A TRAVELLING INCARCERATION. Immobile inside the train, seeing immobile things slip by. What is happening? Nothing is moving inside or outside the train. The unchanging traveller is pigeonholed, numbered, and regulated in the grid of the railway car, which is a perfect actualization of the rational utopia. Control and food move from pigeonhole to pigeonhole: “Tickets, please...” “Sandwiches? Beer? Coffee?...” Only the restrooms offer an escape from the closed system. They are a lovers’ phantasm, a way out for the ill, an escapade for children (“Wee-wee!”) --- a little space of irrationality, like love affairs and sewers in the Utopias of earlier times. Except for this lapse given over to excesses, everything has its place in a gridwork. Only a rationalized cell travels. A bubble of panoptic and classifying power, a module of imprisonment that makes possible the production of an order, a closed and autonomous insularity—that is what can traverse space and make itself independent of local roots.

Michel de Certeau in ‘The Practice of Everyday Life’ (1984, p. 111-12)
Railroads, highways, electrical grids, telecommunication networks, water and sewage systems, these are some examples of the infrastructures that form the foundation of modern societies. Etymologically, the word infrastructure is derived from the Latin prefix ‘infra’ – meaning ‘below, underneath’ – and the noun ‘structura’ – denoting ‘a fitting together’ or ‘the practice or process of building’. Typically, according to Star and Ruhleder (1996), such basic infrastructures are constructed only to then ‘sink into the background’ and become, so to speak, invisible. The sewage system, for instance, does not only exist below the ground in a literal or physical sense. It also becomes invisible in the sense that its users are usually not aware of its existence. It is simply there. It is ‘ready-to-hand’, in Heideggerian (1926/1996) vocabulary, for us to practically engage with all the functionalities it offers in our daily lives.

Infrastructures, as Star (1999, p. 380) explains, are commonly thought of as ‘a system of substrates’, and due to their invisibility we usually tend to imagine a stable and completed product when talking or thinking about infrastructures. However, this comes at a cost. Such thinking obstructs seeing how infrastructures are being kept in place, how they are retrofitted and break down, and how these breakdowns in turn are dealt with. In other words, infrastructure is often thought of as an objective and ‘real’ object out there rather than the complex and dynamic relations between the parts of the whole system: ‘We often see computers not cables, light not electricity, taps and water but not pipes and sewers’ (Larkin, 2013, p. 327). Thus, we turn on our phone to call a colleague on the other side of the ocean, without much thinking of the electronic infrastructure we use to charge that same phone, or without being aware of the cellular network that uses electromagnetic radio waves to zip our voice with the speed of light into our colleague’s ears.

In the opening quote of this chapter, de Certeau poetically describes this invisibility in the context of the practice of everyday train commuting. The passenger, being immersed in the ‘immobile’ inside of the train wagon watching an ‘immobile’ outside pass by, is only subconsciously aware of him or her being in that train. Inside the train there is an organized system of rationality and reason. Below, however, and invisible to the passenger, railroad switches turn and twist to guide the train to its final destination. Above, the train gently

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1 Although infrastructures are, of course, not only a phenomenon of modern times, the literature indicates a strong link between contemporary infrastructures and the larger program of ‘modernity’. Infrastructures in our time have become synonymous with issues of growth, development, and the free flow of people and goods. They have become so normal and almost ‘naturalized’ that they are often taken for granted and form the basics of our modern condition (Edwards, 2003; Howe et al., 2016; Larkin, 2013).
touches the overhead wire to receive just enough power from the electrical grid to brake or to increase its speed. Further away, still, train dispatchers and traffic controllers monitor the train – as well as many others – from a railway control center through several computer systems to work away any potential delays in the train’s journey. If everything goes well, the passenger may very well doze off in the comfortable train seat and the whole experience of using and traveling the railway infrastructure becomes, indeed, invisible.

Larkin (2013) argues that the idea of ‘invisible infrastructures’ is only partially correct, as infrastructures also have this tendency to suddenly become extremely visible upon breakdown (Star, 1999). The railroad switch stops and stalls; the electrical grid ceases to function; two ‘almost-out-of-order’ railway switches cause a ‘very-real-out-of-order’ collapse of the railway system (Schipper et al., 2015). A confused man jumps in front of a train; unexpected snow covers tracks in a thick white blanket; a swan, mourning for the death of his beloved partner, refuses to leave the tracks. Slippery tracks due to fallen autumn leaves; an endangered red panda, escaped from the local zoo, roams around the railways; a train stutters and then simply fails to start.

We seem to think that infrastructures either function or are broken down. Yet, infrastructure may also be understood as a recursive process. It is: i) the technological ‘object’ that fundamentally shapes social life, as infrastructures are the ‘built networks that facilitate the flow of goods, people, or ideas and allow for their exchange over space’ (Larkin, 2013, p. 328); while, ii) infrastructure also emerges through and is being shaped by this social life, for instance through how infrastructures are organized, how they are structured by notions of ‘modernity’, and how social and organizational actors use, change, or work around the system. This dissertation sets out to develop an understanding of infrastructure breakdowns that, rather than drawing distinctions between the infrastructure and the breakdown, is based on the relations between them. This highlights the infrastructure as a duality; both visible and invisible, functioning and breaking down, a stable object and an open-ended process. But what does such an understanding entail?

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2 See http://nos.nl/artikel/2008868-vertraging-op-spoor-door-rouwend-zaan.html
3 See https://nos.nl/op3/artikel/2069212-rode-panda-legt-treinverkeer-rotterdam-stil.html
1.1 Research aims and question

1.1.1 Studying the complexity of ‘routine’ work

‘The snow changed the country into a white fairytale landscape that day. But for our organization, the day was pitch-black’, thus speaks an employee of ProRail, the infrastructure manager of the Dutch railway system. Although snowfall is moderate on 3 February 2012, it is enough to disrupt the complete railway network for several days. What starts as a relatively simple technological disruption – two frozen track switches caused by pieces of ice falling from a passing train – eventually has dramatic effects for the railway infrastructure and train passengers. Thousands of passengers are stuck somewhere in the country, unable to go to work, unable to reach the airport in time for their flight, or unable to go back home in the evening. Those who do make it home see on the television how hundreds of people spend the night on a thin mattress in the halls of train stations, how mothers comfort their children underneath electric heaters, and how volunteers and employees of the Dutch Railways distribute soup, tea and coffee to warm the ‘homeless’. That same day, the members of the Dutch parliament request an emergency debate with the minster of Infrastructure and Environment. The leader of one of the political parties calls the situation in an interview with a broadcasting agency ‘scandalous, unbelievable, and incredible’. Another member of the parliament is ‘surprised and disappointed’.

The next days it stays tumultuous. The railway organizations make significant cuts in the train schedule in order to try and get back in control. ProRail licks the dust and publicly makes apologies for any caused troubles. In the aftermath we also meet Livius, an 11-year-old boy who was travelling to his mother all by himself on that doomed winter day. Livius, in a radio interview and while stuck at Utrecht Central Station, tells his story. When the reporter hears the boy only carries €1.40, too little to buy anything to eat, he offers him a bag of chips. Livius, soon baptized as ‘the symbol of this horror-winter’, eventually reaches his mother with a seven-hour delay. The country is relieved: the boy has survived!

In this dissertation I study breakdowns in the Dutch railway infrastructure, one of the busiest and most complex systems in Europe (Goodwin et al., 2012). It is based on an

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4 See http://nos.nl/artikel/337140-kamer-wil-debat-over-spoorchaos.html
5 See https://nos.nl/artikel/337311-livius-het-symbool-van-de-horrorwinter.html
ethnographic study conducted for the largest part between September 2013 and November 2015. During this period, I participated, for two days a week on average, in the daily lives of those railway employees who were in one way or another involved with breakdowns (e.g. traffic controllers, coordinators, dispatchers, incident managers, train drivers, management/staff, emergency service employees). I also conducted 35 interviews with railway employees, and read numerous documents (such as handbooks, manuals, evaluations, policy plans, and news articles) to gain a broad understanding of what it means to cope and deal with breakdowns in a complex infrastructure. In section 1.3 of this introduction I provide further methodological details concerning this study.

