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ORIGINAL RESEARCH ARTICLE

Visual Maps for Process Research: Displaying the Invisible

Aura Parmentier-Cajaiba[1]* and Giovany Cajaiba-Santana[2]

[1]Université Côte d'Azur, CNRS, GREDEG, Valbonne, France
[2]Kedge Business School, Marseille, France

Abstract

In this article, we present visual maps as a way of visually representing qualitative data to improve rigor and analysis in process research. Visual representation of data is an essential element of scientific discourse, and historically scholars have put a great deal of effort into finding creative and efficient ways of visually representing quantitative data. Nevertheless, despite endeavors to integrate visual methods into organizational and management research, qualitative research still lacks a conceptual grounding of the ontological status of visual representation as well as effective tools to visually display data. We contribute to filling these gaps and start a discussion on qualitative data visualization by proposing Latour's concept of *inscription* as a conceptual framework and the use of visual maps as a methodological tool for qualitative process research. We provide an analytical example of how visual mapping could become a methodological tool that enables recognizing patterns, condensing data, and comparing and examining relationships over time that are not necessarily visible independently of their representations. This also enables researchers to make sense of data, improve analysis, and theorize, thus fostering reflexive thinking and facilitating communication.

Keywords: *Visual mapping; Data visualization; Inscriptions; Process research; Reflexivity*

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Process research focuses on phenomena evolving over time in a particular context. It demands longitudinal inquiry and the analysis of elements that emerge, change, and unfold over time, or 'process data' (Langley, 1999; Langley, Smallman, Tsoukas, & Van de Ven, 2013; Welch & Paavilainen-Mäntymäki, 2014). In order to guarantee rigor, scholars who conduct process research have to face some very specific challenges often linked to the lack of methodologic tools to condensate, make sense, and report data, which hinder the researcher's ability to create visual interpretation and be reflexive during the analysis and interpretation process. Even though there is increased effort during the past few decades toward methodological improvements in process research, we still have little guidance from the literature on how to overcome such hurdles (Berends & Deken, 2019).

In this article, we propose the use of visual maps (as first presented and used by Langley, 1999), ontologically conceived as *inscriptions,* as a structured methodological tool to surpass these problems faced by process scholars when conducting process inquiry. We position our contribution in the large discussion of data visualization in qualitative research, which refers to understanding and communicating data through visual displays (Myatt & Johnson, 2009).

The use of visual inscriptions as a means to bring more rigor to qualitative research has drawn the attention of qualitative scholars in the 2010s mainly due to the increasing discussion of visual methods in organizational research. Bansal and Corley (2012), for instance, suggest that qualitative researchers must think creatively about displaying their data. They draw attention to the fact that in qualitative research "data must be shown, not merely described" (Bansal & Corley 2012, p. 511) to allow the reader to see a clear connection between the raw data and the analyzed data and, thereby, "transport the reader into the context to provide a personal experience of the focal phenomenon and support for the emergent theory" (*ibid*, p. 511).

Although the discussion of visual representation of data in qualitative research is still incipient, it has a long-established tradition in natural science. As Latour (1986) noted, the historical development of scientific thought depended greatly on the use of representational tools or 'inscriptions.' Scholars

***Corresponding author:** Aura Parmentier-Cajaiba, Email: Aura.parmentier@univ-cotedazur.fr

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have devoted great efforts to improve the visual representation of such inscriptions of quantitative data (Bhowmick, 2006; Card, Mackinlay, & Shneiderman, 1999; Greve, 2018; Tufte, 1990). However, even if some researchers have acknowledged the importance of visually displaying data in qualitative research (Davison, McLean, & Warren, 2012; Gioia, Corley, & Hamilton, 2013; Langley, 1999; Langley & Ravasi, 2019; Langley et al., 2013; Meyer, Höllerer, Jancsary, & Van Leeuwen, 2013; Pratt, 2009; Ravasi, 2017), and process research has been an important field for visual representation of data (Howard-Grenville, Metzger, & Meyer, 2013; Langley, 1999; Langley & Truax, 1994; Lawrence, Malhotra, & Morris, 2012; Lok & de Rond, 2013; Smith, 2002), little has been done to propose a structured approach of data visualization for process inquiries. The field still lacks "the conventions of variance studies and clearly presents researchers with challenges and trade-offs" (Langley et al., 2013, p. 8).

Thus, scholars conducting process research are confronted with some important hurdles regarding visual representation of data. The first hurdle is the absence of an ontological discussion about what visual representation of data is, how and why it should be increasingly applied, and what are the implications for organizational research. The second hurdle is the fact that little has been discussed about original and legitimized ways of visually representing qualitative, nonvisual process data as a means to make sense of the data, improve analysis, favor reflexive thinking, increase rigor, and facilitate scientific communication in process research. The last one reflects the small amount of methodological orientation offered to researchers who intend to engage in processual research.

In this article, we intend to help fill these gaps by proposing a conceptual framework of visual representations that holds as a central concept the notion of inscription, and by proposing a structured method for using visual maps as an inscription for data visualization in process studies. The concept of inscription brings to the discussion a different way of conceiving visual representation and its role in the scientific tradition of process research. This can help us move the discussion of visual representation beyond the mere advice for visual displays of qualitative data made in the past in a rather scattered and unstructured way (Langley & Truax, 1994; Meyer, 1991; Miles & Huberman, 1984a) to a more precise role in the practice of process research.

The structure of this article is as follows. First, we situate data visualization in visual methods of organizational and management research and the challenges associated with process research. Second, we propose, justify, and promote the concept of inscription as a conceptual perspective for the visualization of process data. Finally, we present the elements for developing a visual map that we illustrate through an analytical example based on the visualization of a research diary.

Data visualization in qualitative research

Over the past few decades, organizational scholars have made increased effort toward an integration of visual tools in organizational research. Bell and Davison (2013) acknowledge a visual turn in management and organization studies and claim a shift from a linguistic to a pictorial representation. Along the same line, Meyer et al. (2013, p. 489) identify an "undeniable omnipresence" of the "visual" in organizational research with the rise of a novel quality of the use of visual language.

