Technology Performativity and Organizational Resilience : The case of setting up a computer-based information system in the SASS cross-border basin

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Abstract

This research presents the case of setting up a computer-based information system in the SASS (Tunisia-Algeria-Libya) cross-border basin. This study is based on two theoretical perspectives: resilience and the movement of sociomateriality. It shows the way experts have succeeded in absorbing technological risks and in developing their resilience capacity by developing collective choice rules (E. Ostrom, 2007) within consultation meetings. The objectives of this article are twofold. First, it explores the possibilities of adapting the Institutional Analysis and Development (IAD) framework (Hess and Ostrom, 2007) to cooperation situations in which actors manage information via an electronic platform. Second, it identifies the role played by technology in the development of resilience capacities. We conducted a case study using a qualitative research methodology. The results show that the short-term functioning of these self-organizing communities fits within E. Ostrom's conceptual framework for sharing information and knowledge. Organizational thinking integrates materiality which is not limited to what is in itself materially graspable; rather, it extends to the performativity of technology, i.e., to the rules and procedures that are born out of the interaction with the technological artifact. Materiality is present in the negotiation of rules within meetings to allow transboundary countries in case of an emergency to react, to tinker, to innovate, and thus to develop a level of organizational resilience which is essential to maintaining cooperation.

Keywords: Commons, Resilience, Sociomateriality, Performativity, Information System

Résumé:

La recherche examine le cas d'une plateforme en *pair-à-pair* permettant l'échange de données entre pays transfrontaliers, une structure de gouvernance a été mise en place mettant en œuvre un ensemble de règles auxquelles les pays doivent se soumettre s'ils souhaitent interagir avec la plateforme, fournissant en outre des instruments utiles pour l'arbitrage en cas de conflit ou de violation des règles.

Cette étude s'appuie sur deux perspectives théoriques : la résilience et le courant de la socio matérialité, il est alors montré comment les experts ont réussi à absorber les risques technologiques et à développer leur capacité de résilience en élaborant des règles de choix collectifs (E.Ostrom, 2007) dans les réunions de concertation.

La réflexion organisationnelle intègre la matérialité qui ne réduit pas à ce qui est en soi matériellement saisissable mais elle s'étend à la performativité de la technologie c'est-à-dire aux règles et procédures qui sont nées de l'interaction avec l'artefact technique. La matérialité est présente dans la négociation des règles dans les réunions afin de permettre aux Etats transfrontaliers de réagir en cas d'urgence d'innover et ainsi développer un niveau de résilience organisationnelle indispensable au maintien de la coopération.

Une telle situation amène à qualifier la pratique qui émerge *in situ* d'intelligence collective où la connaissance se construit à partir des informations et de l'interprétation collective permettant de stabiliser le sens attribué aux données.

Mots clés : Communs, Résilience, Socio matérialité, Performativité, Système d'information

INTRODUCTION

The literature on management recognizes the benefit of addressing the topic of organizational effects of Information and Communication Technologies (ICT) in terms of their uses (Orlikowski et al 2010 ; De Vaujany, 2003 ; Smith, 2021)

Many authors in the field, such as (Dieng-Kuntz et al, 2000 ; Bouchez, 2004 ; Tourtier, 1995 ; Adrot et al, 2013), draw a distinction between reactive uses and creative uses of ICT. This innovative use, called creative, can be observed through the behavioral dynamics emerging from the situation.

Adrot et al (2010,2013,2017) have identified four behavioral dynamics influencing the transmission of information via the use of technology: reinvention, resignation, abandonment and stagnation. These works also underline the major role of objects with regards to the transmission of information and knowledge in organizations seeking to be resilient in extreme situations.

However, fewer are the articles that take an interest in what precedes these conceptualization concerns and attempt to open the Pandora's box of these uses by monitoring scientific devices and material artifacts in laboratories. Hence, we went to one of those dedicated places, an intergovernmental laboratory that gathers experts on the region's water management.

Taking into consideration the literature on the influence of materiality on the resilience of organizations (Weick, 1993), we explore in this research the influence of technologies on the transmission of information and knowledge in an organization that seeks to be resilient. In an exploratory manner, we focus on the following question:

In what way does the interaction with technology contribute to the resilience of organizations?

To conduct this study, we examined a process of crisis management where some of the actors were unable to use the artifact allowing the transmission of information, which has caused a serious breakdown.

1. ORGANIZATIONAL RESILIENCE AND GOVERNANCE OF KNOWLEDGE COMMONS

Our study is based, first, on two theoretical perspectives: resilience and the movement of sociomateriality. Research on sociomateriality and resilience are closely connected, as they both focus on the consequences of the arrangement of the physical or digital materials of an artifact in certain forms that are resilient across time and space (Leonardi, 2013). We also

compare the alternative theoretical foundations on which the study of the sociomateriality of information systems can be built: “substantialist ontology” and “relational ontology”. We focus our study on the contributions of a relational ontology to the analysis of organizations and the possibilities of action, interactions, and collective action that artifacts, technologies, and boundary objects (Hufschmidt and Kurse, 2014) offer to organizations facing crises. We, then, explore the possibilities of adapting the Institutional Analysis and Development (IAD) framework (Hess and Ostrom, 2007) to a situation where experts who face an emergency where information no longer circulates must innovate, tinker and thus increase their level of organizational resilience which is essential to maintaining cooperation.

