVID, War, etc.) encouraged the trend of digital transformation (DT) and put the focus on systems resilience. Despite this growing interest, there are not enough studies treating digital transformation and resilience subjects (Floetgen et al., 2021). Also, there is a lack of field studies and real examples conceptualizing resilience in information systems, and its dimensions in practice (Heeks & Ospina, 2019).

In this document, we are aiming to fill this gap by treating this research question: What are the practitioners’ perceptions about the interactions between digital transformation and resilience in a crisis context?

We intend to contribute to the managerial and theoretical literature by providing a practitioner feedback on the mutual interactions and which dimensions of resilience and digital transformation are involved. We study these interactions in a crisis context. As Shaluf et al.(2003) et al defined, a crisis is an abnormal situation that presents some extraordinary and high risk to business.

The rest of this article is organized as follows. We first explain the theoretical background by treating the definitions of digital transformation and resilience. We then discuss our research methods. Next, we summarize the insights from our analysis. We conclude with a discussion of the implications and limitations.

2. Theoretical background

The first step of our study consists of defining digital transformation and resilience. We can find a lot of unique definitions in the scientific literature. In this document, we did choose two definitions with a system perspective. This perspective is interesting for our study because it takes into consideration the assembly of resources and procedures united and regulated by interaction to accomplish specific functions.

2.1 Digital transformation

To define digital transformation, we lever the definition of Gong & Ribiere (2021) “a fundamental change process, enabled by the innovative use of digital technologies accompanied by the strategic leverage of key resources and capabilities, aiming to improve an entity and redefine its value proposition for its stakeholders.” This definition provides a clear description for practitioner of all elements of digital transformation. Also, it provides a conceptual definition that was built after a systematic analysis of what has been done in the literature before.

2.2 Resilience

To define resilience, we will refer to the definition by Heeks & Ospina (2019). For these researchers, resilience is “a system’s capacity to rebound to its original state”, which affirms that resilience is a property of a system. Also Heeks & Ospina (2019) cite in their paper that

this property is always defined as a response to short term stress and, as a long term trend. As a property also, it can be measured and supervised as performance indicator. This definition of resilience and its implications provides a clear description for practitioner.

3. Methodology

This paper aims to check the field feedback on the interactions between digital transformation and resilience. We used an inductive approach for theory building as we are in the process developing the concepts of dimensions and interactions between digital transformation and resilience. Also, In our work, we didn't start from theories and hypothesis to test. So, this methodology is more adequate to our field study.

Given the inductive method, we started by gathering data. To do that, we conducted 40 interviews with different users and builders of information systems. Our population is very diverse. We choose different profiles of experts: middle management (senior profiles with 4 to 9 years of experience) and management. (more than 10 years of experience). Further, we did choose a different technical, functional and managerial profiles. For the fields of expertise, we considered many functional and technical areas of study. You will find in the Annex A all the details related to our population. The next step will be the search for patterns and the elaboration of conclusions. This method allows us to conclude by going from the specific to the general.

To design the interviews, we did follow the interpretive method described by Walsham (1995). This method is well-suited for exploring hidden interactions behind complex, interrelated, or multifaceted processes. We designed a semi-structured interview. As explained in their paper, Myers & Newman, (2007) cited that one of the important characteristics of this interview type is the flexibility. This requires improvisation, and openness and gives a lot of potential to explore a no-planned subjects and unexpected details which will enrich the results of the research. With the consent of the interviewees, all interviews were digitally recorded for later transcription.

Then to do the transcription of the interviews we applied the naturalized method. Naturalized transcription is a detailed and less filtered transcription. We did choose this method because its detailed descriptions of the voices and the things mentioned during the interview may afford a more complete and valid picture of the same (Mero-Jaffe, 2011).

To distinguish the different dimensions of digital transformation and resilience we used the grounded theory methodology. This methodology is very interesting in our study as it involves the construction of results through the collection and analysis of data. We adopted the three-coding stages: open coding, selective coding, and theoretical coding (Glaser, 1978) (Urquhart, 2013).

As a first step, we start with open coding. This allowed us to gain a deep understanding of our data and to discover common themes. After that, we are engaged in selective coding to focus our coding on those interesting aspects.

Selective coding was followed by theoretical coding. When the dimensions do begin to emerge, we did engage in a "comparative analysis" continuously comparing our primary result with the paper's findings. In annexes B and C, you can find the details of this study.

As a final step, we studied the types of mutual interactions between the dimensions of digital transformation and resilience. To do that, we did analyze the interview one by one to extract the existing mutual interactions between the different dimensions.