Images and visual artifacts used to be considered only as a means of communication or 'mere transmitters of information' in organizational studies (Meyer et al., 2013). However, with the development and integration of visual methods in organizational research, the 'visual' has become a specific mode to construct and express meaning (Kress & Van Leeuwen, 1996) and also to foster reflexivity (Kunter & Bell, 2006). Ravasi (2017), for instance, claims that in qualitative organizational research we have not given due consideration to the ways in which we can enhance our visual representations of data to develop richer means of understanding our modes of inquiry. He also suggests that engaging visually with data may help researchers in the coding process and be key to the "mystery of theorizing from qualitative data" (Ravasi, 2017, p. 4). Langley and Ravasi (2019, p. 188) further advance that visual information stimulates creativity and enables the viewer to "see new relations between phenomena that are not bound by convention or preconceived notions of linear cause and effect."

In organizational research, Miles and Huberman (1994) and Meyer (1991) were among the first to propose visual representation of qualitative data. They proposed using visual representation to communicate in organizational research with greater clarity and precision. Despite the potentialities of a visual perspective on representing data, the discussions about a structured and theoretical grounded framework for visual representation and the propositions of methodological tools to represent textual data in qualitative research remain sparse and limited in scope (Langley & Ravasi, 2019; Pauwels, 2010; Ravasi, 2017).

The visual in process research

Although we agree with Langley and Ravasi (2019) that visual representation of data has the potential to bring more rigor to qualitative research in general, we propose launching a discussion about the use of visual displays in the context of qualitative process research. We present the use of visual maps as a methodological tool for process research and a means to overcoming important challenges faced by researchers conducting qualitative inquiry in this area.

In process research, researchers found themselves overwhelmed when faced with huge amounts of raw data from

rich contextual settings that need to be selected, condensed, interpreted, analyzed, and communicated. As Langley (1999, p. 691) bluntly says, "[P]rocess data are messy. Making sense of them is a constant challenge." The interpretation encompasses large periods of time and requires numerous actors. As such, process researchers must be able to see the big picture as well as sensitive details. It is up to the researcher to find rational and methodical ways to bring order to that mess so that theoretical insights can emerge, despite the fact that methods to achieve data condensation and analyze these data are rather scattered and loosely defined (Langley & Ravasi, 2019).

Process research aims at unraveling "how and why things […] change, act and evolve over time" (Langley, 2007, p. 271), which makes time an important element of analysis (Abdallah, Lusiani, & Langley, 2019; Langley, 2007; Langley et al., 2013) because one seeks to "capture and express the experience of temporality, flow, activity and emergence in concrete terms" (Langley & Tsoukas, 2017, p. 10). The longitudinal analysis typical of process research creates various challenges for researchers, such as selection of data, reconstruction of chronological logics, and bracketing data into meaningful wholes for further analysis and conceptualization. Researchers must constantly call on reflexivity and be imaginative when selecting and analyzing data to communicate their findings and show how their analysis makes theory emerge from qualitative data.

As we demonstrate later, visual representation may be an effective methodological tool to surpass those hurdles as long as one could structure the field of visual representation on a solid conceptual and methodological ground. One important and particular flaw of visual research is the fact that 'the visual lacks theory' (Maire & Liarte, 2018), which also applies to visual representation of data. Indeed, visual representation of data has no shared ontological status in qualitative research. The lack of an ontological discussion about visual representation hampers the progress of the field because there is no shared conceptual framework in which we could base the discussion and propose new theory and practice. The use of visual representation may bring important benefits to process research as well as new answers to those methodological and ontological hurdles faced by researchers. We discuss in next section the concept of inscription as a conceptual framework for visual representation of process data and then move on to the particular use of visual maps.

Visual representations as inscriptions

To communicate knowledge, researchers must decode it using signs that are understood and shared across the scientific community. The dominant sign system used in organizational research to communicate and represent knowledge has been primarily oriented toward text (Hughes, 2012; Langley & Abdallah, 2011). Gephart (2004, p. 455) acknowledges that qualitative research "relies on words and talks to create text," and Fyfe and Law (1988, p. 4) criticize social sciences as being "obstinately verbal both in its methods and its subject matter." In his study of laboratory life, Latour (1986; Latour & Woolgar, 1986) argues that the rationalization that took place during the scientific revolution was mostly based on a revolution of sight (Ivins, 1938; Ware, 2012). For Latour, reasoning through visualizing was crucial for enabling discovery and establishing the properties of natural and social phenomena. He analyzes how scientists give visibility to things that are not necessarily visible independent of their representations and affirms that "no scientific discipline exists without first inventing a visual and written language" (Latour, 1986, p. 13). Visual representation touches "the very essence of all scientific activity" (Pauwels, 2006b, p. viii) and has become an essential part of scientific discourse.

Latour (1986; Latour & Woolgar, 1986) argues that science is communicated through the use of inscriptions. He refers to inscriptions as marks, signs, illustrations, pictures, prints, or diagrams made by humans to visually represent data and phenomena. The creation of inscription is described by Chaplin (2002, p. 192) as the process through which "data are transformed into representations of data." Latour analyzes the cognitive advantages of inscriptions based on two central concepts: their *mobility* and their *immutability*: he calls them *immutable mobiles*. With pictorial representation, the represented objects become immutable and mobile; they can be transferred, translated, and analyzed from different perspectives without losing their internal properties (Quattrone, 2009). Therefore, the concept of inscription invites us to reflect on what it brings to process research, as well as why and how thinking in terms of inscription can affect the doing of process research in practice.

First, the concept of inscription brings not only a name or an ontological status to visual representation of data but also a different way of conceiving and creating visual representations of data. This is because the process of creating inscriptions according to Latour is not only a cognitive endeavor but also a social dynamic that can explain the social practices of scientific activity. Latour's research was interested in "the many ways through which inscriptions are gathered, combined, tied together and sent back" (Latour, 1987, p. 258) to understand scientific practice. Thus, by using inscription as a theoretical concept, we are leaving room for analyzing visual representations not only as a cognitive effort of the researcher to depict a scientific reality but also as the result of the relationship between people and their settings and practices (Roth & McGinn, 1998; Roth, Pozzer-Ardenghi, & Han, 2006). Inscriptions are deeply integrated with a nexus of processual activities that include observation, measurement, description, analysis, and communication (Lynch, 2006). An inscription has a process

dimension that explains that it is not just the result that counts (the data visually represented), but how it was attained and the ways in which the inscription can be employed (Pauwels, 2006b). This implies that the process of inscription should be described by the researcher to enable the readers to understand the observations, choices, interactions, descriptions, and analyses.