To gain an in-depth understanding of the experiences and work practices of railway operators I chose to conduct an ethnographic study, as such an approach can unravel the complexities and intricacies of organizational life by getting out into the organizational ‘field’ for a prolonged period. True to the ethnographic tradition I was interested in both the mundane and the extraordinary of organizational life. I focused on those breakdowns that disrupted the infrastructure and the work of railway operators as much as that I was interested in those days where nothing seemed to happen, and work seemed like an orderly and routinized flow of events. I emphasized ‘seemed’ in the previous sentence, as it forms a crucial element for the frame through which one could interpret the empirical data I present or understand the theoretical arguments I make in this book. For, underneath the surface of those days that at first glance appeared utterly boring to me (e.g. no disruptions, no major delays, no accidents or collisions, no technical failures, no extreme weather), I discovered a whole world of work. In other words, it takes a whole world of work of humans as well as technologies – collaborative practices, machines, computer systems, the perfunctory and almost invisible pushing of apparently random buttons, phone calls, daily operational reports, working around procedures, algorithms, handbooks, interactions, managerial performance indicators, tacit knowledge and the habitual handling of objects, etc. – to work away all sorts of potential and actual breakdowns and to move a single train from A to B. Much of this work is routine, streamlined by systems and organized by operational procedures. But it is work nonetheless.
1.1.2 Defining infrastructure breakdowns

Perhaps the remarks made above may seem rather arbitrary or even banal, as one could make a solid argument that it takes at least some degree of work and organization to achieve nearly anything. But, so I would argue, refusing to put this work and organization central has established a false dichotomy in relation to infrastructure breakdowns. We tend to think of infrastructures as either functioning as we expect them to or as in the state of being broken down. Yet, how infrastructures function is fundamentally rooted in how they are being made to function and how organizational actors cope with the complexity of breakdowns. In fact, so I will illustrate with my empirical data, an ethnographic view on breakdowns reveals how the two conditions of an infrastructure – i.e. functioning or broken down – cannot and should not be understood as the two extreme poles of an isolated ‘thing’ we call infrastructure. The aim of this book, then, is to give an account of infrastructure as existing on a continuum, showing the organization work that is involved in making complex infrastructures function as well as how breakdowns in such infrastructures are dealt with. The core argument I want to put forward in this dissertation, is that breakdowns are not exceptional to but constitutive of infrastructures (see Howe et al., 2016): infrastructure exists on this threshold where breakdowns are always a potential while the system is always simultaneously in repair. Before we begin to distill the consequences of such a view in theoretical as well as operational and methodological terms, we should first dig deeper into the question why dichotomous thinking about breakdowns is problematic.

Put very simply, breakdowns can range from ‘dramatic disasters’, such as the Space Shuttle Challenger crash (Vaughan, 1997), to the more incremental decay found in ‘daily disruptions’, such as the slow clogging of city sewers by discarded fat (Marvin and Medd, 2010). It would be without exaggeration to state that the former has received far more attention in academic work as well as in public debates. Crisis and disaster response or management have become pressing issues for studies on organizations and public policy (e.g. Boin, 2009; Perrow, 2011; Turner, 1976; Weick, 1988; Weick and Sutcliffe, 2001), covering a broad range of crisis situations such as Hurricane Katrina (Comfort, 2007), the Tenerife air crash (Weick, 1990), the Chicago heath wave (Klinenberg, 2015), oil spills (Beamish, 2000), breakdowns in critical infrastructures (Boin and McConnel, 2007), and environmental (Gephart, 1984), mountaineering (Kayes, 2004), or fire (Weick, 1993) disasters. The list goes on and on. A common denominator in these studies is that they analyze such crisis situations
– often retrospectively – to understand how we can learn from disasters in order to improve our responses, adapt our systems, and prevent future disasters.

My main difficulty with this stream of work is how it addresses and treats the idea of complexity, namely as one where complexity is an enemy that should be reduced by us humans. Now, to be sure, the scholars cited above would be the last to argue for a simplistic view on organizations or to say that disasters are black and white. In fact, complexity – although often not formally conceptualized – seems to be a common thread running through these studies, with a strong focus on how contemporary problems are increasingly global, consist of many interrelated parts, and behave in often unexpected ways (see for example Perrow, 2011). Take Weick’s seminal work on sensemaking in crisis situations, for instance, and it becomes apparent that the complexity of disasters is acknowledged but only to the extent that it can be simplified:

When people take some action, they often transform a more complex task into a simpler task… action clarifies what the problem may be, specific action renders many cues and options irrelevant, and action consolidates an otherwise unorganized set of environmental elements (1988, p. 315)

Understanding complexity with the ultimate purpose to reduce complexity is in some respects flawed. It implicitly treats the breakdown as exotic, as an anomaly which origins can be traced back to a single ‘failure’. This is problematic as it conceptualizes infrastructure and how it functions as the property of a collection of individual components rather than a property of the whole system (Leveson, Dulac, Marais and Carrol, 2009).

Yet, we seem to have a strong preference for such disasters, not in the least because crises are popular topics allowing for some impressive and dramatic storytelling. Another reason why academics and the lay public alike put so much emphasis on the ‘dramatic disaster’ at the cost of the ‘daily disruption’, is that the former has established a discourse that promises solutions and ideas of greater control. Seeing the infrastructure as a dichotomy that is at one point functioning and at another point broken down cuts away most of what lies between these two states. This invites us relatively easily for causal reasoning reminiscent of a classical ‘whodunit’: this led to that; he is guilty; this was the straw breaking the camel’s neck; here are the solutions; this should be changed; here are the new rules; etc. In order to understand breakdowns from such a perspective – where the infrastructure is either working or not – distinctions are drawn between the different processes that make up the system.
However, and paraphrasing Aristotle, the whole system consists of more than simply the sum of its parts, and it may very well be this ‘grey matter’ of the system (i.e. the relations and interconnections between the parts) that we call complexity. In other words, dichotomously thinking about infrastructure hampers a profound understanding of how infrastructure functions, and a focus on ‘daily disruptions’ may potentially enhance our understanding of the complexity of infrastructure breakdowns.

Weick’s sensemaking view on organizational disasters comprises a very important shift from earlier studies on crises (Maitlis and Sonenshein, 2010), since he argues that disasters are not merely caused by technological failures in objects but always involve some sort of cognition and human conduct. The emphasis on such a view in many studies on crises and disasters indicates a common premise: an unexpected situation breaches our expectations and we engage into sensemaking to ‘restore’ order back into the world. Arguably, this makes sense from a psychological perspective on organizations, where sensemaking can be induced as a ‘stress-reliever’ once we are faced with ambiguous input. However, and this cognitive slant in research on sensemaking has recently been critiqued (Brown et al., 2015; Holt and Cornelissen, 2014; Sandberg and Tsoukas, 2015), such a perspective also neglects that sensemaking is an ongoing process that is not only triggered by external and extreme events. More often than not, breakdowns are encountered and order is restored in ways that are not purely cognitive but, while being immersed in a specific situation, through practical coping (Chia and Holt, 2006; Dreyfus, 2006), and in a practical and embodied sense (Bourdieu, 1990; Sandberg and Tsoukas, 2011, 2015).

I am not claiming here that disasters are a topic unworthy of study. On the contrary, such events have very real – and often very unfortunate – consequences. Yet, complexity is conceptualized in a problematic way because it is given a concrete appearance, thereby consolidating the separation between ‘us’ and ‘it’: faced with a disorderly world, we apparently make sense of the situation and engage in attempts to forge order out of this chaos. As Chia (1998) argues, complexity is not an objective state of a situation: it is the indeterminate flow of life that we find complex and then we organize in the attempt to reduce this perceived complexity until order has been restored. Thus, my main point of critique here, is that studies on disasters and crises claim to unravel the complexity of situations by, for instance, accounting for human as well as technological involvement, but, in the act of unraveling, they stop taking complexity serious! Cutting up complexity – which is perceived complexity – de facto talks complexity into being: it becomes an objective state of a situation.
that humans can then try to manage or control. From such a view, complexity can ultimately be fantasized away, and the inherent indeterminacy of life can be resolved by increasing amounts of information. However, following Chia (1998, p. 346), treating complexity as inert matter with some objective state ‘awkwardly brutalizes the moment it touches the fluid and living and thus is characterized by a natural inability to comprehend the dynamic complexities of life’. In other words, and this will be further elaborated in chapter 2, it seems we have reached an epistemological impasse: is it possible to know more about complexity by reducing it and cutting it up in smaller and fewer pieces?