4. The results

4.1 The digital transformation and resilience Dimensions

4.1.1. The Digital transformation’s dimensions

Through the analysis of the interviews, we can identify three dimensions of digital transformation (technical, structural, and cultural).

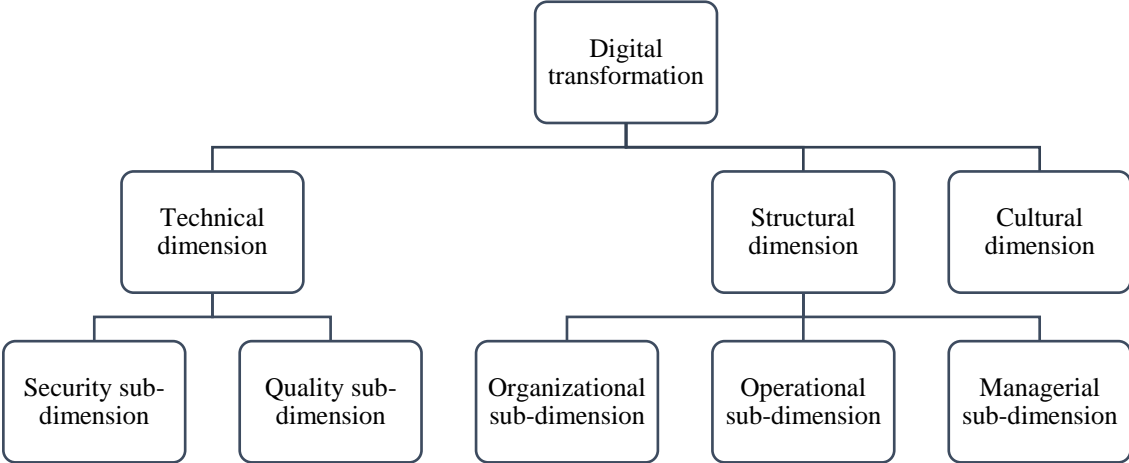


Figure 1 : list of the dimensions related to digital transformation

4.1.2. The resilience’s dimensions

Through the analysis of the interviews, we can identify three dimensions of resilience (technical, structural, and environmental dimensions).

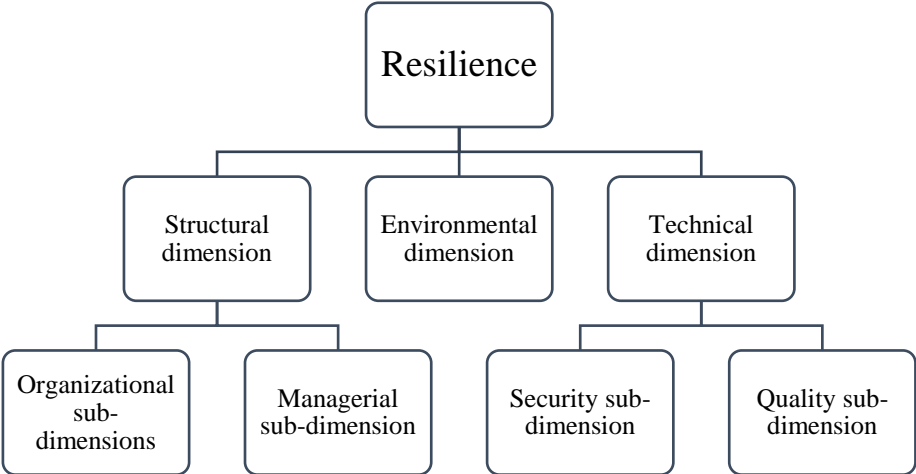


Figure 2 : The List of Dimensions Related to Resilience

4.2 The interactions between the digital transformation and resilience dimensions

In this study, we conducted 40 interviews with IS experts. After that, we did a transcription and analyzed the data. As result, we noticed many focus subjects and interactions. In the Annex D you will find a recapitulation of all the interactions that we did find in our study.

4.2.1. work organization

In this part, we will deal with the different difficulties facing the organization of work during a crisis.

- Communication between the team member

During the last COVID crisis, there was a change in the relationship between team members. Due to the working-from-home policy, there was less contact. So, there was no visibility in the project. This did lead to stress for the project leader. As an immediate action, the directors tried virtual meetings (individual-level meetings with the employees and the managers, daily coffee meetings at 9 a.m., daily work debrief meetings, and information meetings at a company level). These actions presented an organizational resilience. After the first wave of lockdown, *“The team had a very good relation, so the management asked that we keep these habits: every day at 9 a.m. we had a meeting just to drink coffee. There are some other calls of three to four hours to do a peer review. The management was very surprised by the result: the team Kept the same quality level of code.”* In this example, we have an organizational resilience that did lead to an organizational transformation (interaction I1 in the Annex D).