1.1 THE CONCEPT OF RESILIENCE

The concept of resilience has been for a long time associated with the control of environmental turbulence. Over time, resilience has attracted the attention of other disciplines such as management sciences that have become interested in the concept of resilience by distinguishing the individual level (Thong and Yap, 2000) from the organizational one (Riolli and Savicki, 2002). The former suggests personal and situational adaptations in the presence of stress factors while the latter involves community adaptations during times of change.

At the organizational level, the term “resilience” first appeared in the context of research on the resilience capacity of High-Reliability Organizations (HROs). The analysis shifts then from the individual level to the organizational and collective one. Some examples, such as the Mann Gulch disasters, reveal the central role information sharing plays in the development of the resilience capacities of high-reliability organizations (HROs). Several authors from the field of management science have focused on the good flow of information and knowledge as a factor of resilience (Lengnick-Hall C. A. and Beck T.E. (2005), Altintas G. (2007), Hamel G. and Välikangas L. (2003), Koninckx G. and Teneau G. (2010)). More recent studies focus on organizational resilience from the perspective of information and knowledge sharing (Lebraty et al, 2008).

At the community level, several authors (Wenger, 1998; Josserand, 2004; King, 1995; Tish, 2018; Duguid, 2005) have shown that the access to and sharing of information and knowledge can facilitate the response to crises. At the individual level, the term has been used to describe the ability of employees to adapt to change or adversity (Luthans, 2002; Thong et al, 2003).

1.2 THE SOCIOMATERIALITY OF INFORMATION SYSTEMS AS AN ANALYSIS GRID

One of the most debated topics in the field of information systems today is sociomateriality. This philosophical movement is characterized by its focus on the relationship between the social and the material within an increasingly digital society. Various approaches to sociomateriality have emerged building on different philosophical trends: “agential realism” and “critical realism”. The ontology of agential realism assumes that “the social and the material are inseparable; there is only the sociomaterial” (Orlikowski, 2010; Orlikowski and Scott, 2008; Barad, 2007). However, critical realism, as a philosophical trend allowing the study of materiality and the role it plays in an organization, suggests dealing with technologies as a structural property independent of people and outside the domain of action (Leonardi, 2012; Mutch, 2013).

1.3 INFORMATION SYSTEMS AND THE RESILIENCE OF ORGANIZATIONS

Recent work on resilience has originated from several disciplines such as computer science, ecology, psychology, socio-ecology, and security-related crisis management. The state of the art provides an overview of the different approaches to research on resilience: (1) the engineering approach, (2) the cognitive approach, and (3) the organizational approach. As crises are occurring successively and the environment is growing more complex and turbulent, information technology has become a platform in which information and knowledge flow beyond geographic boundaries.

In recent years, companies, whose borders have been significantly altered as a result of outsourcing strategies, had to adapt their information systems during crises in order to respond to changes that disrupt their functioning. According to Rioli et al (Rioli et al, 2003), the analysis of the individual and the organizational levels represents the two parameters of organizational resilience with relation to information systems. The authors explain that coordination among community members, and communication and information sharing during times of crisis enable organizations to develop their resilience capacities. Other works (Samuel et al, 2011) highlight the issues of resilience and learning within communities of practice with relation to information systems. In both monographs, the information systems were not able to anticipate the crisis but were adapted during the crisis response phase through a reconfiguration of the supply chain.

The several authors who have contributed to developing the theoretical framework of resilience and crisis management agreed on defining three major phases that are strongly intertwined. The first is an anticipation and prevention phase built on precautionary principles (Goodman et al, 20011; Fink, 2007; Royer, 2009; Mitroff and Gus, 2000, Weick et al, 1999). The second focuses on the ability to manage the crisis during the crisis itself (Weick, 2009). Finally, the last is a reconstruction phase which constitutes the post-crisis learning phase (Mitroff, 2005; Royer, 2009; Sellnow and Seeger, 2006; Weick and Sutcliffe, 2007).

The literature on resilience has addressed materiality and the transmission of information. Researchers have illustrated, through empirical studies, the relationship between the social and the material in a context of an increasingly digital society. These studies demonstrate how the materiality of the information system is not limited to what is materially graspable per se. On the contrary, it extends to the technology affordance, which is defined as the potentials for action offered by this tool (Datnow, Park and Kennedy Lewis, 2013; Leonardi, 2011), and to the performativity of technology as it emerges in situated practices (Gherardi, 2012; Feenberg, 2012; Castor, 2016).

1.4.THE ROOTS OF COMMON THINKING

Elinor Ostrom (1990) is today a reference on the question of commons. She echoes the thinking of Garrett Hardin in his famous article on the "tragedy of the commons", but she criticizes the theoretical foundations of this model, which recommends state or market solutions to avoid the overexploitation of commons. For Ostrom, there are other theoretical and empirical alternatives to this model where communities self-organize and shape different ways of governing the commons. She has undertaken a series of empirical studies of resource management cases around the world, combining a wide range of references, particularly in economics and political science, synthesized in her framework "Analysis and Institutional Development" (IAD).