1.1.3 Breakdowns as ‘daily disruptions’: a focus on concrete practices

Another way to look at infrastructure breakdowns, the alternative I want to offer in this book, is to focus on and further scrutinize the role of ‘daily disruptions’ rather than ‘dramatic disasters’. This means to look beyond an infrastructure as it is – or, as Star and Ruhleder (1996) argue, to move beyond the question ‘what is infrastructure?’ – but instead, to be attentive to the idea that infrastructure is in a continuous and simultaneous process of breakdown and repair (Graham and Thrift, 2007). This does not mean that breakdowns become innocent. On the contrary: although disasters may often come with a bang, they tend to originate from those very mundane anomalies that slowly accumulate and are not yet visible to the eye (Beamish, 2000; Vaughan, 1997). Moreover, such an alternative perspective has the potential to highlight the otherwise hard to grasp continuum on which infrastructure exists, that is, that infrastructure is not either in function or in the state of breakdown but most of the time somewhere in between: it has to be made to function while breakdowns, the ‘daily disruptions’ that are always on the lure, have to be dealt with.

In terms of operationalization such an alternative has several consequences. First, the management of breakdowns transcends those rationalized aspects of organizational life that are aimed at preventing, controlling, or containing these breakdowns (e.g. public policies, handbooks and manuals of operators, computer systems, reorganizations or the restructuration of official lines of communication). On the contrary, it should include how people ‘on the shop floor level’, especially in their interaction with technological artifacts, are coping with breakdowns. How does the train driver decide when to report an anomaly along the railroad tracks? When does the traffic coordinator escalate a potential disruption and to whom (and why not to others)? How does staff implement new managerially accorded procedures, and how, if at all, does the train dispatcher comply with this? Second, it implies
that the breakdown *an sich* is not the event to analyze nor that it is to be reconstructed in a post-hoc fashion. A breakdown is not only an immediate disruption of the orderly flow of operations, but it also concerns a continuous struggle to keep the infrastructure as a system available. Issues pop up. Disruptions come and go. Some are explosive, many are contained, and most reside somewhere beneath or within the system as an enduring possibility. This suggests that a focus on ‘daily disruptions’ to understand breakdowns in infrastructure should, at least in first instance, refrain from the temptation to look at that what immediately catches the eye, screaming ‘BREAKDOWN!’ while doing so. This can be done in a methodological sense. Star, in making reference to the idea of ‘infrastructural inversion’ (Bowker, 1994), explains that this entails ‘foregrounding the truly backstage elements of work practice’ (Star, 1999, p. 380). A lot may be learned by attending to how the daily life of railway operators unfolds and how they cope with the almost routine occurrences of breakdowns, where the next one may always be just around the corner.

Third, whereas ‘dramatic disasters’ ask for a deliberate and acute type of response (the life and death of people may be at stake), ‘daily disruptions’ are often repaired in more absorbed ways of coping with the situation at hand and may involve a certain degree of improvisation (Yanow and Tsoukas, 2009). Improvisation, however, should not be regarded as a solo endeavor that involves no preparation. It happens from the midst of action within a community of a practice in which practitioners ‘necessarily draw on collectively established distinctions and standards of excellence’ (Yanow and Tsoukas, 2009, p. 1345). This suggests it is valuable to look at and uncover those taken-for-granted and phenomenologically grounded aspects of the practices of railway operators. These points will be further elaborated in section 1.3, where I will argue for a practice-based and interpretivist approach to study breakdowns.

Following from the above discussion, much can thus be learned about the relational nature of infrastructure breakdowns once we turn to the complexity of breakdowns à la ‘daily disruptions’. Consequently, the research question that I aim to answer in this dissertation is the following: *how do organizational actors cope with the complexity of breakdowns and how does this shape the functioning of the railway infrastructure?*

Closing the gap between infrastructure and breakdown means to be sensitive to i) process and temporality, and ii) sociomaterial entanglements. To elaborate the former, infrastructure is the open-ended and indeterminate outcome that springs forth from the flux and flow of life where organizational actors try to stabilize and organize a system. For instance, the emergence of order and disorder in Tokyo’s commuter train network (Fisch, 2013) or the
birth and death of ‘Aramis’ – a Personal Rapid Transit system in Paris – (Latour, 1996), directs our attention to the idea that infrastructures should not be thought of as something that is simply and unproblematically ‘there’ but, rather, fundamentally in a process of ‘becoming’. In chapter 7, for instance, I study the event of railroad suicides to show how the dead body becomes a breakdown triggering a range of actions throughout the system. This shapes not only how the infrastructure emerges at that point in time but also, due to the almost ‘routine’ recurring of railroad suicides in the Netherlands, how this has shaped the functioning of the infrastructure, namely as a ‘clean’ and rationalized system.

Understanding such dynamism from an organizational perspective, Tsoukas and Chia (2002) claim, primacy should be given to the concrete practices through which actors organize. This focus on practices is contrary to the general privilege given by theorists as well as practitioners to resort to abstract representations in trying to understand organizing work, such as manuals, organization charts, structure or organograms, official evaluations, etc. (Brown and Duguid, 1991; Tsoukas, 1997). It means to think movement rather than stasis (Chia, 1999): infrastructure is not a stable or finished object, but it only temporarily reaches a stable appearance which, in turn, is achieved through continuous, though perhaps microscopic, transformation. How, for example, do railway employees make decisions regarding a potential winter storm affecting the train service, and how are these decisions locally negotiated in micro-interactions and are they supported (or not) by representational tools such as matrices and decision trees (see chapter 4)?

Second, breakdowns in complex systems are often the result of interactions between the – human as well as non-human – entangled and tightly coupled elements of this system (Perrow, 2011). Leonardi (2011), for instance, argues that routines and technologies together produce infrastructures that enable people to carry out their work. Such practices, then, are what he calls the imbrication of human and non-human agencies. In a similar vein, objects may play a crucial role in setting up an infrastructure that allows people to collaborate across disciplinary boundaries, something that would be much harder by verbal agreement or communication alone (Bechky, 2003; Nicolini et al., 2012). In chapter 6, for instance, I explore such forms of collaboration at the national control center from an explicit materially informed perspective by zooming in on how the spatial setting of a control center enabled and constrained collaboration.

Such a view resonates strongly with recent discussions on sociomateriality in the social sciences in general and organization sciences in particular (Callon, 1984; Latour, 1990,
1993, 2005; Law, 1991; Orlikowski, 2000, 2007, Suchman, 2005, 2007). Imagining organization as sociomaterial starts from a relational ontology where ‘the social and the material are inherently inseparable’ (Orlikowski and Scott, 2008, p. 456). Thus, when talking about the different elements that make up a system, we have to consider the idea that these ‘elements’ do not have any fixed properties a priori their relationship but that these only temporarily emerge when enacted in practice (cf. Barad, 2003). Infrastructures, then, convey images of, as Haraway (1987) would put it, a ‘monstrous’, ‘chimeric’, or ‘mosaic’ world without clear boundaries between humans and machines. This issue is taken up in chapter 5 where I show the entanglement of material and representational tools (performance indicators in this case) on practices and, moreover, how coordinators may comply, resist, or work around this indicator as a material artifact. The boundaries between the human and machine are further dissolved in chapter 3 by focusing on the role of embodiment in the production of knowledge at a dispatching post; embodiment shows how knowledge is not the mere result of human intellect alone but how it is embedded in the skillful practices of dispatchers’ bodies as well as in the materiality of the actual infrastructure.

The concrete research aim of this dissertation concerns to develop an understanding of those practices through which organizational actors cope with the complexity of breakdowns in infrastructures. Some argue that organizations, when dealing with complex issues and in the face of potential disorder, resort to management techniques that can be classified as representational devices meant to simplify an otherwise complex world (e.g. Chia, 1998; Cooper, 1986; Law and Mol, 2002; Tsoukas, 1998; Tsoukas and Dooley, 2011). As Kallinikos (2005) claims, such efforts spring forth from broader regimes of knowledge and reflect certain ambitions to render a contingent world more inspectable and controllable. Complexity, from this vantage point, is a Monster that has to be tamed; a Mess that should be tidied up. However, drawing on Korzybski’s (1933) insight that the map is not the territory that it represents, we must ask how such efforts to simplify a complex railway world in order to tidy or tame it shape the becoming of infrastructure. To understand how this happens at the Dutch railway organizations, I now zoom in on the background of the Dutch railway infrastructure. The issues of complexity and representation, which lie at the core of how we believe that breakdowns should be managed, will be further scrutinized in Chapter 2.
1.2 Research context

The Dutch railway system is one of the busiest in the world. Daily, more than 1,000,000 passengers step into a train, and this number is only about to grow in the next decades. Since the railway infrastructure is so dense, a local breakdown easily spreads through the network to evolve into a larger one, or even into a national ‘out-of-control’ situation. These out-of-control days are disruptive to the railway organizations and Dutch society at large, not in the least place because of financial consequences. It is thus of great significance to understand what happens during such breakdowns and how they are being dealt with.