This growing use of virtual meetings pushed the editors of some communication software to technically transform their platforms (for example before we have a few attendees in a virtual meeting; now there are no limits). This transformation is presented by the interaction I2 in the Annex D.

- Remote Work

Remote work was an obligation during the different lockdowns of 2020 and 2021. This method was first introduced as organizational resilience. This led to a transformation in the mentality of the managers. As one director confirmed: *“Honestly for me, I was convinced that I need to see the employee working in front of me. Now I can see that remote work is very effective also.”*

For others, remote work *“added more stress to the usual work life. Before it was 8-9 hours of work, you don’t have the obligation of results because your manager can see in real life what you are doing and the problems that you do face in the task. Meanwhile, in a remote work environment, you have a goal obligation so you can pass more time working.”*

Another category of managers forced the developers to adopt a hybrid work organization. This led to a conflict of mentality, *“There are some directors that don't trust the developers, so they are obliging you to be in the office just to control you for eight hours. I think that this is a bad idea for a developer.”* This cultural transformation sometimes leads to depression for the employees. In this example, we have an organizational resilience that did lead to a cultural transformation (interaction I3 in the Annex D).

- The availability of the workforce

During the COVID crisis, there was some delay in the project implementation due to the availability of resources. The cause of the fewer resources available is the health issues for everyone affected by the virus. We had also the firing of some employees due to the new strategy of limiting the charges. As a result, we had the same amount of work and fewer available resources.

“As an immediate solution, we did try to organize ourselves and optimize our way of working.” Also, the companies did change their strategy and stopped any new design and development in the running application. *“The only goal was just to keep the application running.”* They did also compose two teams: a crisis team and a support team. All of these solutions present a quality technical resilience related to the implementation and an organizational resilience related to the creation of crisis teams.

As a more permanent solution, *“The company used more alternant’s students in the projects. This is the optimal solution to avoid the cost of hiring a full-time employee.”* Some other companies *“adapted the work from anywhere policy so it can attract the most talented profiles and have more availability.”* These solutions present a shift in the organization (an organizational transformation). In this example, we have an organizational and technical resilience that did lead to an organizational transformation (interaction I4 in the Annex D).

- Transformation of the Work Organization Using a Digital enterprise resource planning (ERP)

Following the Microcontroller shortage crisis, the factories of Bus construction started an immediate solution to pass the buses from the production line without adding the needed equipment (organizational resilience). To keep the traceability of these buses (and other missing tasks), the factory implemented SAP as an ERP to optimize their work (a technical transformation). As a result, we have an organizational resilience that did lead to a technical transformation (interaction I5 in the Annex D).

- Training of the Team

During the COVID crisis, there were a lot of problems with the team member and the new joiners’ training. The process of onboarding passed from 100% remote training—as an urgent solution (organizational resilience)—to a hybrid process currently. This change in the process led to *“a digitalization of the company knowledge so it can be available online.”* (a technical transformation). As a result, we have an organizational resilience that did lead to a technical transformation (interaction I6 in the Annex D).

4.2.2. Global company strategy

- The change of priorities and business model

During the first stage of COVID, a lot of clients stopped many projects so there was a decrease in work in a drastic way. The first reaction as managerial resilience to this crisis was to fire some employees.

As a more permanent solution, a lot of IT companies changed their field of expertise to adopt a more stable revenue. For other companies, the solution was to go for the remote activities and target the gross margin (the big companies) because they are more stable financially. These changes present many managerial transformations.

As a result, we have a managerial resilience that did lead to a managerial transformation (interaction I7 in the Annex D).

- The Change of Customer Behavior and the New Business Opportunities

During the crisis, we noticed a change in the customers behavior (an environmental resilience). This did trigger some immediate adaptation of the companies like the adaptation

of digital platforms and more innovative ways to promote their products. *“For the survival of the small business, all of them were obliged to use SHOPIFY, for example.”* (technical and organizational resilience). These actions led to a more permanent change (operational and organizational transformation of the way of working). Some examples of these big transformations can be found in platforms like DOCTOLIB, e-commerce applications, etc.

In this subject, we have an environmental resilience that did lead to a technical and organizational resilience and then an operational and organizational transformation (interaction I8 in the Annex D).