Among Elinor Ostrom's major contributions to the analysis of the commons is her analysis of institutions that promote self-organization and self-governance of the commons. The contributions of Ostrom's framework for institutional development analysis are considerable, and three possible contributions can be highlighted here: A first major contribution is based on her critique of Hardin's thesis on "the tragedy of the commons", Hardin refers to a situation of free access where no public or private institutional arrangement regulates the use of the resource. Hardinien's argument is in line with the economic reasoning of rational choice,

where man seeks to maximize the exploitation of resources, without restraint to the point of degrading them.

The second contribution relates to the reversal of the private property paradigm. Ostrom's proposals for broadening the circle of ownership are based on a conception of ownership as a "bundle of rights". With this notion, Ostrom joins institutional economist John. R. Commons, who highlighted the plurality of proprietary models. The third contribution is based on the recognition of the collective's capacity to self-organize, self-govern and define different institutional arrangements.

Information resources raise special challenges for implementing the eight principles that could contribute to the success of local institutions in governing common resources, the eight principles are discussed in turn (see case study).

The eight principles are : 1) clearly defined boundaries ; 2) Congruence between appropriation and provision rules and local conditions; 3) collective choice arrangements; 4) monitoring; 5) graduated sanctions; 6) conflict-resolution mechanisms; 7) minimum recognition of rights to organize; 8) nested enterprises.

1.5. FROM GOVERNING NATURAL RESOURCES TO GOVERNINIG COMMON INFORMATION RESOURCES

Drawing on the work of Ostrom, this section seeks to establish the bases on which natural resources and information resources can be compared. Information commons have three original characteristics compared to those of the land commons (Coriat, 2015): They deal with sets of resources made up of non-rival and generally non-exclusive assets; information commons are characterized by particular property regimes: the set of intellectual property rights (IPRs); the governance structure ensuring the distribution of property rights between partners has as its main task, alongside maintaining the stock of information, its enrichment (table 1). In the analytical apparatus that she has built as a basis for studies of commons, Ostrom (2011) has studied the external factors that affect a situation of action at a given time, such as the biophysical conditions and attributes of a community. Many researchers have shown that the problems faced in governing information commons are the same as those faced in managing natural resource commons (Kollock and Smith, 1996; Forte et al, 2009; Cardon and Levrel, 2009).

(Hess and Ostrom, 2007) explore the question of what frameworks of analysis are most beneficial in building a research agenda for this new commons. Some of the questions posed

were: Is it possible to transfer lessons learned from the traditional commons to the information-commons ecosystem? What can research on traditional commons teach us about the dilemmas of governing information as a common ? How can scientists, information specialists and laypersons, non specialists, can give their views on technical subjects of such great complexity? (Callon, 2009).

Table 1: From traditional to new commons: common traits and differences

	Traditional commons	**Information commons**
Common traits	Congruence between rules and local conditions (Viégas et al, 2007) Monitoring (Kollock and Smith, 1996) Graduated sanction (Forte et al, 2009) Conflict-resolution mechanisms (Tschopp et al, 2018)	
Differences	Clearly defined boundaries Physical/ Tangible resources Rivalrous and excludable goods The governance is oriented to the conservation of resources Property regimes: bundle of rights	The boundaries of the community are ill-defined Intangible resources Information commons involve sets of resources composed of non rival and (usually)non-exclusive goods The governance is oriented not towards the conservation of resources but toward their enrichment and growth(Coriat, 2011) Intellectual property rights

2. PROPOSED FRAMWORK

The objective of this paper is to identify the role played by technology in the development of resilience capacities. I use a theoretical framework, adapted from Ostrom and Hess (2007) to specify the process by which experts interact, share information, and create the institutional arrangements that shape their collective action. The IAD framework is particularly appropriate for analyzing traditional commons dilemmas; it has been developed to understand one of the most fundamental political and social questions: How experts work together, create communities of practices share information and knowledge in order to sustain a resource.

In the IAD framework, we submit three clusters of variables that are basic factors affecting an action situation and the patterns of interactions. Ostrom and Hess (2007) have shown that several variables developed in the analytical framework are present in information systems such as biophysical characteristics, attributes of the community, monitoring, graduated sanction, rules in use, conflict resolution (Kollock et Smith, 1996; Forte et al, 2009; Cardon et Levrel, 2009). A strand of literature focusing on decentralized forest governance increasingly stresses information and power in the community as keys to understand how the resource is allocated (Anderson, 2006).

The top level of the model is the context in which biophysical environment, socioeconomic conditions and institutional arrangement at this level are located. Boundaries of the analysis or the action arena are located at the second level of the model. The action arena may be associated to the most suitable geographic unit of water resources management like the basin scale. Pattern of interactions are located at the third level of the model.

The core of the IAD framework is the "action situation", Figure 1 shows three categories of external variables affecting an action situation:

(i) Biophysical conditions

(ii) Attributes of Community

(iii) Rules-in -Use.

The IAD framework can also help in analyzing patterns of interactions, information flows and organizational resilience through an infrastructure lens Ostrom (2005) and (Anderies et al, 2016).

While the IAD framework has been the most commonly-used framework for analyzing the commons to cooperation situations in which actors manage information via an electronic platform. E. Ostrom's analyses of self-organized and self-governed systems justify the ability of community actors to self-organize and self-govern to manage production and sharing of information as a common- pool resource. A recent movement (Frischmann, 2012; Anderies et al, 2014) recognizing the importance of thinking in terms of infrastructure and systems. An "infrastructure " is a coherent structure, Frishmann (2005) distinguishes between (i)hard infrastructure like roads, information system, (ii) soft infrastructures or human made instruction like algorithms (iii)natural infrastructure, (iv) human infrastructure or knowledge and social infrastructure.