My research was sponsored by ProRail, the infrastructure manager of the Dutch railways, and by the Dutch Research Council (NWO). It is part of a larger research program that was initiated by both these parties and is called ‘ExploRail’. The main question ProRail hopes to answer through this program is how the vulnerability of the Dutch railway system to breakdowns can be reduced. ExploRail consists of several research groups that tackle this problem from diverse perspectives, ranging from a study into smart and intelligent railroads, the development of ‘a new generation’ of steel to make railway tracks more durable, to cognitive work analyses at control centers to make the system more resilient. ProRail also invited several social scientists – me, amongst others, as an organizational ethnographer – to give insights into the social dynamics around collaboration during breakdowns in the railway infrastructure. I was basically giving a *carte blanche* to study breakdowns from this perspective, giving someone with a background in the social sciences the unique opportunity to ‘get up close’ with people in a world where technology dominates.

My research was part of the research group ‘Managing Complex System Disruptions’, and conducted in collaboration with a PhD candidate at Erasmus University. This candidate focused in his research on a dynamic social network analysis of communication and coordination during disruptions in the railway system. We thus both studied the same phenomena but on different levels (system level vs. micro level), in order to gain insight into how organizational actors respond to the complexity of breakdowns within the railway network. My research, and in fact the whole of ExploRail, should be seen in light of the long and often turbulent history of the Dutch railway system; a history with many ups and downs that center around breakdowns and governmental involvement.

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6 See [http://explorail.verdus.nl/1334](http://explorail.verdus.nl/1334) for an English summary.
1.2.1 A (very) brief historical overview

20 September 1839. It’s a beautiful autumn day. There are celebrations in the cities of Amsterdam and Haarlem. The first railroads in the Netherlands are opened today. For the Dutch people this is a new phenomenon. It is almost like a world-wonder one can only gawk at. But at the same time, it is also something frightening. The train is a fire-spitting monster, steam hissing from all its crevices. An invention by the devil himself, according to many (Veenendaal, 2004, p. 14, translated from Dutch).

In 1837, the Hollandsche Ijzeren Spoorweg Maatschappij (Holland Iron Railroad Company), the first Dutch railway organization, is founded. With financial support from the government, the company builds a short railroad line between the cities of Amsterdam and Haarlem, and two locomotives imported from England operate it. These trains are baptized ‘de Arend’ (the Eagle) and ‘de Snelheid’ (the Speed).

As the development of new railroad lines takes off relatively slowly, at least in the opinion of the government, the state decides to develop a national railway network in the following decades (Veenendaal, 2004). At the turn of the century, a large part of the country is within easy reach for most of the Dutch citizens, changing the life of many drastically. With the advent of the First World War and the Great Depression, the need for the different Dutch railway organizations to collaborate more intensely grows, but this is eventually deemed insufficient. Other means of transportation slowly take over the monopoly of railroad transportation, as the infrastructure of roads and highways grows rapidly. In 1937 the two independent railway companies merge into the Nederlandse Spoorwegen (Dutch Railways), a concern with all its shares in hands of the Dutch government.

After the Second World War, major parts of the infrastructure and organization of the Nederlandse Spoorwegen (hereafter NS) are left devastated. With its ups and downs, the company slowly rebuilds the railroad tracks in the years to follow. However, increasingly voices are raised questioning the (financial) involvement of the state in the Dutch railway

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7 Most of the information in this section is based on an extensive book on the history of the Dutch railways by Guus Veenendaal (2004), a ‘media-scan’ conducted by a student-assistant prior to the start of my PhD, and a workshop organized by the Dutch Railways on the history of the railway system in the Netherlands.

network, only fueled by a European directive suggesting the separation of the management and the exploitation of European railroad infrastructures. Then, under the adagio of neoliberalism, the NS is de-nationalized in 1995. Several years later, in 2003, NS becomes an independent passenger railway operator with the Dutch state as the sole shareholder, and ProRail becomes an independent body at the behest of the Ministry of Infrastructure and Environment. As the infrastructure manager, ProRail is responsible for the maintenance and extensions of tracks, allocating rail capacity, and traffic control. One of the rationales behind the split up is the conviction of the Dutch government that de-nationalizing NS and allowing other operators on the railways will automatically increase competition and, consequently, increase the efficiency and the quality of train services in general (Veenendaal, 2004).

Although de-nationalized, the involvement of the government remains intense. NS is granted a transportation concession, receiving the individual right to operate the main rail network until 2025, while ProRail is granted a concession to oversee the infrastructure management until 2025. The concessions are accompanied with a great deal of performance indicators and agreements that must be met on an annual base. Both companies can be (and they are) fined when agreements are not met. In the last decade, several parliamentary inquiries take place to shine light on supposed ‘mismanagement’ in the railway system, and in 2016, shortly after the end of my fieldwork, it is decided that ProRail, plagued with financial miscalculations in several large construction projects, loses its independency. The responsible State Secretary falls and ProRail might soon become a government-task organization falling under closer supervision of the Ministry of Infrastructure and Environment. It is expected that more direct involvement influences and improves how the Dutch railway network is managed and that breakdowns become less disruptive.

1.3 General methodology

This dissertation is based on a practice-based ethnographic study, which enabled me to study an organization in an interpretive way to see and understand the nitty-gritty details

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9 See, for example, the report on the public tender of the new high speed train ‘Fyra’: https://www.tweedekamer.nl/sites/default/files/atoms/files/publicekssamenvatting_rapport_fyra_281015.pdf

10 Source: http://www.volkskrant.nl/economie/prorail-wordt-bestuursorgaan-het-spoor-is-weer-van-ons-allemaal~a4396816/
of organizational life. Ethnography, traditionally seen as the anthropologist’s preferred method of conducting research, is perhaps a stranger amid organization scholars, even more so in the field of technologically oriented organizations. However, with attention for social dynamics and an eye for the mundane details, ethnographers can, especially in these kinds of organizations, develop creative and novel interpretations that may change the way we look at a broad array of organizational conduct (see for example Barley, 1996; Dalton, 1959; Fine, 2008; Jackall, 2009; Kunda, 2009; Ogasawara, 1998; Orr, 1996; Pachirat, 2011). In terms of the current study, an ethnographic approach on infrastructure breakdowns allowed me to imagine complexity – and I mean ‘imagining’ in terms of Weick’s (1989) idea that theory construction is a form of disciplined imagination – outside the confines already set by the organizational system, i.e. that complexity is something to be reduced. Other research methods would, arguably, find it significantly harder to do so as they would test, measure, or explain complexity from within an already given framework. In the empirical chapters I will offer an alternative interpretation of the complexity of infrastructure breakdowns – one that gives space to ambiguity, improvisation, bodies, emotions, and even death – in the technocratic world of the railway organizations. In the pages below, I will argue for the fit between a practice-based ethnographic study and my research question and interests.

1.3.1 An interpretive ethnographic approach

As argued before, in the scholarly literature in organization studies in general and infrastructure in specific there is little attention for how ‘daily disruptions’ shape the functioning of organizational systems. An ethnographic approach is a fitting methodological lens to study precisely this, as it can generate insights into how people cope with complexity in practice. Through prolonged observations and, to some extent, participating in the daily life of organizations, ethnographers aim to show the underlying social structure of what people do and why they do what they do. An in-depth understanding of those practices and routines that at first instance may seem mundane and irrelevant to studying breakdowns may uncover the practical logic of employees and how this helps or constrains them in coping with complexity. This could not so readily be understood or, indeed, even observed through more ‘distanced’ methodologies such as surveys. Especially so as an understanding of organizational practices and actors is not something that comes readily available to the researcher. Thus, rather than cutting up a complex world into numbers or categories, an interpretive approach
is capable of capturing the thickness of such complexity (Prasad, 2002; Prasad and Prasad, 2002). With ‘an appreciation of the complexities of the everyday in organizational settings’ (Ybema et al., 2009, p. 1), ethnographic research is apt to gain an insider perspective in order to find understanding that digs beyond the surface.