Second, by proposing a reflection on the visualization of process data, the concept of inscription also contributes to what Pauwels (2006b) calls 'visual scientific literacy.' Visual literacy represents the ability to make the content and form of visual representations more intersubjective by being able to describe them in a nuanced and lucid way through the combination of images and words in 'multimodal ensembles' (Trumbo, 2006). Process research in organizational and management studies lacks widely accepted/shared tools to visually represent data. Hence, many researchers are ill prepared to perform scientific visual representation of data in a meaningful and edifying way. To deal with this problem, the focus on inscriptions entails a greater attention to the establishment of shared and common practices. The acceptance of an inscription as a legitimate representation of a phenomenon depends on the degree to which the practices of data transformation into visual representation are based on legitimate and shared procedures. This is attained with a collective implication of the research community on the definition of guides or heuristics to implement visualization through the inscription process.

Finally, inscriptions are intrinsically related to reflexivity because the process of inscription involves *translation*: a process whereby a phenomenon is captured, transformed, and recreated. Translation has a geometric, semiotic, and political sense in the theory of translation (Callon, 1984). Geometrically, as in the case of data visualization, translation is the result of a mediator (in our case, a visual map) that "captures the movement of an entity in space and time through which associations and relations are established" (Nicolini, 2010, p. 3). A visual representation of data carries meaning in itself that was translated from the raw data; therefore, when it is used for scientific communication, it acts as a boundary object (Roth & McGinn, 1998; Star & Griesemer, 1989). Roth and McGinn (1998, p. 42) acknowledge that inscriptions are in their very nature boundary objects because they serve as "interfaces between multiple social worlds and facilitate the flow of resources (information, concepts, skills, materials) among multiple social actors." In the case of visual representation of data, inscriptions, as translated elements from raw data, act as boundary objects of shared meaning between the researcher and the reader. Again, conceiving visual representations as inscriptions turns the focus from representation as a mental activity to inscription as a social activity (Light & Anderson, 2009). The semiotic sense implies that the translation carries out a shift in the meaning. The visual map is not the data anymore but a visual representation of how the data were rearranged. Translation also has a political sense that can be seen in the instrumental use of the visual map as, for instance, a tool for scientific publication. This process of translation affects the way we undertake research because there are objects and phenomena in organizational research with aspects "that only become visible with special representational means" (Pauwels, 2006a, p. 2). Translation is a meaning-making process that delimits what can be inscribed and what should be highlighted or obscured.

Inscriptions and reflexivity

There have been several calls for integrating reflexivity into qualitative research (Hardy, Phillips, & Clegg, 2001; Hibbert, Sillince, Diefenbach, & Cunliffe, 2014; Lee & Cassell, 2013; Nadin & Cassell, 2006). Langley and Royer (2006, p. 86), for instance, underline the extreme importance of reflexivity for qualitative research that "tends to demand it as an element of method." Hardy et al. (2001) highlight that reflexivity aims to overcome the limitations of researchers in representing the subjects under study. Inscriptions, like words, are objects ontologically independent of the scientific reality of the phenomenon represented. The relationship between the phenomenon observed and its representation is thus a matter of reflexivity rather than a matter of correspondence (Roth & McGinn, 1998).

With these arguments we move the discussion from mere advice for portraying data on visual displays as it was proposed by Miles and Huberman (1984a) and Meyer (1991) to a process of data visualization that encompasses the different sequences of the research process. With inscriptions we position visual representation as a methodological process instead of an illustrative effort (Steyaert, Marti, & Michels, 2012). Now that we have conceptualized visual representations as inscriptions, we can propose their use in process research associated with the scientific activities of analysis and dissemination (Coopmans, Vertesi, Lynch, & Woolgar, 2014). We present next the use of visual maps as inscriptions, which enables us to develop visual literacy in process studies.

Visual mapping

Visual maps have been clearly associated with process research since Langley's (1999) seminal article. They are graphic tools with a time dimension, created to organize, manage, make sense of, analyze, and share data visually.

The time dimension of a visual map sets it apart from other types of static data visualization tools conceived to depict qualitative data. An example is the 'visual data structure' of Gioia et al. (2013), which is arguably the most influential effort to propose visual representation of inferences made from data to increase rigor in qualitative research in the

context of grounded theory. The authors present 'data structure' as a 'sensible visual aid' that provides a graphic representation of how the researcher progresses from raw data to the coding terms – a way of demonstrating rigor in qualitative research. However, 'data structures' are a "static picture of a dynamic phenomenon" (Gioia et al., 2013, p. 22), with no representation of time. Although the Gioia methodology provides a valuable means for analyzing process data, it does not incorporate temporality. As Walsh et al. (2015, p. 11) acknowledge in their critical review of grounded theory, researchers face the need for "more tools for visualizing coded data (at least some graphs) in order to spot longitudinal patterns in data on […] scale."

By representing data in a graphical and synthetic form that corresponds well to human cognition, visual maps enable viewers to overcome the linearity of written accounts and their underlying limitations in literary form. Maruyama (1986), for instance, acknowledges that human cognition synthesizes visual inputs by maintaining the spatial orientations and the interrelationships of multiple components. Easily recognizable patterns enable us to see what is meaningful, help us make sense of what we see, and compare and examine relationships (Mitchell & Rands, 2012).

As shown next, visual mapping demands reflexivity in its elaboration, which helps the researcher make sense of data (Lok & de Rond, 2013; Mainela & Puhakka, 2008) and organize data (Howard-Grenville et al., 2013; Langley & Truax, 1994; Lawrence et al., 2012). In this sense, visual maps may play an important role in the data analysis process when researchers face, as is frequently the case, an overwhelming amount of data that tend to be "complex, messy, eclectic, and with varying degrees of temporal embeddedness" (Langley & Abdallah, 2011, p. 106). Nonetheless, some scholars have used visual maps longitudinally alongside data collection (Howard-Grenville et al., 2013; Langley & Truax, 1994).