Our work focuses on how the IAD framework contributes for analyzing an action situation by envisioning it as an information processing infrastructure that interacts with human infrastructure. The resilience of an organization depends on the transmission of information when the system is hit by a shock, the resilience literature has taken into account materiality, the concept of affordance offers many possibilities in terms of innovation.

The IAD framework recognizes two timescales, the two differ profoundly in terms of interactions and collective dynamics. One slow, linked to external variables considered as functional infrastructures (Figure 1), some of which may disrupt the system and lead to breackdown of one or more nodes in the system. One fast in which humans attribute a sense to objects through interaction with technology. According to the dynamic logic, the rules of governance of the shared resource are not determined by the institutional framework but emerge from the interactions between human-infrastructure and non-human-infrastructure. Depending on their interaction with the technological infrastructure, it's an entire organizational system that collapses or is maintained, thus contributing to collective resilience.

While the IAD framework is the probably the most commonly-used framework for thinking about institutions and the resilience of socio-ecological systems for over 30 years, the material turn in neo-institutional theory has so far stayed relatively far away from it.

3. EMPIRICAL ANALYSIS

3.1.METHODOLOGY

We begin with a brief introduction to the laboratory ethnography method before outlining the specific scientific workplace we have worked in. There seems to be a consensus among Management researchers about the importance of a qualitative methodology when studying unfinished knowledge from a sociological perspective, the knowledge that is yet in the process of being constituted (Callon and al, 1991).

Our collection of observations within the scientific workplaces has led us to a kind of research primarily concerned with the details of scientific activity rather than a global analysis.

The idea is based on the study of science and technology, in action, and in the middle of controversy. We opted for a one-month in-situ observation in the OSS laboratory. For the work presented here, the qualitative research design is particularly relevant because it allows us to observe the behavioural dynamics that emerge from the interaction with the artifact in emergency situations. To conduct this study, we conducted a laboratory ethnography in the SASS department of the OSS in line with E. Ostrom's ADI framework of analysis. The ethnographic investigation in the SASS department of the OSS is devoted to the description of the interactions, communication and sharing of information between the experts. The collective management of the information resource is thus at the heart of the ethnographic description. To gather information, we have both triangulated methods: field contact (1 month of observation), complementary documents (reports, publications (2014-2018), numerous discussions with experts, engineers and administrative managers, non-participant observation at consultation meetings, questionnaires to experts by electronic means). We frequent the offices, attend discussions in the assistant's office, in the corridors. Our presence in the research laboratory allowed us to describe the scientific work in the SASS laboratory, as well as the inscriptions, documents, instruments and materials that occupy the researchers and play an important role in the production of scientific facts (Latour, 1980). Other complementary documents, maps, graphs, and reports were collected between 2014 and 2018. In addition, non-participant observation at consultation meetings allowed us to analyse the power relationship between the three countries that share the SASS basin as well as to observe the interactions between physically distant experts. (Annexe A).

3.1.1. Laboratory Studies: Contribution of the method in scientific workplaces

Since the 1980s, sociologists and anthropologists have multiplied laboratory studies, mainly developed from the work of (Collins, 1975. The laboratory is defined as an artificial setting in which experiments are organized, objects on which experiments are performed such as electrons, neutrinos or genes (Callon and Latour, 1982, 1985). The idea is based on the study of scientific controversies, scientific facts and the study of science and technology through the observation at the root where knowledge is produced in scientific workplaces.

Developed in the 1980s by Michel Callon, Bruno Latour and other researchers at the Center for the Sociology of Innovation, the actor-network theory or the sociology of translation combines two terms: actor and network. By refusing the separation between humans and non-humans, the ANT offers an original solution based on allocating an active role to sciences and technologies in the construction of reality (Callon, 2006, p. 276).

The ANT is based on the notion of inscription (Latour and Woolgar, 1979). This concept refers to maps, charts, diagrams, and images that are made by instruments. The role of scientists is to produce inscriptions (such as an atom, an electron ...) and then combine them with other traces or inscriptions. As they circulate, the inscriptions articulate a network, which Callon (1986) describes as sociotechnical, i.e., a network that allows the articulation of entities (such as an electron, a molecule …) to humans.

The idea of the laboratory is often associated with a world apart from society; the picture of the isolated scientist is exciting and mysterious. As several researchers have pointed out, scientists evolve in a type of society and then become autonomous from society (Vinck, 2005). The study of the social construction of scientific knowledge became the methodological focus of laboratory studies; the method used is the ethnography (non participant observation) with discourses analysis components. Experts form the hard core of laboratory studies, studying them however required a special methodological approach.

3.1.2 Conducting a laboratory ethnography

SASS laboratory experts interact via a computer-based information system centralized at the SASS basin level (Annexe B). The notion of information ecosystem (Moore, 1993), is used here to analyze the interactions between heterogeneous actors associating humans and non-humans(ERP/MIS/) which give a certain stability and irreversibility to the technical-economic network (Callon, 1991,P.196).