Interpretive research is often used indistinguishably with qualitative research. Although interpretive research is indeed a form of qualitative research (it is not concerned with quantitative data), it does have its own specific methodological and philosophical presuppositions. These are different from positivist qualitative research, where ‘reality is assumed to be concrete, separate from the researcher, and cognizable through the use of so-called objective methods of data collection’ (Prasad and Prasad, 2002, p. 6). Ontologically speaking, interpretive research does not regard the reality-status of the ‘things’ under study as an objective reality. Rather, social realities are socially constructed, inter-subjectively between individual actors and researcher. How, then, can we know anything about these socially constructed realities? In other words, how do we define the know-ability of the ‘things’ under study and how do we justify truth-claims we make about the meaning-making practices of those we study? Epistemologically, knowledge about these socially constructed realities comes about through interpretation. The researcher becomes the primary tool in accessing and generating data, as “[d]ata, in this approach, are not things given... but things observed, made sense of, interpreted’ (Yanow and Schwartz-Shea, 2006, p. xix).

An interpretive research design cannot be thoroughly planned beforehand. Instead, a considerable amount of scholars has argued that its design is necessarily fluid and flexible, that it should have ‘an openness to messiness’ (Pachirat, 2006, p. 378) in which ‘surprise, paradox, play, and irony’ (Ybema and Kamsteeg, 2009, p. 103) play a role. O’Reilly (2005), for example, focuses on the iterative-inductive quality of interpretive research, in which the theoretical and the empirical worlds are, so to speak, in conversation with each other. In a slightly different vein, Schwartz-Shea and Yanow prefer to call this a form of abductive reasoning that ‘begins with a puzzle, a surprise, or a tension, and then seeks to explicate it by identifying the conditions that would make that puzzle less perplexing and more of a “normal” or “natural” event’ (Schwartz-Shea and Yanow, 2012, p. 27).

Although, at a first glance, abductive reasoning might seem to resemble inductive reasoning, the main difference lies in the role of the prior knowledge that the researcher brings to the field. In inductive research designs the researcher, ideally, wants to enter the field as a blank slate, at least as closely as that is humanly possible, to let concepts and theories emerge
from the field. Abductive research designs, on the other hand, begin with prior knowledge ‘at whatever point is available or accessible, with whatever one’s understanding is at that point in time’ (Yanow, 2006b, p. 16). The role of prior knowledge acts as a starting point to get the research going (Agar, 2010), as either theoretical or experiential prior knowledge can be a ‘source’ of surprise (‘this is different than what I theoretically know’; or, ‘this is different than how I expected things to be’). Surprises encountered in the field thus must be taken seriously as they keep the interpretation process going and going (Schwartz-Shea and Yanow 2012). It is in this sense that an interpretive research design must be flexible, as one does not know what surprises will be encountered and, thus, where one will end up. Being open to surprises with an attitude of doubt\textsuperscript{11} can be generative for interpretive research (Locke et al., 2008).

A specific approach within interpretative research is the ethnographic approach. What an ethnographer exactly does when conducting ethnographic research has been discussed in many ways. Bate describes it as ‘[trying to] capture the richness of local cultural worlds’ or to ‘grasp the native’s point of view’ (Bate, 1997, p. 1151). Ethnographers generally agree that to study something ethnographically means to study groups of people in specific cultural contexts: it concerns ‘the close study, over time, using participation and observation, of a group of people, with the emphasis on obtaining the insider view’ (O’Reilly, 2005, p. 21-2). To understand those people you study and to be able to give a detailed description of their life-world with all its ambiguities, a quick visit is insufficient. Ethnographers emerge themselves for an extended period of time in the very world they are studying\textsuperscript{12}, to be able to not only see those things that strike the researcher as exotic or strange but also to uncover the mundane and routinized dimensions of organizational life (Ybema et al., 2009).

Drawing on different methods, ethnographers immerse themselves in the setting they study to understand the complexities of organizational life from the inside (see photo 1). Furthermore, ethnographers should be constantly aware of their role in the research

\textsuperscript{11} I elaborate a bit more on the role of doubt in the research process in a blog written for the Graduate School of Social Sciences: https://socializingsciencevu.com/2014/11/18/doubting-with-the-stars-why-doubt-is-actually-constructive-for-your-project/

\textsuperscript{12} It must be noted that, contrary to what could be defined as ‘traditional’ anthropology where ethnographers study a single place over an extended period of time, contemporary ethnographers are increasingly concerned with not one single place but with the study of different places in order to understand how ideas travel and transform in an interconnected world (e.g. Freidberg, 2001; Hannerz, 2003; Johnson, 1982; Marcus, 1995).
and how they are co-creators of the knowledge that is generated (referring to the idea that ethnographers interpret what they observe rather than measure or test it). A core challenge in ethnographic studies, then, is the extent to which trustworthy claims can be made about their interpretations. A critique often raised is that ethnographic studies lack systematicity. Yet, this criticism is based on positivist ontological and epistemological presuppositions, namely that there is a reality out there that can be measured by objective means. Such a philosophical stance falls short in answering interpretive research questions, and vice versa, an interpretive research design would deem incapable to test hypothesis. Ethnographers must rely on other ways to ‘convince’ their audience about their study, and they mainly do so in writing up their ethnographic text.

Photo 1. A selfie of the ethnographer – disguised in a ProRail uniform – in action

An indispensable part of the ethnographic research process is the writing of the ethnographic text (Geertz, 1973; Van Maanen, 2011). An ethnographic text relies for a large part on the fieldnotes that were written during the study. Fieldnotes are not so much concerned with accurate representations of what ‘actually’ was going on during the research or with verbatim reports of conversations but, rather, are first and foremost a way to access the lived experience of the ethnographer during the fieldwork (Jarzabkowski et al., 2014).
Golden-Biddle and Locke (1993) argue that an ethnographic organizational text, being a subjective account, can convince in the following three ways. First, the text must make appeals on authenticity, meaning that readers are assured that the ethnographer indeed has in-depth knowledge about the organization under study. By providing ‘thick descriptions’ (Geertz, 1973) and a great detail of particular events, the reader, through the text, should get a feel for what it must have been like being there. Second, the textual account must provide a plausible story. The ethnographer must go to great lengths to connect the empirical world described with the theoretical world of the community that is being addressed, so the audience of the text is convinced that the story ‘makes sense’ to them. Third, an ethnographic account should have some degree of criticality, meaning that the story given is not only plausible but also challenges some of the assumptions of the audience. Ethnographic texts, then, can potentially ‘challenge conventional thought’ and ‘reframe the way in which organizational phenomena are perceived and studied’ (Golden-Biddle and Locke, 1993, p. 600).

1.3.2 A practice-based approach

In order to understand how railway operators cope with complexity means to specifically focus on the practices of these people. Practices are those ‘bodily doings and sayings or actions that these doings and sayings constitute’ (Schatzki et al., 2001, p. 56), and a focus on practices means to study how people in situ deal with breakdowns. One could, for instance, look at how they use or avoid those protocols and procedures that were designed to solve breakdowns. This is especially relevant when taking into consideration that such protocols and procedures are always, to some extent, inaccurate representations of what is going on. In other words, the design of the solution (a rule) and the actual problem (the situation) are never 100% compatible, and how railway employees deal with this tension and how they decide to go forward is what constitutes the practice. Thus, a focus on practices essentially entails a shift from studying organizations as rational, formal and static entities towards a dynamic understanding of the activities people undertake when doing their work.

However, this idea should not be taken too lightly, as a focus on the activities of individuals does not necessarily bring one closer to the ‘reality’ of organizing (Nicolini, 2012). Instead, a practice-based approach is concerned with a performativ view on the world, a perspective that tries to uncover how elements of a practice (actions, a rule, a tool or technology) are not merely neutral carriers of that practice but should be seen as a form of ‘world-making’ or a reconfiguring of meaning (2012, p. 217). A rule or procedure, for instance,
is not just a description of a practice but is co-constitutive of that practice; it shapes, to some extent, how work is done. Looking at the performativity of practices, then, means to see practices as forms of collective action in order to understand ‘why and how practices continue to be practised in organizations, which normative and institutionalizing power they unfold and how they are changed (mended) and their implicit norms are questioned and reflected’ (Geiger, 2009, p. 140). It is in this sense that practices are seen as ‘the building blocks of social phenomena’ (Schatzki et al., 2001, p. 10) where the production and reproduction of social or organizational order takes place (Nicolini et al., 2003).