The process of visual mapping also enables the researcher to display the sequences of events, see how they are categorized, and how they evolve over time, rendering visible relationships not easily perceived in written accounts. Visual mapping provides the researcher with the opportunity to condense data by displaying "tremendous detail in a small space" (Smith, 2002, p. 385), which is, according to Miles, Huberman, and Saldana (2014), an essential part of the analysis. It is a convenient way of increasing transparency in the interpretative process. It illustrates findings and transports the reader into the 'scientific reality' the researcher created (Lynch, 2006), providing visibility to elements hidden in a literal form. It may increase rigor in process research by playing the role of an intermediate medium between raw data and theoretical conceptualization. In her analysis of strategic change, Fenton (2007) acknowledges the usefulness of visual maps 'in the development and verification of theoretical ideas', which Langley (1999) proposes as a strategy for theorizing from process data. Langley and Truax (1994, p. 625) acknowledge that visual representation using visual maps incorporates "an intermediate level of theorizing between the raw data and a more abstract and general process model." Indeed, visual mapping can be used to bridge the gap between empirical data and theory, what Klag and Langley (2013) call the ability to make 'conceptual leaps'.

According to these authors, researchers must find ways to make data speak and make conceptual sense of what was observed through the data (Gersick, 1992). They also suggest that making conceptual leaps is intrinsically based on 'seeing' and 'articulating' what the researcher can grasp from data. *Seeing* involves finding new ways of making sense of some aspects of an existing social world, and *articulating* implies the representation or visualization of this new understanding. Both *seeing* and *articulating* are improved by the analytical use of visual maps, as we will demonstrate with our example.

The process of inscription through visual mapping is not a method *per se* but rather a methodological tool that can bring important benefits to process research. Therefore, we propose visual mapping here not only as an analytical tool but also as a process of selecting, representing, and integrating raw data visually in a comprehensive and clear manner. We present next an empirical example of a research diary created in the context of a collaborative process study.

Visual mapping in practice

The example we present here is part of a process research project undertaken during the first author's PhD (Parmentier Cajaiba, 2010). The research took place at a biotechnology firm that develops biocontrol products, which are environment-friendly organic pesticides. The focus of the PhD was to contribute to a better understanding of the development of an organizational capability, and to this end Author 1 was recruited as a researcher. She also had the responsibility as a practitioner to create a new process for the company – product registration – to comply with recently modified European regulations. Product registration is a legal procedure by which pharmaceutical and pesticide companies obtain authorization to sell their products. Registration characterizes both the process and its result. In the early stages of inquiry, Author 1 decided to implement a diary in a reflexive sense, that is, as a tool to reflect on the way the research was conducted and how this process shaped the outcomes (Hardy et al., 2001; Nadin & Cassell, 2006). When the time for data analysis arrived, the creation of a visual map emerged as a possible means to make sense of the data in a reflexive perspective. The next section details the visual mapping in practice and highlights the benefits of its main features.

From data to visual mapping

As previously discussed, the process of inscription is also a social activity based on legitimized and meaningful visual representation practices. A visual map becomes a full-fledged inscription only when accepted and understood as a legitimized representation of a longitudinal process in organizational phenomena. To pursue this effort, we present an analytical example of the use a visual map in context and in coherence with the concept of inscription. As we advocate, the description of the inscription process and the underlying reflexive process is part of a method of visual representation of data through which the researcher describes her practices and choices. In our case, Author 1 started elaborating the visual map at the beginning of the data analysis stage thorough a reflexive process as described in the next section.

Reflexivity and elaboration

When Author 1 started the analysis of data, she needed to make sense of data that seemed at first messy and overwhelming in amount. In this effort, she needed to contextualize data, select and represent data relevantly, situate data in time, and relate data meaningfully. These four needs led her to adopt a reflexive glance at the data with the idea of organizing it using a visual map. The creation of the map involved her thinking about the four elements simultaneously. For the sake of clarity, we present them separately.

Contextualizing data

The first representational need was to have as much contextuality as necessary to represent relevant events. The events under scrutiny took place in different domains across the organization; these domains interacted and influenced each other throughout the process of capability elaboration. Therefore, the representation of these domains enabled a better contextualizing to relate events on the map. The basic premise of contextuality is that human actions are, by their very nature, situated in context. We cannot fully understand the former without taking into account the latter (Hammersley, 2008). By increasing contextual elements, we open the door to increasing the level of complexity that an inscription, such as a visual map, can represent. Verweij and Gerrits (2013) assert that one major response to complexity is producing rich and detailed descriptions of social life, which can be achieved by incorporating contextualization in the analysis. Nevertheless, every representation is an oversimplification of complex phenomena, which also applies to textual inscriptions, as highlighted by Abdallah et al. (2019). Hence, visual maps have as a boundary condition the fact that they cannot represent complexity in an encompassing way but rather capture more of the complexity by increasing the contextuality of the phenomenon analyzed.

In this sense, defining the domains in which events are represented enabled Author 1 to better 'see' and understand how interactions across domains contributed to the process under analysis. In this example, the organizational domains are labeled *Company Development*, *Registration, Funding*, *Top Management*,