The platform is managed by a team of experts who play the role of platform administrator, this self –governed form of community has emerged in order to manage this collective informational to produce and manage a common knowledge at the border between open source and data security: organizational routines, collaboration between cross-border countries, sharing of data, tacit and explicit knowledge between experts.

This community of practice (wenger, 1990) proposes an administration of information flows, its main tasks are:

- ✓ Analyze existing information at the level of three countries
- ✓ Design an information system
- ✓ Implement a database and management information system
- ✓ Integrate the three components of the information system(relational database, MIS, and digital model): integration of geographic information in the database, establishment of MIS-model links).

Information ecosystem involves a variety of interrelated tangible artifacts such as computers, software, digital platforms, machines, devices, databases. Information system infrastructure includes the digital platforms where computers are grouped in a *cloud* computing infrastructure, a virtual pool of various computing resources such as centralized mainframe computers, local devices, data management services which enable data storage, analysis and application software. The information management system is based on a centralized architecture where queries are sent to the common database at the central level. The SASS database administrator defines clear procedures for updating information, defines specific codes for each type of data, defines strict rules in order to facilitate updates and management in a common database, implements data security mechanisms (access authorization, preventing free-riding).

The advantage of such architecture is the homogenization of data and the low cost of data transfer, since peers communicate with the central server. The main disadvantage is that the administrator of the common database serves both as a facilitator and as a bottleneck for the processing of geographically disparate information which makes it fragile. For managing information in the cross-border basin, there are three action arenas where the management rules are elaborated (the regional level, the national level and the SASS level).

During the Arab revolutions in 2011, engineers in Libya quickly abandoned the use of the electronic platform, the abandonment consists of a brutal break in the use of the artifact at the national level but that affected the regional database. The abandonment of the artifact is explained by the discrepancies between the affordances offered by the technology and the

emergency situation. It’s at the operational level that actors are no longer able to develop collective coordination solutions.

The consultation workshops are the places where agreements can be reached on the rules of collective choice. These rules concern the regulation of conflicts through amicable negotiation processes that favor learning rather than punishment. At this level, the role would not be to impose legal sanctions, but to promote incentive mechanisms for sharing information and results by country and area of expertise . The rules of constitutional choice are now problematic in the absence of the legitimacy of a single body which defines who has the right to use these informational that peers cannot share.

3.1.3. Consensus-building by the Delphi method

Our objective here is to propose the use of the Delphi method developed within the Rand Corporation based on the questioning several times by questionnaire of a panel of experts (Godet, 2006 ; Okoli et Pawlowski, 2004). This survey technique is used in prospective studies as a preliminary step to the construction of scenarios, it has thus been applied in prospective military studies (Dalkey et Helmer, 1963). The three rounds of questionnaires reveal the hard trends (behind the consensuses), areas of major uncertainty (behind dissensus), but also disregarded seeds of change (minority positions).

3.1.4. Implementation of the Delphi technique

Three steps appear in the implementation of a Delphi survey, the design stage of the initial questionnaire, the stage of selecting experts, and the stage of carrying out three successive questionnaires. Regarding the size of the panel of experts, it is justified according to the stakes, the sector of activity and the context (Okoli and Pawlowski, 2004).

Laboratory ethnography conducted in the intergovernmental organization between 2014 and 2018 enabled the precise identification of 24 experts: remote sensing engineers (3), hydrology engineers (12), university researchers in economics(2), experts in other research organizations (7).

3.1.5. The stage of the three rounds of questionnaires:

The various questionnaires were sent by e-mail in Word format. For the first round, the response times vary between 1 week and 1 month, the relaunch of the messages is necessary in order to have the response of the experts. Response times in the second and third rounds vary between 1 day and 3 days. 5 main themes are addressed in the three rounds of the

questionnaire (general context, evolution of the sector, environmental constraint, external actors, obstacles), taking into account the temporal sequence past-present-future. In the first round, the experts are first asked to note their agreement on each proposal on a Likert scale from "don't agree at all" to "completely agree". In the second round, each expert is given the median and histogram of the first answers, experts must confirm or change their positions on controversial issues taking into account the opinion of other experts. A second Likert scale is constructed (from « A, very important » up to "D, not very important ». For the third round, we identify three configurations of actors (Group 1 with a broad consensus on the important issues, Group 2 with a low level of consensus and issues deemed to be of little or no importance for the future of the sector, Group 3 with groups with low consensus but addressing important issues for the sector, these positions are important to analyze controversies.

3.1.6. Delphi survey results:

The Delphi survey first reveals consensuses between the 1st and 3rd rounds around the choice of piezometers in the SASS basin. The opinions of experts converge on their difficulty in accessing information on the quantitative and qualitative state of the water table in Libya.

4. DISCUSSION AND CONCLUSION

We will first return to the research question and the results of the survey. We will then discuss the links between technology performativity and organizational resilience, the criticism of science, the notion of risk and the precautionary principle.

4.1. RETURN TO THE RESEARCH QUESTION

In the introduction, we asked ourselves to what extent does interaction with technology contribute to the resilience of organizations? To carry out this study, we studied a crisis management process where some of the actors are unable to use the artifact allowing the transmission of information which has caused a brutal rupture. If the mode of governance here is called polycentric, it is because it allows the entanglement of different rules of information management. Nevertheless, biophysical conditions such as the geographical distance of the experts have caused a sudden break in the transmission of information at national level and in the regional database. This case highlights how materiality embodies performativity, which is implicitly mentioned in consultation meetings.