Although practice theory has not developed in one unified way (Nicolini, 2012; Schatzki et al., 2001), they do draw on a certain family of philosophers and theorists, and some common principles can be discerned. First and foremost, for practice theorists even those aspects of society that are considered to be most durable and stable (e.g. institutions, structures, organizations) are a result of practices: they only exist because they are sustained by the recurrent actions that people undertake. Therefore, following Weick (1995), the vocabulary of practice theorists is processual, and the dynamics of verbs and gerunds are preferred over the stability of nouns. Thus, practice-based studies generally reject enduring social dualisms such as nature/culture (Latour, 1993), structure/agency (Giddens, 1984), or objectivism/subjectivism (Bourdieu, 1990), dualisms that sociologists long considered as separate aspects or ‘realities’ of the world. For instance, in his essay on the observability of ‘macro-phenomena’¹³, Coulter (2001) shows how social institutions cannot and should not be reified. They only exist as long as they are performed. A bank, for example, exists because people are engaged in activities of banking (offering mortgages, withdrawing money, calling the helpdesk for a new credit card, etc.). In a similar vein, a practice-based approach to infrastructures means to look beyond the infrastructure as a stable object to, instead, look at how it is practiced, organized, sustained or transformed.

Second, a common principle in practice theories is that practices are embedded in social and historical contexts, a Marxian legacy (Nicolini, 2012). Thus, to understand human conduct one must consider the context in which this human conduct takes place. Practices

¹³ Coulter uses scare quotes here to argue that talking about something as ‘macro’ (or ‘micro’ for that matter) poses an ontological problem. It reifies relationships – which are processes – to things, without taking into consideration how these ‘things’ (scare quotes again) are eventually only temporary categories that are practiced into reality. (A similar argument can be found in chapter 5 of this dissertation, where I use the work of Karen Barad (2003, 2007) to show how categories do not exist a priori their relationship but are emergent).
can be seen as institutionalized ways of doing. This does not, however, imply any form of historical determinism, as ‘[a practice] is always the product of specific historical conditions resulting from previous practice and transformed into present practice’ (Gherardi, 2012, p. 200). Practice is then both a matter of reproduction of previous practice as well as an opportunity to renew or change the future conduct of that practice. Bourdieu, referring to his concept of habitus, puts it as follows: ‘The habitus – embodied history, internalized as a second nature and so forgotten as history – is the active presence of the whole past of which it is the product’ (Bourdieu, 1990, p. 56). To practice something means to engage in routines\textsuperscript{14} as much as in improvisation, to follow the rules and normative constraints that a practice sets as much as navigating those rules and constraints in exploring new possibilities which themselves can become a new norm for that practice.

Third, practices are bodily accomplishments that take place through material artifacts, that is, practices always happen through tangible human bodies and with concrete tools. In the context of this study, understanding how railway operators cope with complexity in infrastructure breakdowns means, by necessity, to understand how they do so through their (bodily) techniques, skills, technologies, apparatus, etc. Even ‘thinking’ or ‘theorizing’ is not an entirely rational or cognitive activity, as knowing happens first and foremost through the body and our senses\textsuperscript{15} (Merleau-Ponty, 1945/2012). It is in this regard that practice theorists argue that knowing and practice are intimately related (Nicolini et al., 2003). For Orlikowski and Scott (2008), there are no a priori boundaries between the social and the material. Sociomateriality, without a hyphen they insist, is a way of understanding the entanglement of both human and non-human actors. In other words, a practice-based approach is a way to understand how railway operators and their tools and technologies together shape how they cope with complexity and deal with breakdowns.

Summarizing, to study how organizational actors cope with the complexity of breakdowns in infrastructures through a practice lens means to take the context of the complexity of ‘daily disruptions’ in consideration by studying how it is being dealt with in

\textsuperscript{14} I am not referring to the colloquial use of ‘routines’ here (mindless or habitual behavior), as there is a whole literature problematizing the notion of routine by highlighting its performative dimensions (see, for example, Feldman, 2000; Feldman and Pentland, 2003; Howard-Grenville, 2005; Parmigiani and Howard-Grenville, 2011).

\textsuperscript{15} This will be taken up in chapter 3 of this dissertation where the notion of ‘sensible knowledge’ is developed.
The privilege given in public debate and scholarly work to ‘dramatic disasters’ has established a specific discourse and theoretical lens that is aimed at the retrospective analysis of causes and effects to answer the ultimate question: what has happened? Practices, on the contrary, invite us to look at what actually happens in the course of actions, how and why people do as they do, why they do not do it otherwise, to eventually give an in-depth and non-judgmental account of an organizational system. It is a move away from, what Sandberg and Tsoukas (2011) call, an understanding of organizations from a scientific rationality that is characterized by propositional statements to determine causal relationships as a mode of explanation. Such if-then explanations may allow making general statements about a complex world in order to simplify it. However, they fail to appreciate the complexity of organizations in all its complexity, as propositional statements i) cannot deal with particular circumstances (for then the whole logic of the proposition would collapse), ii) do not incorporate purposes and practical orientations of organizational actors made in specific situations, and iii) exclude the time and temporality, with all its uncertainties and contingencies, in which a practice unfolds (Sandberg and Tsoukas, 2011; Tsoukas and Hatch, 2001). A practice-approach to coping with complexity, although perhaps not able to make bold causal statements, allows to study interconnections and relations between the entangled elements that make up the whole of a system.

1.3.3 Methods and analysis

Once in the field, the researcher must extensively ‘map the field’ in order to find a match between questions asked and methods used to generate the data that may answer these questions. As interpretive researchers (and especially ethnographers) are concerned with the multiplicity of meanings of different actors in the field (Ybema et al., 2009), ‘the goal of mapping is to maximize research-relevant variety in the researcher’s exposure to different understandings of what is being studied’ (Schwartz-Shea and Yanow, 2012, p. 85). Exposure is both a matter of whom you talk to (different hierarchical and functional roles) and where and when you are present (various locations and moments). Extensively mapping the field and sufficient exposure to the field contributes to the researcher’s sensemaking, as having accessed the multiple voices in the field may bring about opportunities to study the ‘intertextuality’ of the concepts under study. Intertextuality means a comparison of the different accounts of meaning-making processes across the different sites of the field, to
generate deeper understanding of what the researcher wants to know. Or, as Schwartz-Shea and Yanow put it, ‘interpretive researchers “read” evidence analytically from a variety of sources “across” the experienced reality of the situation under study (whether rendered in literal texts or, analogously, in acts and/or physical artifacts, historical or current), to assess meaning-making around a particular idea, concept, or controversy’ (2012, p. 86).

I started my research at the national control center of the Dutch railways – the Operational Control Center Rail (OCCR) – a strategically situated site (Marcus, 1995) where the different railway organizations are located together in one place to manage breakdowns in the railway system. Thus, from the OCCR I was able to make myself familiar with different understandings on how organizational actors coped with complexity. In first instance I saw the OCCR as my ‘home station’ from which I was able to explore what other kinds of sites were useful to study. After about the first half year, I found that one recurring issue was the relationship between the OCCR and regional control posts. Whereas the OCCR was established as a national coordination center taking charge during large disruptions, in practice this was often deemed difficult since they were still dependent on information that had to be communicated from the bottom up (i.e. from the regional posts). I thus gained access to a regional control post to understand this relationship better and to study how actors cope with complexity from this specific perspective. Similarly, after more than a year at different control centers I came to realize that I had a limited view on a central subject of my study, namely breakdowns. This was especially surprising since my ‘assignment’ from ProRail was to study breakdowns, and they saw the control centers as the most useful sites for doing so. However, breakdowns from the perspective of the control rooms concerned a technical problem that coordinators or dispatchers would see on their computer screens, rather than an actual derailed train or broken railway switch with concrete consequences for operators as much as affecting passengers (see also chapter 7). I thus started the process of getting closer to the ‘actual’ breakdown by getting in touch with train drivers and the emergency service department to eventually continue my fieldwork at those sites.