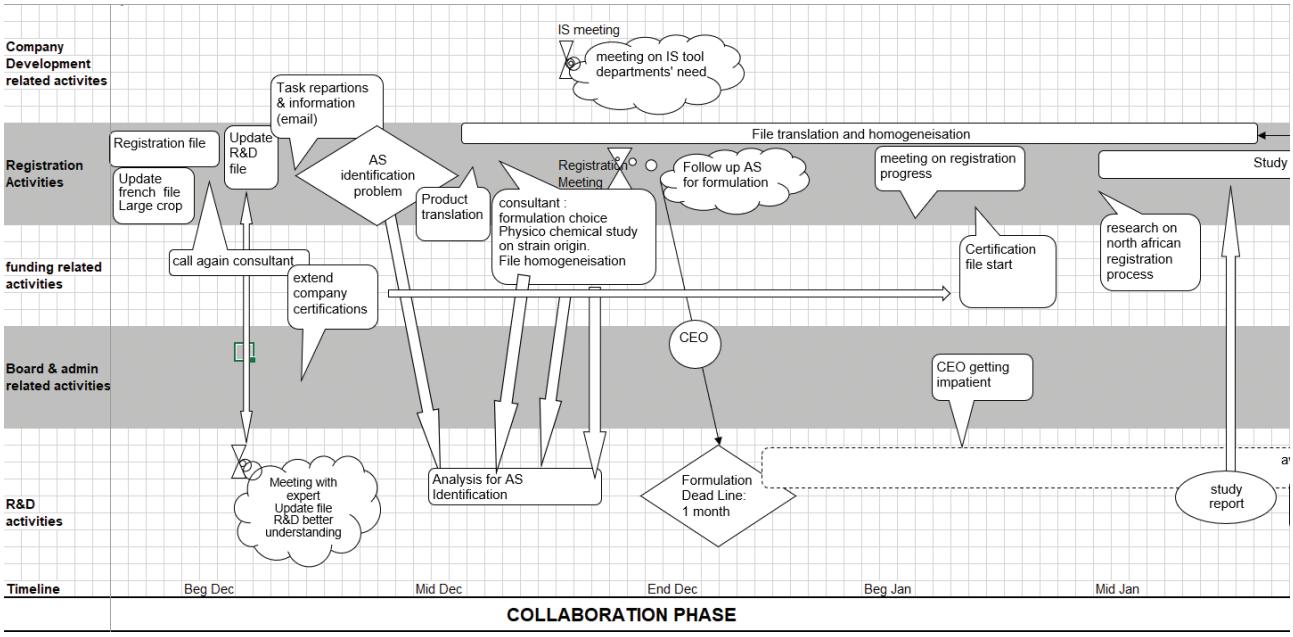


Figure 1. Excerpt of the collaboration phase

and *R&D* (Figure 1). Those labels do not represent all the organizational domains of the organization studied but a selection of the domains to which selected events are related. This selection already implies reflexivity and renouncing some of the data that are not central to the case.

Selecting and representing events

Another need comprised the identification, selection, and categorization of the types of events to include in the mapping, in other words, which event should be inscribed. The selection of events is a full-fledged reflexive phase; the researcher must select certain information at the expense of others because the creation of a map requires situating a large number of events in a limited physical space. As such, Author 1 needed to select and condense data to represent events and actions that would provide a meaningful whole. We share with Alvesson and Sköldberg (2009, p. 9) the idea of reflexivity as the "interpretation of interpretation" or "the launching of a critical self-exploration of one's interpretations of empirical material." Author 1 developed a reflexive routine to deal with the selection of events, their label, and the dynamics to be inscribed based on the following reflexive questions:

- How important is this event to the phenomenon studied?
- To what extent does this event contain relevant information to understand the phenomenon?
- How much information would I miss if this event was not inscribed on the visual map?
- Would I interpret the phenomenon differently if this event was not inscribed?
- What is the nature (internal, external, meeting, phone call, etc.) of the event and its quality (critical, important, and potentially impactful)?
- How are events related to each other?

Once the events were selected, Author 1 needed to reflect on the type of symbol or visual representation for the events to ensure what Bertin (1981, p. 5) calls "maximum visual efficacy." The challenge was to guarantee both the diversity in information despite the reduced space and the analytical organization of the events in a virtual space. This turned out to be an important step in the process, whereby the chosen events were transformed and re-created as visual elements, which brought to the fore important issues about the creation of multimodal ensembles. The basic epistemological questions about visual representation of data come from an old discussion on sociology regarding 'sociological description' or "to represent what actually happened, what was there, or some describable state of affairs" (Smith, 1979, p. 314).

The description, which has a rhetorical nature, is the analytical substance of any social analysis, but, as Weber (1949, p. 78) put it, "we are helpless in the face of the question: how is the causal explanation of an individual fact possible – since a description of even the smallest slice of reality can never be exhaustive?" Therefore, having in mind that any representation of a social reality is a simplification of this reality, Author 1 made representational choices and acknowledged the instrumental use of these representations, which is, in our case, to convince readers and to be coherent with the theoretical framework employed.

One of the main challenges of social description is to ensure what Berard (2005) calls 'disinterested description', or descriptions that are not politically or morally driven but rather driven by scholarly concerns based on principles of empiricism and logic instead of ideology. As Bezemer and Mavers (2011) suggest, and being coherent with the inscription proposition, we need to account for visual representations as transcriptions that become artifacts elaborated as a social meaning-making practice.

By looking at previous uses of visual maps (Fenton, 2007; Gehman, Trevino, & Garud, 2013; Howard-Grenville et al., 2013; Langley & Truax, 1994; Lawrence et al., 2012; Lok & de Rond, 2013; Smith, 2002), Author 1 noticed the lack of diversity in representing events that evolve on the maps; quite often events are represented by text inside circles or boxes. Author 1 did not find any guidance in the literature besides the work of designers on meaning making in visual semiotic modes (Kress & Van Leeuwen, 1996); therefore, she used forms available on traditional spreadsheet software programs combined with captions because there is no universal convention in visual representation for the symbols one should use to represent events and their interactions. Indeed, visual artifacts represent social processes that cannot be explained by reference to internal esthetic factors (Chaplin, 2002). Moreover, no object conveys content on its own; symbols must be interpreted (Card et al., 1999). This is because these representations become socially accepted as inscriptions when recognized as legitimized representations of specific phenomena (De Vaujany & Vaast, 2016).

Table 2 presents the graphical signs used to represent the events. Author 1 felt the need to represent the diversity of different events in order to pinpoint and differentiate their impacts on and influences over the structuration of the process. Author 1 created two kinds of events (Table 1): those that are punctual, meaning that they take place in a very short period of time (e.g., meeting, structuring event, decisive event, potentially important activity, and crisis), and those that occur throughout the process (e.g., background activity and intensive activity). The first type of event is either a unique event or a collection of few events that makes sense, whereas the second type of event is a condensation of micro-tasks and activities that do not make sense when considered alone but represent an important event when put together.

Table 1. Graphical signs for the representation of events

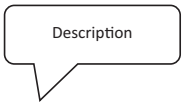
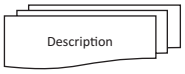
Relation to time	Events	Graphical signs
Punctual events	**Meeting** concerning the registration and organizational development of the company	
	Structuring event in the process (encounter, email, experience, etc.)	
	Decisive event occurring in the organization with an effect in the short term	
	Potentially important activity (implies a strategic choice later): occurs in the company and may have an effect in the medium term	
	Crisis: an unanticipated event having an influence on the sequence of events	
Lasting events	**Background activity**: an activity punctuated by many other tasks	
	Intensive activity: an activity punctuated by few other tasks	

Table 2. Graphical forms of the dynamics between events

Graphical sign	Type of dynamic
	Used to indicate causal relation between events.
	Used to indicate a punctual activity occurring between different dimensions. The thickness of the symbol reflects multitudes of micro-exchanges that occur.
	Used to indicate a transfer of information. The base of the arrow indicates the origin of the information. The thickness of the symbol reflects multitudes of micro-exchanges that occur.
	Used to represent phases of intensive information exchanges (e.g., meetings, exchange of emails, work files).