4.2.3. Change of the legislation

To keep up with the quick change of events during the COVID crisis, there were many changes in the law texts to deal with the new circumstances (Environmental resilience). The companies needed to be resilient enough to cope with these changes rapidly (like the preparation of a valid VPN for the sudden remote work policy: a technical resilience). After that, they needed to transform their infrastructure and platforms to be more flexible (technical transformation). One manager confirmed that *“no one was expecting that they will put all their employees connecting from outside the office, so there was a problem in the scalability of the VPN. For the first period, we had a very limited connection. Then, the company transformed all the infrastructure in two months to have more accessibility.”* In this example, we have an environmental resilience that did lead to a technical resilience and transformation (interaction I9 in the Annex D).

4.2.4. Security and the design of the application

The new circumstances in the crisis triggered many design changes in the web application to absorb all the new user requirements. An important subject was the design of security. As an immediate reaction to all the new connections on the platforms, many companies did limit the number of people connected and did provide secure connections to the key users (a technical resilience). After this first phase, a lot of companies adopted the cloud solution (delegating the security and scalability responsibilities). Other companies did invest to add more firewalls, change the architecture of the application and recruit security experts (a technical transformation).

In this example, we have a technical resilience that did lead to a technical transformation (interaction I10 in the Annex D).

5. Discussion

The goal of this paper is to present examples of the mutual interactions between resilience and digital transformation from a practitioners' perceptions. To achieve this goal, we conducted a series of interviews with different information system experts.

This field feedback is critical to our understanding, gives us more visibility, and will allow us in the future to predict the behavior of an information system during a crisis.

We can notice through our results that the interviewees did mention some digital transformation and resilience dimensions that don't have interactions with each other. They confirmed that some companies did just react to the crisis through the resilience of the system, but after the crisis companies didn't do a digital transformation. This decision can have multiple reasons like budget problems after the crisis or the resistance of the employees.

6. Conclusion

This paper presents a field study discussing digital transformation, resilience, and the mutual interactions between them.

Although this field study can't claim to be exhaustive, it does present several implications. The aim of this work is to present real feedback from information system experts about what they lived during a crisis.

Our document presented a study that can lead us to some limitations. We did present in the discussion section some points that could be the subject of future papers.

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Annex

Annex A: list of the interviewees

Interviewees	Dates	Years	Function	Industry	Length
Interview 1	01-01-2022	14 years	Vice president	Finance	35min
Interview 2	01-01-2022	13 years	Tech manager	Banking	38min
Interview 3	02-12-2021	20 years	CEO	Consulting	40min
Interview 4	02-12-2021	9 years	Tech leader	Supply chain	51min
Interview 5	03-02-2022	5 years	Senior consultant	Supply chain	32min
Interview 6	04-02-2022	6 years	Senior developer	Finance	30min
Interview 7	04-12-2021	6 years	Senior developer	Data management	52min

Interview 8	04-12-2021	12 years	Project manager	Maritime field	1h
Interview 9	05-12-2021	5 years	Senior developer	Banking/media	49min
Interview 10	05-02-2022	12 years	Manager	Consulting	45min
Interview 11	06-02-2022	4 years	Lean engineer	Biomedical	30min
Interview 12	06-02-2022	5 years	Quality manager	Automotive	1h
Interview 13	08-01-2022	10 years	Senior consultant	Supply chain	1h
Interview 14	09-12-2021	4 years	Quality engineer	Automotive	30min
Interview 15	10-01-2022	4 years	Quality engineer	Train construction	40min
Interview 16	11-12-2021	10 years	Tech leader	Finance	47min
Interview 17	12-02-2022	6 years	Senior developer	Banking	30min
Interview 18	14-02-2022	4 years	Project manager	Automotive	1h4min
Interview 19	15-12-2021	7 years	Senior developer	Banking	52min
Interview 20	16-01-2022	27 years	CEO	Consulting	48min
Interview 21	18-02-2022	7 years	Senior developer	Banking	36min
Interview 22	21-01-2022	10 years	Project manager	Maritime field	30min
Interview 23	21-02-2022	9 years	Tech leader	Banking	30min
Interview 24	21-11-2021	7 years	Senior developer	Banking	37min
Interview 25	21-11-2021	7 years	Senior developer	Banking	37min
Interview 26	21-12-2021	4 years	Lean engineer	Bus construction	1h14mi
Interview 27	22-02-2022	7 years	Senior consultant	Banking	30min
Interview 28	22-11-2021	6 years	Senior consultant	Consulting	44min
Interview 29	23-01-2022	15 years	Senior manager	Banking	49min
Interview 30	25-02-2022	37 years	Senior manager	Water distribution	47min
Interview 31	25-11-2021	6 years	Product owner	E-commerce	49min
Interview 32	25-12-2021	5 years	Senior consultant	Insurance	1h
Interview 33	25-12-2021	4 years	Quality engineer	Aeronautic field	1h6min
Interview 34	26-01-2022	4 years	Senior developer	Public sector	30min
Interview 35	27-02-2022	4 years	Product manager	Boat construction	34min
Interview 36	28-01-2022	27 years	Senior manager	Supply chain	1h
Interview 37	28-11-2021	6 years	Airport officer	Aeronautics	56min
Interview 38	29-01-2022	5 years	Reliability ENG	Tech resilience	37min
Interview 39	30-12-2021	8 years	Project manager	Telecom	32min
Interview 40	30-12-2021	5 years	Data scientist	Data science	32min