The OCCR and the regional control rooms operate on a 24/7 basis. This meant that I tried to be in the field on various occasions. For example, I scheduled my visits in such a way that I would be able to observe the different shifts during the day (7am to 3pm, 3pm to 11pm, 11pm to 7am). Due to practical reasons this was sometimes difficult, and most of my visits happened roughly between 6am and 9pm. The busiest periods in terms of breakdowns were usually during rush hours (early morning and late afternoon), although
quieter moments were particularly useful to gain a better understanding of the mundane aspects of organizational life (see for example chapter 5 where I elaborate on the role of the kitchen during dinnertime). I also planned my visits dispersed in equal periods over the year, as the different seasons each had their own particular problems and types of breakdowns (e.g. summer storms, winter snow, slippery tracks in autumn).

A key challenge in my research concerns the fact that breakdowns are easy to miss. They unfortunately do not always present themselves so clearly beforehand and it is difficult to determine where to be at what time. Moreover, I was often dependent on train transportation, so during breakdowns it was sometimes particularly challenging to reach the site of the breakdowns. I was assigned a research coach at the OCCR, who turned out to be key informant and gatekeeper during the whole research. Since he was working at the OCCR he was ‘in the field’ more often than I was, and via WhatsApp we were regularly in touch to determine interesting moments to schedule the next visit. After several weeks I was also put on a mailing list of the OCCR, so I was updated four times a day on the status and evaluations of disruptions.

The main method of enquiry was, like most ethnographic studies, participant-observation, which can be described as ‘the fine art of hanging out – with a difference’ (Pader, 2006, p. 163): ‘hanging out’ by immersing oneself in the everydayness of the setting under study while looking for ‘patterns of behavior, artifacts, and knowledge that people have learned or created’ (Spradley, 1980, p. 86, emphasis in original). It thus asks for simultaneous moves of getting close to gain an insiders perspective while keeping academic and reflective distance (Ybema and Kamsteeg, 2009). Although I was not always able to fully participate – as the work of railway coordinators asks for a great deal of specific technical knowledge – I used the technique of shadowing (Czarniawska, 2007) to follow a specific informant during the course of his or her shift. This gave some structure to my observations and also enabled me to participate in the more mundane aspects of organizational life, such as joining meetings or enjoying lunch breaks together. Sometimes my role shifted from passive observer towards more active participation, for example when I was invited to organize workshops around specific disruptions or when someone asked me to take notes during the intake of an emergency call after an incident. In table 1 I have summarized the field visits I conducted during my study, where one visit could last as little as one hour to as long as ten. On average, I estimate each visit lasted around five to six hours.
<table>
<thead>
<tr>
<th>Research site</th>
<th>Number of field visits</th>
<th>Type of workers observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCCR</td>
<td>59</td>
<td>Traffic coordinator&lt;br&gt;Train and rolling stock coordinators&lt;br&gt;Incident coordinators&lt;br&gt;National coordinators&lt;br&gt;Travel information coordinators&lt;br&gt;Decision-making teams (in case of large disruptions)</td>
</tr>
<tr>
<td>Regional control and dispatching posts</td>
<td>32</td>
<td>Train dispatchers&lt;br&gt;Regional traffic coordinators&lt;br&gt;Information announcers&lt;br&gt;Team leaders</td>
</tr>
<tr>
<td>Train</td>
<td>11</td>
<td>Train drivers&lt;br&gt;Conductors</td>
</tr>
<tr>
<td>Incident and emergency post</td>
<td>22</td>
<td>Emergency service employees (emergency force)&lt;br&gt;Duty officers rail&lt;br&gt;Incident inspectors&lt;br&gt;Technical crew</td>
</tr>
<tr>
<td>Headquarters ProRail and NS</td>
<td>23</td>
<td>Managers&lt;br&gt;Staff&lt;br&gt;Consultants</td>
</tr>
<tr>
<td>Other</td>
<td>19</td>
<td>Participants at workshops&lt;br&gt;Attendees of general rail-related events</td>
</tr>
<tr>
<td>Total</td>
<td>166 visits</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. An overview of visits to the field

Since this study was conducted from a practice-based approach, an important question remains: how to observe practices? Nicolini (2009) provides ethnographers with some specific theoretical and methodological ‘lenses’ on how to zoom in on practices. Zooming in on practices is an effort to render them visible; practices do not just reside in organizations but they ‘need to be drawn to the fore... turned into an epistemic object’ (Nicolini, 2009, p. 1392). He argues this can be done by focusing on the diverse ways that actors perform their practice: focusing on the sayings and doings, the role of tools and materials, the goal of that particular practice, how actors improvise within the boundaries set by the practice, and how actors learn a practice and how it is made durable over time. Besides zooming in on practice, it is important to also ‘zoom out’ to ‘show panoramic views of the institutional
context, the historical background, power relations, and societal discourses’ (Ybema et al., 2009, p. 7). This zooming out movement aims to reveal how practices are interconnected. It is, for example, impossible to make clear where a practice stops or begins: is selling a shoe part of the same practice as producing the shoe, or not? Performances of a practice are thus consequential, and ‘zooming out’ is a way to uncover the ‘inter-connected nature... of practices and their connections’ (Nicolini, 2009, p. 1408).

One way to establish this ‘zooming out’ movement was done with the help of other ethnographic methods such as interviewing and document analysis. The documents I read, such as handbooks or manuals, were useful to help reflect on my observations from a wider perspective, mainly in terms of how work should be done (according to rules and procedures) and how it was practiced. I tried to pragmatically use these differences or oppositions, if there were any, to stimulate further probing into why this might be so. The reading and analysis of documents allowed to explore the meaning of a practice from different perspectives. Whilst a lot of the talking was already an indispensable part of the participant-observations (e.g. the informal chit-chats at the printer, during lunch breaks, or in the hallways), I also conducted 35 more formally organized interviews (see table 2 for an overview). All interviews were recorded and transcribed verbatim, with the interviews lasting between 43 to 148 minutes.

<table>
<thead>
<tr>
<th>Number of interviews</th>
<th>Function/job</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>OCCR coordinators</td>
</tr>
<tr>
<td>4</td>
<td>OCCR managers</td>
</tr>
<tr>
<td>2</td>
<td>OCCR consultants</td>
</tr>
<tr>
<td>10</td>
<td>Train dispatchers</td>
</tr>
<tr>
<td>6</td>
<td>Incident and emergency crew</td>
</tr>
<tr>
<td>6</td>
<td>Others</td>
</tr>
<tr>
<td>35</td>
<td><strong>Total number of interviews</strong></td>
</tr>
</tbody>
</table>

*Table 2. Overview of interviews conducted*

There were two main reasons why I chose to use interviewing as an additional ethnographic method. First, although an important rationale behind an ethnographic study is to observe people in their ‘natural’ environment while practicing unreflectively without
being too much aware of the researcher, it also proved useful to sometimes ask informants for a more reflective stance. The interview setting – being agreed beforehand, without much distraction from others or work-related tasks, and in a private environment allowing informants to speak freely – was used to consciously dig deeper around certain phenomena or themes. Moreover, interviewing was a way to gain better access to, what Tomkins and Eatough (2013) call ‘the feel of experience’ to explore how people experience work. Second, I saw the interviews as an opportunity to engage in member checking. I usually organized the interviews in a semi-structured way and included those themes I found particularly interesting or controversial. I would then share some observations and thoughts, which often triggered exploring these themes from different perspectives. In the end, although the interview data sometimes challenged my interpretations, I believe it grounded my empirical data and interpretations more firmly to reflect the experiences of railway employees.

1.4 Travelling through the dissertation

Since this dissertation is paper-based (i.e. all the individual chapters are based on papers that are or are about to be submitted to a journal to consider for publication), I would now like to give a brief overview of how the rest of this book is structured. Below, I summarize the main arguments of each chapter to give a succinct idea of how the individual chapters are linked to the broader argument. Moreover, at the start of each empirical chapter I will briefly summarize how each individual chapter relates to the main research question.