In Figure 1 the event 'File translation and homogenization' is represented as a lasting event. This event constitutes several micro-activities that did not made sense alone, such as 'translating from French to English', 'looking for an official registration pattern', 'adapting existing pattern', 'finding corresponding internal scientific data,' 'simplifying the claim,' and 'calling to *X* in relation to part *Y*,' which were extracted from different data sources (research diary, email database, and company documents). The visual map enabled the condensation of these data into a form of single event by categorizing data in a process of "translation of diversity into unity" (Blanchet, 2017, p. 376) or transforming heteroclite elements into coherent units. Once condensed, this event would be related to other groups of events and their mutual influence over time and across different organizational domains can then be clearly reconstructed with a visual representation.

Situating data in time

Another representational need was to set a time frame. The use of a time line involves thinking how to situate events without overloading the visual representation. Reaching this implies a serious reflexive endeavor related to the accumulation of events in time, their relative importance, and their temporal succession with regard to their relations. In line with Langley and Tsoukas (2010), the elaboration of visual maps assumes

that in longitudinal organizational research, organizations must be analyzed in a continuous process of becoming instead of as monolithic entities that change step by step. Author 1 followed Ancona, Goodman, Lawrence, and Tushman's (2001) suggestion of using visual maps to assemble activities and pinpoint the temporal location of specific phenomena – their pace, cycles, and rhythms – as they repeat over time. This enables the researcher to "draw the interactions across temporal maps and the shape of changes over time" (Ancona et al., 2001, p. 646). Indeed, the elaboration of the visual mapping pushed Author 1 to make time more explicit in the research design into what eventually "would improve the quality of empirical research in our field" (Ancona et al., 2001, p. 647).

For the chosen time frame in our example, one square represents roughly 1 day in the example shown in Figures 1 and 2. However, the choice of a temporal scale was not straightforward and demanded trial-and-error attempts when considering whether to examine days, weeks, or months, which had a direct influence on the granularity of the analysis. In our example, we portrayed time objectively, as measurable, regular, and forward moving; however, there are several ways of describing different aspects of time (Hernes, Simpson, & Söderlund, 2013; Hurmerinta, Paavilainen-Mäntymäki, & Hassett, 2016). Fenton (2007), for instance, used an irregular time frame because it was more important to visualize the arrangement and succession of events through domains than over a regular period of time, whereas Ancona, Okhuysen, and Perlow (2001) suggested the use of visual maps to map activities based on the subjective experience that individuals have with time.

Relating events meaningfully

A last representational need involved specifying the links between events. This required choosing the visual representation to best translate these links: lines, arrows, filled arrows, and so on. This task helps in surfacing the dynamics as well as the regularities identified in the phenomenon. On their road to theorizing with visual maps, Langley and Truax (1994) described an increasing effort to create codes and concepts in the form of boxes and arrows that furthered the emergence of patterns from the maps. Frequently, scholars who use visual maps limit the visual representation of dynamics to lines and arrows that indicate causal relations (Fenton, 2007; Gehman et al., 2013; Howard-Grenville et al., 2013). In order to ensure representing more variance, Author 1 created four different types of dynamics among events with specific graphical signs that encompass all relations between events retained and pictured on the map. We list in Table 2 all the graphical signs used for the construction of the mapping showing the dynamics at work.

In Figure 1 we see the importance of differentiating the links between events; for instance, the causal relationship between 'Follow up AS for formulation' and 'Formulation deadline 1' is quite different in its form from the transfer of information that arises between 'Consultant: formulation choice' and 'Analysis for AS identification.' Hence, this example shows that visual maps also offer a large opportunity to be creative in representing the different types of relations that are constitutive of the processual phenomenon at stake if one engages reflexively with the nature of the relations between selected events.