Annex B: Coding for the digital transformation dimensions

Examples	Open codes	Selective codes	Theoretical codes
<p>-“a design transformation of the security: double identification, triple coding of the application, add of FireWire, etc.”</p> <p>-“There was a change to the employees: a training every 3 months to face the new trends in security threats.”</p>	<ul style="list-style-type: none"> • Improve the security policy (VPN, firewall, etc.). • Improve the knowledge about security (trainings, etc.) 	Transformation in the Security management	Technical dimension
<p>-“There was also a study to improve the quality of the applications: manual tasks can be implemented as a tech solution.”</p>	<ul style="list-style-type: none"> • Improvement of IS design • Implementation of the project 	Transformation in the Quality of IS service	

-“ There was a change in the way of working, we were in a phase of testing of a project that I need to install some scripts in the client environment, but I did not have access to this environment... the solution was that I did a detailed document that explain the steps and they did install without the need of me being onsite.”	<ul style="list-style-type: none"> • Testing and quality process. 		
“There was also a change in the organization of the project, you can’t apply the card game for example in the Sprint meetings. So, you need to respect the remote rules: there are some software companies that did use this gap to create a web application”	<ul style="list-style-type: none"> • Transform the team Orga. • Organization identity (best practices apply the managerial strategy decisions) 	Transformation of the organizational methods	Structural dimension
“There is a change in the teams; now there is no hierarchy. After the COVID there was more trust in the developers.”	<ul style="list-style-type: none"> • Operational methods (practice theory, agility) 	operational sub-dimension	
-“There was the project to start targeting the big companies.” - “Previously I did fix a goal of 200% of growth each year for 5 years I did revise that to 50%”.	<ul style="list-style-type: none"> • Adapt a new digital strategy (opportunities, roadmap) 	managerial sub-dimension	
-“The second transformation: the writing culture. Now there is a need to keep a trace of the information.” -“Honestly for me, I was convinced that I need to see the employee working in front of me. Now I can see that remote work is very effective also.”	<ul style="list-style-type: none"> • Improve the knowledge systems. • Change the mentalities, • Mental health : stress, depression, etc. 	Improve the cultural adaptation.	Cultural dimension

Annex C: Coding for the resilience dimensions

Examples	Open codes	Selective codes	Theoretical codes
“During the COVID, there was a lot of remote work, so the links were exposed from outside the company. This did create a risk”.	<ul style="list-style-type: none"> • Security KPI • security and risk management 	security resilience	Technical dimension
“The priority during the crisis was the quality of the product with no evolution of the application.”	<ul style="list-style-type: none"> • The capacity of solution delivery • Implementation of the application despite the interruptions. 	Quality resilience	

<i>“We needed to stop all the unnecessary projects. As a result, we had an organizational problem keeping the employees busy.”</i>	<ul style="list-style-type: none"> • Organizational disruption. • Task force, etc. 	Organization methods for resilience	Structural dimension
<i>“The crisis did change many things; the goal was just to keep the application running with no new functionalities.”</i>	<ul style="list-style-type: none"> • Anticipate shocks • control the challenges 	Managerial strategies for resilience	
<i>“There were a lot of low texts about changes in pay and HR regulations in each country. There was a need to implement these changes.”</i>	<ul style="list-style-type: none"> • The political constraints • New law text. • The capacity to adapt 	Environmental possible influence on resilience	Environmental dimension

Annex D: the list of interactions

Reference	The interaction
I1 communication	Organizational resilience → Organizational transformation
I2 software	Organizational transformation → Technical transformation.
I3 mentality	Organizational resilience → Cultural transformation.
I4 availability	Technical resilience → Organizational resilience → Organizational DT
I5 ERP	Organizational resilience → technical transformation.
I6 Training	Organizational resilience → Technical transformation.
I7 priority	Managerial resilience → managerial digital transformation.
I8 opportunities	Environmental resilience → Organizational / technical resilience → operational / organizational transformation.
I9 legislation	environmental resilience → Technical Resilience → Technical DT
I10 security	Technical resilience → technical digital transformation.