4.2. TECHNOLOGY PERFORMATIVITY AND ORGANIZATIONAL RESILIENCE

The discussion of organizational resilience with the performative turn of network theory (Callon, 1986) leads us to consider the possibility of a counter-performativity where the effect of the use of the artifact does not change practices. (Mackenzie, 2006).

The term ‘actor network theory’ combines two words: actor and network, the performative turn of the ANT gives a central place to the technical device or «arrangement» in the performation of the real. The idea is to go beyond Austin’s thesis strongly inspired by the philosophy of language by giving importance to material devices in the construction of reality. Many economic sociologists have been interested in the notion of performativity. (Callon, 1998) whose work is based on the field of scientific studies proposes to explain the performative character of economics, "economics performs, shapes and formats the economy, rather than observing how it functions" (1998b, p. 2), economic theories do not describe a reality that is external to them but create that reality. Economics as science can affect economics in many ways, by observing by measuring, predicting, providing theories to explain or instruments to regulate them (Mackenzie, Muniesa & L. Siu, 2007). The notion of performativity is therefore complex and can be used in different disciplines, in economics, social sciences or management sciences. For Callon, who is in the field of the sociology of science, the performative process of economics is associated with the instruments and devices used to perform the world (Callon, 1998b). The device is the crutch that allows the expression of the theory in practice, the socio-technical device is therefore an assembly of humans and non-humans, made of discourse and non discourse that can govern behaviors. It can be a computerised monitoring system, observation devices, a presentation of slides in strategic management, an architecture of a strawberry market in France, a publication of accounting spreadsheets, accounting audit reports, an introduction to performance indicators, a presentation of business models and business plans. Muniesa (2014) developed a vocabulary he called the performative turning point, which is based primarily on how mainly economic theories can change practices. Recent discussions on economic science performance (Mackenzie, 2007; Muniesa and Siu, 2007) propose two possible orientations of the vocabulary of performativity (the first would be more sensitive to language phenomena, to the discursive performativity of statements produced by the economic sciences; The second approach to performativity focuses on the sociotechnical arrangements and material devices that make economic theories exist (Muniesa & Callon, 2009). Weick (1990) shows that when an organisation decides to introduce a technology, it faces the difficulties of constructing

meaning. We believe that the abandonment of technology during the crisis in Libya embodied this contribution, the experts gave a particular meaning to this technology, they stopped the interactions and the transfer of information. Depending on the ratio of the experts to the objects, a whole computer system collapses or offers new behavioural dynamics contributing to the common resilience.

4.3. THE ACTION ARENAS

The observation not taking part in regional workshops allowed to follow the process of elaboration of the rules of collective choice circumventing technological risks, the rules of constitutional choice elaborated validate the conceptual framework (ADI) of E.Ostrom.

4.4. THE EXPERTISE CRISIS: A DELIBERATIVE IMPERATIVE?

Current sociological approaches raise the question of unexpected overflows of scientific choices by expert communities. Callon et al (2001) evoke a crisis of expertise related to the existence of technical and scientific uncertainties, thus figures of counter-expertise are invited to give their point of view. Harry Collins and Robert Evans. (2009), pose the problem of legitimacy and the problem of extension[2] in politics. It is about denouncing the accepted traditional image of scientists by virtue of what they do as scientists, rather than as individuals. In other words, it is a question of denouncing from an epistemological point of view the distinction between the specialized knowledge of scientists and the experiences of others. Breaking away from the dominant trend of research in scientific studies over the past decades where social questions have prevailed over epistemological questions, The authors shift the focus by questioning the foundations of scientific knowledge. The issue of expertise begins to be expressed in the political field, the mobilization of the expert's knowledge in politics is for example one of the issues that will interest Latour (2004). The expert is not just someone who has knowledge, it can be used in politics. "It will never be known, for example, whether the apocalyptic predictions that environmental activists threaten us hide the power of scholars over policies or the dominance of policies over poor scholars" (Latour, 2004. p13). The model of expertise advocated by Michel Callon (1999) is opposed to the irrational beliefs of the distinction between expert knowledge and secular knowledge; hybridization must now be organized. Expertise can only be collective, experts and lay people are invited to share their knowledge and experience. As Callon points out about the "hybrid forums" in which he points out the role of learning, consultation meetings are a place for "co-production of

knowledge" in which experts interact directly, establish rules of collective choice, measure the exposure of populations to the hazard and assess the risks it generates by scientific algorithms increasing the image of objectivity of their approach. The establishment of de-identified information management procedures for the exchange of information and the validation of co-produced knowledge.