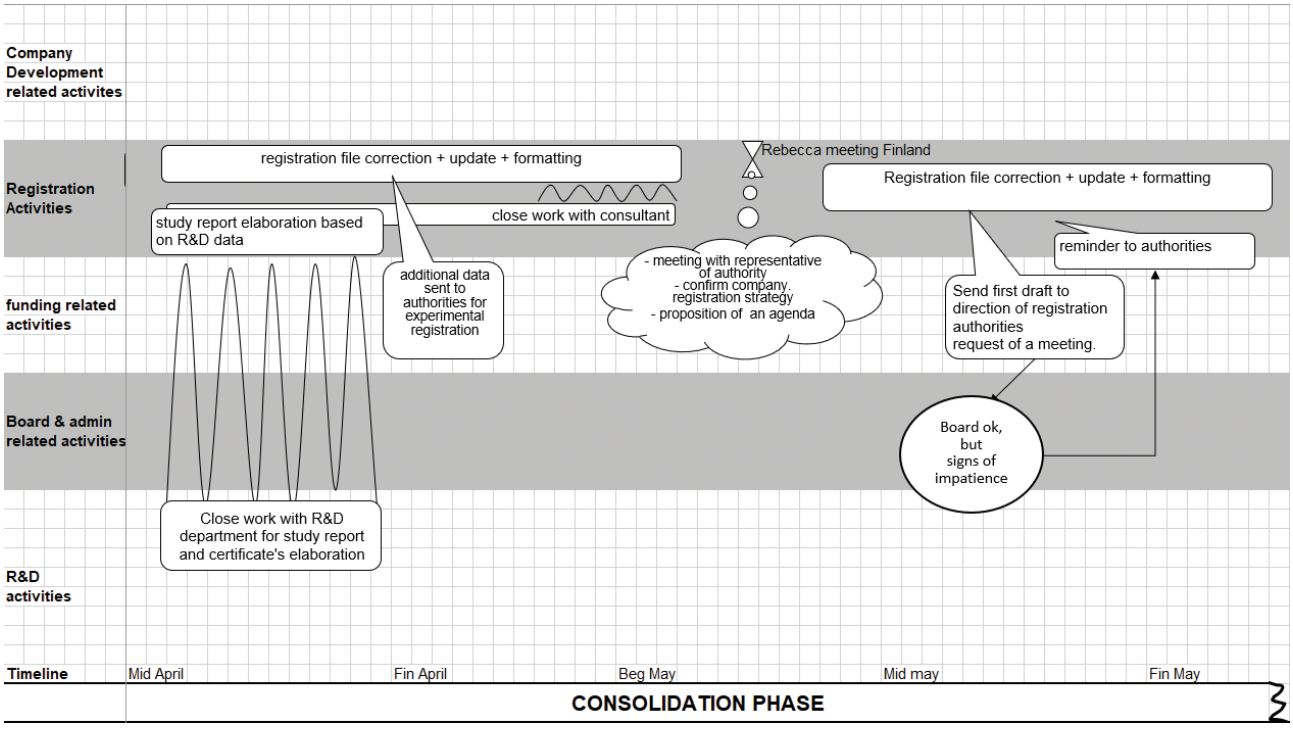


Figure 2. Excerpt of the consolidation phase

Box 1. Stages identified by using the research diary

New activity elaboration
Stage 1: November 2005–April 2006: Creating a base of knowledge with the necessary information to understand the registration process
Stage 2: May 2006–August 2006: Elaboration of a template complying with the new European regulations to guide the registration process
Stage 3: September 2006–August 2007: Elaboration of the first European registration project

Reflexivity and analysis

Visual mapping enhances data analysis in at least two complementary and mutually supporting qualitative data analysis strategies: categorizing and connecting (Maxwell & Miller, 2008). The categorizing strategy is based on the comparison and classification of data. The connecting strategy is based on the analysis of relations and connection between data and observations. Although reading written data as in a personal diary enables identifying salient facts, certain relationships within the data set do not appear in an obvious manner. Visualization enables perceiving emergent properties, categorizing events, and new ways of connecting other elements not foreseen through reading. Let us examine how Author 1 analyzed the registration activity from the research diary and after the visual representation. The following example shows how things only visible through visual representation guided the researcher toward a stronger theorization of the phenomenon.

Author 1 used the visual map in a pragmatist constructivist perspective (Avenier, 2010; Avenier & Thomas, 2015); the theorizing was abductive and dialogical (Avenier & Parmentier Cajaiba, 2012; Romme et al., 2015). First, information from the field revealed the need to elaborate the registration activity. Second, a back-and-forth movement between the field and the literature led to studying this phenomenon as the elaboration of a new organizational capability using the resource-based capability approach. The development of the registration activity took place between October 2005 and August 2007. Before deciding to use visual mapping, Author 1 broke down this period into three stages. These stages are outlined in Box 1 and were intuitively determined based on the company's activities and her experience in the organization.

The visual mapping analysis enabled a better *categorization* of the data and their temporal relation, which enabled the identification of five phases of the registration process (Box 2). These phases are a richer and more detailed account compared to the stages intuitively identified previously and presented in Box 1. Rather than providing a linear flow of activities as presented in the raw data, the visual mapping provided new perspectives for a different breakdown, which helped Author 1 'see and articulate' (Klag & Langley, 2013) different organizational patterns of the registration process. The breakdown resulting from the mapping focused on the same period from October 2005 to December 2007; however, the number of phases and their temporal bracketing differs.

Box 2. New stages elaborated by using the visual map

1. Discovery (October 2005–April 2006)
2. Strategic implementation (April–August 2006)
3. Tactic implementation (September–November 2006)
4. Collaboration (December 2006–April 2007)
5. Consolidation (May–August 2007)

The visual mapping analysis helped Author 1 break the process into phases that would not have been identifiable without the visual analysis of the inscription. From a temporal perspective, the five phases identified correspond to stages 1–3 (Box 1), implying an increase in the precision with which the process is detailed. The three-stage version of the registration activity elaboration is closer to a narrative account from the researcher's perspective. The five capability elaboration phases that emerged from the mapping analysis suggested a breakdown of the process focused on social interactions. This specific examination of the data resulted from the careful observation of the shapes that emerged in the visual mapping. The first characteristic noted was the way data were distributed by bracketing according to the activity within and between organizational domains. As shown in Box 1, the stages of the process were not labeled. With the visual mapping, the labeling of phases derived in a logical and coherent manner.

By using the two extracts of the visual map (Figures 1 and 2) we can demonstrate how the analytical process evolved and was improved by the visualization. Stage 3 was initially identified as the 'Elaboration of the first European registration project,', which was later broken down into three phases: tactical implementation (3), collaboration (4), and consolidation (5). These three phases were identified due to their dynamics on the visual map. During phase 4 (collaboration – Figure 1), events were distributed mainly between two main domains (research and development [R&D] and Registration). Events are linked by information exchange dynamics and, to a lesser extent, by causal relationships. This phase is characterized by an increased exchange of information between registration and scientific (R&D) domains. We can perceive the links of different tasks and the elaboration of specific resources, such as artifacts, embedding different types of knowledge.

By contrast, the consolidation phase (Figure 2) represents a time lapse in which lesser events appear and information exchanges are more structured, aimed at stabilizing the knowledge created in the previous phases. As we can observe in Figure 2,

events figure mainly in the registration domain, and the dynamics differ from previous phases. Events are almost exclusively tasks that evolve over longer periods. Interactions between events are not as varied as in the collaboration phase, and they are mainly associated with intensive periods of information exchange.

The collaboration and consolidation phases differ in their visual content and dynamics. The collaboration phase (Figure 1) also presents more variety and density in terms of events than the consolidation phase. This is consistent with the fact that actors in the organization experienced new practices during the collaboration phase and were trying to adapt them. On the other hand, the consolidation phase (Figure 2) is rather simple in terms of interactions. The visual map shows interactions concentrated between registration and R&D activities at the beginning of the phase, followed by a concentration of events in the registration domain. The collaboration phase aims to create a new way of working and can be compared to the creation of new routines to respond to the introduction of regulatory constraints, whereas the consolidation phase aims to refine the new practices and routines created in the collaboration phase. It is the recurrence of certain events and relationships appearing in the mapping that help label and characterize the phases.

The phasing based on the mapping helped the researcher to better theorize and not only define temporal brackets. This brings to the analysis new insights on the micro-practices carried out to elaborate knowledge and the observation of artifact construction activities related to existing resources. In this example, the mapping not only helped identify the major phases inherent in the development of the organizational capability but also enabled Author 1 to identify the specificities of each phase and how the company levels were involved. The visual map helped the researcher to better see and articulate data and thus led her to a new and coherent conceptualization of the process (conceptual leaps as suggested by Klag and Langley, 2013), later theorized as phases of a capability construction. As Latour explains, an inscription gives visibility to properties that are not necessarily visible independent of their representations. Due to the visual map, we were able to establish properties of the phenomenon that were otherwise invisible. Structuring the process in such a way enables human cognitive abilities to perceive it more clearly, facilitating the analysis, interpretation, and communication. The visual mapping also enabled the researcher to refocus on central elements in the interpretation and coding work.

Discussion

Despite the ubiquitous presence of images in everyday life, qualitative researchers have been quite reticent about the use of visual representations of nonvisual data in their research. This can be at least partly explained by the fact that organizational and management studies inherited from social science a rhetoric tradition that is predominantly text-based, which structured the field as "mostly a discipline of words" (Steyaert et al., 2012, p. 48). In parallel, a cohesive foundation is lacking as well as an agreement on how to visually represent qualitative data (Pratt, 2009; Trumbo, 2006). In this article, we propose the use of a specific visual representation tool – the visual map – in the specific research field of qualitative process research. We then propose reinforcing visual maps as a methodological tool to represent data in process research, hence inviting researchers to engage more with process research. We contribute to the visual representation of qualitative process data and, to some extent, to qualitative research in general in several ways, as detailed below.

Inscription as an ontological framework

Proposing visual maps as inscription gives us a sound theoretical framework for visual representation of qualitative data and entails changes in the way we conceive of, use, and communicate with visual representations. As inscriptions, visual maps should be understood as a visualization process that can integrate practices, measurement, description, analysis, and communication. Therefore, the process of creating an inscription is as important as the inscription itself, because it shows the researcher's choices in elaborating the visual map, bringing more transparency and showing the rigor of the interpretative process. Some scholars have used visual maps only as an analytical tool and present the whole process with a rather minimalist description, such as 'we engaged in visual mapping of the data.' Such 'descriptions' do not tell us how the visual map was conceived, across which organizational domains the events evolved, which elements were displayed, or how the elements were chosen and visually represented.

Furthermore, an inscription is legitimized when accepted as a shared practice. To date, there are no widely accepted means of creating visual maps in organizational research despite their marginal use in process studies. Visual mapping lacks the conventions and best practices of visual representation that we find, for instance, in grounded theory data sets. The heuristic that we used for the elaboration of a visual map contributes to the creation of shared and legitimate practices that can reinforce the rigor in qualitative inquiry of process research that has been sometimes associated with the lack of common methods.

Therefore, the process of creating the map leads to a reflexive effort on the weight and role of events, implying a reflection on the elements that will be selected for mapping. Such a work is generally not carried out explicitly and is a means of displaying choices transparently. Mapping has, so to speak, the role of a developer in the photographic sense. The researcher has to reflect on her own practice and understanding of the phenomenon to select events and their relations.

Data condensation

Visual mapping refines Miles and Huberman's (1984a, 1984b, 1994) and Miles et al.'s (2014) data condensation concept as a vivid and encompassing way of condensing data. Rather than condensing data through recurrent steps of coding, categorizing, and regrouping into broader concepts, it is achieved through the creation of categories of events and dynamics among them, selecting relevant events and looking for their mutual relationships, which associates both categorizing and connecting strategies (Maxwell & Miller, 2008).

Transparency

Visual mapping also brings greater transparency to the interpretive process by providing the reader with the possibility of viewing the scientific reality as perceived and understood by the researcher. It is thus a way of enabling peers to understand and reflect on the researcher's perception of the observed phenomenon and the logic underpinning the research.

Theorization

In their paper 'What theory is not', Sutton and Staw (1995) list elements of visual representation such as diagrams as 'not theory.' In responding to this paper, Weick (1995) acknowledges that such visual representations are not theory in themselves, but they should be seen as important elements on the path to developing theory. In line with Weick (1995), we extend Langley's (1999) work by showing that the elaboration of visual maps can foster conceptual leaps and, consequently, make the emergence of characteristics and phases visible in an evolving process and not only through a surface process. Visually mapping qualitative process data enables inscribing literary objects into graphical form, providing an overview of the phenomenon under analysis and a better understanding of patterns of actions. Therefore, visual mapping enables the researcher to anchor his or her results in a concrete artifact, providing a response to the question, 'what are the results of your research based on?' In this respect, visual representations may play an important role in the gray area between raw data and derived theoretical contributions. Visual maps can help theorization by enabling a better visualization and articulation of data and new ways of connecting and classifying the elements of analysis.

Representing time

Visual mapping also enables time-sensitive analysis, mapping activities chronologically, and capturing subjective perceptions of time, because the researcher can choose the conception of time he or she wants to acknowledge in the visual map. Researchers can make visual inferences about the evolution of an event over time. This is possible because in visual mapping with a temporal dimension we can visually identify recurrences, sequences, pace, rhythms, and cycles.

Reflexivity

Visual maps are not only an element of analysis (Janczak, 2006; Lok & de Rond, 2013) and visualization (Lawrence et al., 2012) but also constitute a tool for reflexivity (Spekkink, 2013). Visual maps, conceived as inscriptions, are visual representations ontologically independent of the phenomenon represented and the raw data that structure them. Their elaboration, analysis, and interpretation are thus a matter of reflexivity rather than a matter of correspondence. Each step to contextualizing data, selecting, representing, and relating events meaningfully calls for iterative cycles of reflexivity to provide a visual representation of elements that may be hidden in the literal form.

To conclude, although we acknowledge the importance of reflexivity in the elaboration of a visual map, little has been said about being reflexive during visual representations of data. Researchers may face problems when deciding what, how, and why to inscribe elements of their fieldwork. We therefore need more guidance as well as theoretical perspectives to enable reflexive thinking to occur during the process of creating inscriptions. Also, any representation of a complex system is a simplification of the system. The researcher chooses what to show (or not) depending on what he or she wants to highlight concerning a research question. The result obtained, or rather an overall objective perspective of the data, is the representation of a scientific reality that is meaningful in relation to the research question and what the researcher thinks is important to show.

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