4.5. CRITICISM OF SCIENCE AND THE EMERGENCE OF THE CONCEPT OF RISK

The concept of risk raises the question of the inability of experts and decision-makers to protect populations at risk. The notion of risk and the appearance of the precautionary principle show that the scientist must face uncertainties, despite his knowledge. However, the problem of risk is not limited to the social acceptability of scientific choices but of the acceptability of all stakeholders in the SASS basin (FMN, hotels, industry, etc.). Risks are not localized but cross local, national and temporal boundaries (impact on future generations). And they are difficult to assess. Callon et al. (2001) refer to "risk" as a hazard that is not known to occur but is known to occur. We are thus witnessing the spread of the notion of risk but also the illusory claim of experts to produce an objective knowledge. This does not mean that we are risking more by introducing technological innovations, but only that we need a new form of steering and management of drifts in the technical system. Assessing the risks associated with technical innovations, and monitoring any spillovers, then refers to mobilizations downstream of scientific production, The aim is to mobilize the theoretical and technical knowledge of lay people in order to make informed decisions. Risk results from deliberate political choices. This theme was developed by Callon who strives to denounce the non-participation of laymen in technological choices. Callon et al (2001) presents a very rich conceptualization of the concept of risk and technical democracy. The discussions of the technical choices that engage the collective can however take place in public spaces that Callon calls «hybrid forum». Breaking with the idea of the authority of scientists and the objectivity of science, the crisis of expertise was accompanied by the problem of risk management. Controversies about industrial, health, and food risks could replace the technical vision of experts with a more democratic vision where the public participates in risk management in hybrid forums.

4.6. EXPERTISE AND THE PRECAUTIONARY PRINCIPLE

The precautionary principle is included in the Maastricht Treaty (1992), and it illustrates a certain ethic of man in the environment: 'where damage, although uncertain in the state of scientific knowledge, could seriously and irreversibly affect the environment, public authorities shall ensure, applying the precautionary principle to the implementation of risk assessment procedures." By applying this principle, public authorities ensure that the environment is at the centre of public policy. The dissemination of the reference to the precautionary principle has led to a proliferation of work on the link between science and policy since the role of experts is to develop a careful framing of risk assessment by disengaging from the political sphere. In this approach, experts circulate between laboratories alerting public authorities to risks by disengaging from the political decision-making process (constitutional choice rules) since they are required to present objective expertise, their posture is described as "pragmatic precaution" (Granjou and Barbier, 2010).

CONCLUSION

The article scrutinizes the case of a peer-to-peer platform that facilitates cross-border data exchange. A governance structure has been established; it stipulates a set of rules to be followed by the states if they wish to interact with the platform, and it also provides useful tools for arbitration in case of disputes or violation of the rules.

Nonetheless, the government structure is not self-adaptive to the potential needs of the community of peers. Adapting the rules in order to tackle endogenous problems requires closer tools than what can be provided by the architecture. In the case study, a collective intelligence informally emerges during the concertation meetings where the experts assign a particular meaning to the stored data.

Ostrom's analytical framework appears as an interesting approach to study the influence of technology and information systems on the resilience of organizations, but the IS is not a neutral artifact, it can be a vector of regulation or deregulation. The results show that the short-term functioning of these self-organized collectives is part of E Ostrom's conceptual framework on information and knowledge sharing. Organizational reflection incorporates materiality, which does not reduce to what is in itself materially graspable (biophysical conditions) but extends to the performativity of technology, i.e., to the rules and procedures that are born of interaction with the technical artifact. Materiality is present in the negotiation of rules in meetings in order to allow transboundary states to react in case of emergency, to

tinker, to innovate and thus to develop a level of organizational resilience that is essential to maintain cooperation. This analysis shows the need for organizations aiming for greater resilience to offer their actors spaces for deliberation, which Callon proposes to call "hybrid forums" where technical choices that commit the collective are debated.

The adopted approach inherently imposes limitations to our research. If the in-depth case study brings to light that it is within the interaction with technology that tacit knowledge emerges (Nonaka and Tachechi, 1995) and stabilizes, that poses the risk of over-estimating the researcher’s intuition in analyzing the organizational effects “organizing” of the use of technology.

REFERENCES

Adrot et al.. (2022), Transboundary Resilience. [Research Report] University Paris Dauphine-PSL. 2022, pp.29. ffhal-03958067f

Aggeri F., How can performativity contribute to management and organization research ? Theoretical perspectives and analytical framework, *M@n@gement*, Vol. 20, Issue 1, pp 28-69.

Becker, H. S., Writing for Social Scientists: How to Start and Finish Your Thesis, Book, or Article (2nd ed.). (Chicago, IL: University of Chicago Press, 2007),

Cabantous, L. & Gond, J.-P. (2011). Rational decision-making as a "performative praxis". Explaining rationality's éternel retour. Organization Science
, 22(3), 573-586.

Cabantous, L., Gond, J.-P., Harding, N. & Learmonth, M. (2016). Critical Essay: Reconsidering critical performativity. Human Relations, 69(2), 197-213.

Callon, M. (2007). What does it mean to say that economics is performative? In D. MacKenzie, F. Muniesa & L. Siu (Eds.), Do Economists Make Markets? : On the Performativity of Economics (pp. 311-357). Princeton, New Jersey: Princeton University Press.

Desreumaux, A. (2015), *Organization Theory*, 312 p, EMS Editions.

De Vaujany, Francois-Xavier, Figures That Manage Sociotechnical Change (2003). Sociologie du Travail, Vol. 45, No. 4, pp. 515-536, October 2003.

Muniesa, F. (2014). The Provoked Economy. Economic Reality and the Performative Turn. New York, NY: Routledge.

Muniesa, F. (2017). Grappling with the performative condition. Long Range Planning, Advance online publication, Volume 51, Issue 3, June 2018, Pages 495-499

Chapuy P., Monti R. (1998), Collectively foreseeing future issues: Prospective strategy contributes to the Agriculture and Food Systems' 'Futures Studies' Club, *Technological Forecasting and Social Change*, 77(9):1540-1545

DOI: 10.1016/j.techfore.2010.06.025.

Derumez, I; Djedidi, A and Eila, Szendy. (2018), An Experiential Approach to Learning about Change Management, *Journal of Management Development*, 38(3).

Hess C ; Ostrom, E. (2007), *Understanding Knowledge as Commons, From Theory to Practice*, The MIT Press Cambridge, Massachusetts, P 383.

Hollnagel E; Journé B et Laroche H. (2009), Reliability and Resilience as Dimensions of Organizational Performance: introduction M@n@gement, 12(4), 224-229.

Janssen M. (2011), Resilience and adaptation in the governance of social-ecological systems. *International Journal of the Commons*, *5*(2), 340–345.

Janssen, M. A., Goldstone, R. L., Menczer, F., & Ostrom, E. (2008). Effect of rule choice in dynamic interactive spatial commons. *International Journal of the Commons*, 2(2), 288–312. DOI: http://doi.org/10.18352/ijc.67

LeCompte, M. D., & Preissle, J., Ethnography and Qualitative Design in Educational Research (2nd ed.). (San Diego, CA: Academic Press. LeCompte dan Preissle, 1993), h. 239.

Leonard P. M. (2013), Theoretical Foundations for the Study of Sociomateriality, *Information and Organization* (23), pp. 59-76.

Orlikowski, W. J. (2010), The Sociomateriality of Organizational Life: Considering Technology in Management Research, *Cambridge Journal of Economics* (34:1), pp. 125-141.

Pesqueux Y. (2007) Governance and privatization, PUF, Paris.

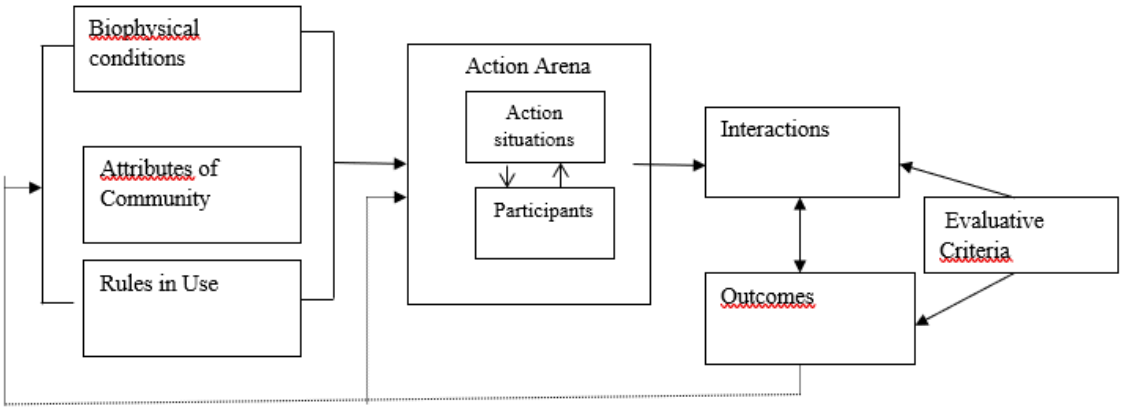
Smith , S. (2021), On Relationality and Organizationality: Degrees of durability, materiality, and communicatively constituting a fluid social collective, *Organization Studies* 43(11).

Weick, K. E. (1993), The collapse of sensemaking in organizations: The Mann Gulch disaster. *Administrative Science Quarterly*, 38(4), 628-652.

Weick, K. E. & Sutcliffe, K. (2001), Managing the Unexpected. Assuring High Performance in an Age of Complexity.San Francisco, CA: Jossey-Bass.

Westrum R., 2006. A typology of resilience situations, in Hollnagel E., Woods D., Leveson N., ResilienceEngineering : Concepts et préceptes, Ashgate.

Figure 1 : The IAD Institutional Analysis and Development Framwork (Hess,C & Ostrom, E. (2007)



	A	B	C
1	X	Y	QIMP_CI
2	565227.100	393594.100	0.920
3	556255.000	378362.500	0.721
4	474671.800	344352.400	0.105
5	486773.700	347482.100	0.286
6	498875.500	350611.900	0.319
7	510977.300	353741.600	0.320
8	523079.200	356871.400	0.359
9	535181.100	360001.100	0.417
10	547282.900	363130.900	0.937
11	429394.200	319731.500	0.044
12	441496.000	322861.300	0.058
13	453597.900	325991.000	0.063
14	465699.700	329120.800	0.329
15	335709.200	282591.700	0.044
16	347811.000	285721.400	0.063
17	359912.800	288851.200	0.099
18	372014.700	291980.900	0.096
19	384116.500	295110.700	0.098

Figure 2: Excel table developed by experts on the Continental Intercalar

Annexe A: Qualitative Research Design

Laboratory ethnography	**Additional Documents**	**Complements of observation**
Field Contact 1 Month of observation	Reports, Publications (2014-2018)	Interviews with local key informants that is., by collecting the data through observation and record field notes. Consensus-building by the Delphi method. Non participant observation in scientific workplaces.