Chapter 2 establishes the theoretical lens for the empirical core of the book. In it, the notion of ‘complexity’, often used to define system breakdowns or infrastructures, will be further scrutinized. I argue that the management of complexity can be seen as an attempt to simplify an indeterminate and dynamic world, something that, *ipso facto*, can be considered an *oxymoron* (Chia, 1998). Situations themselves are not complex. To say that something is complex means to say that our knowledge about that something is incomplete and that we cannot fully grasp it. Thus, coping with complexity through representational ‘maps’ (e.g. performance indicators, architectural design, procedures and protocols) involves the danger of mistaking the representations of the world for the actual world (mistaking the map for the territory). We use such techniques as a way to cut up and categorize an otherwise complex and holistic world and, while doing so, forget that they are nothing more and nothing less than representations of that world: it is similar to ‘eating the menu card instead of the dinner’
The chapter concludes by presenting this map-territory relation as a metaphor through which the rest of the dissertation can be read.

In **chapter 3** I zoom in on what coping with complexity from within the territory entails. The chapter is based on a study I conducted at one of the regional control posts of ProRail, and investigates the work of train dispatchers. What became apparent during the study was the implicit knowledge that dispatchers drew on in doing their work skillfully. To investigate this ‘invisible’ knowledge I used the literature on embodiment to make sense of dispatching practices. The most promising way to study these aspects of knowledge was in the context of the master-apprentice relationship between new and senior dispatchers. I studied how apprentices learned their work ‘on the job’, as it was in these moments that the largely tacit and embodied knowledge residing in practices had to be articulated more clearly. Using the phenomenology of Merleau-Ponty (1945/2012) and Heidegger (1926/1996), this chapter explores how knowledge does not reside in minds or procedures and training modules alone, but is intricately bound up with the actual and material aspects of the railway infrastructure.

From within the territory, then, dispatchers cope with the complexity of routine breakdowns by bringing their bodies and senses in tune with practical situations and perturbations in their environment. Complexity, from this perspective, is not represented in rules and procedures but is dealt with in practice through the many different aspects of railway knowledge that dispatchers gathered through years of experience.

Whereas chapter 3 focuses on several general dynamics that describe how train dispatchers deal with complexity, **chapter 4** explores these dynamics further by zooming in on one specific case: the decision-making procedures of railway coordinators during a severe winter storm. As argued earlier, from the perspective of the storm as a ‘dramatic disaster’ it would be reasonable to study, for instance, the flows of information and communication in the days preceding the storm. In a retrospective way, questions could be asked concerning who the central actors were in the decision-making process, why some cues in the environment and changing weather circumstances were picked up while others were ignored, to eventually come to the conclusion whether or not the right decision was made and how this should inform future conduct. An ethnographic approach, however, treats the severe winter storm not as a case of a ‘dramatic disaster’ but as an informative example of a ‘daily disruption’. Following a team of coordinators, this chapter unravels how the storm – as a potential breakdown – was made sense of with the help of representational devices such as a weather matrix and decision-tree. The data in this chapter provide a clear example of
how I try to understand infrastructure in this book: the storm is not a breakdown as a one-off occurrence, but it is the potentiality of the storm as a breakdown and the ambiguity of its cues that disrupts the infrastructure. Coping with such forms of complexity from within the territory shows that this does not merely involve ‘rational’ questions concerning the probability or the precise details of the breakdown, but it involves a continuous struggle to keep the infrastructure available as long as it is possible to do so safely. Thus, taking the potentiality of a breakdown as a starting point rather than considering the breakdown after the fact, sensemaking can be understood differently than the attempt to rationalize and restore order in a disorderly world: it may sometimes be very functional for the infrastructure to keep a potential breakdown ambiguous.

Chapter 5 looks at how the ‘complexity’ of the railway world is being dealt with managerially. The work of employees in the organizations, being largely tacit as explained in chapter 3, is controlled through a great deal of representational tools such as plans, procedures, or performance indicators. I zoom in on the performance indicator ‘punctuality’, as this proved a valuable case in point to illustrate how the complexity of coordination practices was managed. In the OCCR, the indicator punctuality was ‘materialized’ on several enormous video walls, thereby acting as a continuous gaze controlling the work of coordinators. What became most apparent during this study were the following two things: i) ProRail deals with the complexity of a punctual train service by means of indicators in order to map and ‘cut up’ the interrelated aspects of coordination practices, thereby making tacit knowledge more measurable and observable; and ii) this map-making is performative (i.e. the territory is increasingly brought in line with the map) in the sense that it changes coordination practices in crucial and sometimes unintended ways, something that was resisted by the coordinators in an attempt to safeguard their professional values. The chapter shows how coping with complexity through representations has consequences for how the infrastructure operates. Moreover, by zooming in on how coordinators resisted the unwanted consequences, this chapter argues that work is to be understood as an entanglement of human and non-human actors: how punctuality emerges is an effect of the human and the material world (i.e. the indicator) interfering with each other.

To further understand such entanglements between social and material worlds, chapter 6 zooms in on the OCCR from an explicit spatial perspective. Following several disruptive events at the beginning of this century, it became apparent that it was necessary
to improve and intensify collaboration between the different railway organizations that are responsible for the management of breakdowns in the railway infrastructure. This chapter is concerned with how ideas of better inter-organizational collaboration were ‘mapped out’ in the spatial design of the building of the co-located OCCR and how this collaboration developed in practice. Hitherto, the literature on co-located buildings remains ambiguous in explaining if and how a reduction in physical distance leads to increased collaborative efforts. The findings presented in this chapter show how OCCR employees developed several territorial practices through which they resisted the design of the control center. Through these practices, employees produced the space of the control center as ‘dis-located’ rather than co-located. Like the previous chapter, this chapter also shows how attempts to reduce perceived complexity through representations are performative and, in a sense, produce complexity. The clear and well-thought-out plans and designs of the spatial ‘map’ of the OCCR is not a neutral idea but has actual and, to a certain extent, unintended consequences.

In chapter 7 one of the unfortunately more ‘routine’ incidents on the Dutch railways is explored: railroad suicides. On average, this happens every other day. The chapter discusses how the different actors of the railway organizations deal with such incidents. Whereas the previous chapters all focused on how coping with complexity in breakdowns occurs at one specific site, this chapter explores breakdowns as a matter of a disruption of the system. Empirically speaking, it ‘follows’ a suicide to see how it travels from site to site through the railway system. The chapter looks at how suicides are experienced ‘in the territory’ by train drivers who see it happen and emergency service responders who have to clean up the body. But also from a distance there is also a lot of coordination work involved from the many control centers. These employees see, literally, another kind of suicide: the dead body becomes a disruption that is represented on the lines on their computer screens. They see a performance indicator saying a suicide should be handled within 130 minutes, while the emergency services in the territory are dealing with missing body parts, blood-covered tracks, or upset passengers. The chapter looks at what happens when these two worlds meet in handling breakdowns. The lifeless body on the railroad tracks is not just an unfortunate event that disrupts the order of daily operations for a moment, but railroad suicides define what infrastructure is in more crucial ways: it shows how a suicide is a complex event that triggers and disrupts the system at large, how much organizing work it takes to restore order, and that this process will most likely recur the next day.
Chapter 8, the last chapter of the dissertation, discusses the empirical chapters in light of the theoretical framework. I will argue that attempts to deal with complexity by means of simplification works only partially: the empirical chapters all show that such attempts, ironically, also introduce new kinds of complexity. I analyze the findings by once again turning to the idea that the map is not the territory that it represents, and give three different scenarios of how we can understand the map-territory relationship in the context of coping with complexity in infrastructure breakdowns. To this end, I will formulate an alternative reading for how we can look at complexity in infrastructure breakdowns: rather than seeing complexity as a Monster to tame or a Mess to tidy, in this chapter I explore possibilities of befriending Monsters and embracing Mess. In the conclusion, several theoretical and practical implications are drawn, and I will end the chapter by providing future research suggestions to extend and refine the insights of this dissertation.

1.5 Chapter background and some more

The empirical chapters in this dissertation are based on papers that have been or are about to be submitted to international, peer-reviewed journals and to several conference proceedings and presentations for academics as well as practitioners. Below I will give a succinct overview of the background of this output, as well as several other activities that were conducted during the PhD project but that are not a part of this dissertation. The empirical chapters, except for chapter 3, have been co-authored and were thus originally written in the ‘we-form’. However, to maintain the flow and focus of this dissertation I have chosen to use the ‘I/me-form’ in all chapters. For three out of the four co-authored chapters in this dissertation I was the first author and I took the lead in both the research and writing process. For chapter 4, based on a paper we wrote with our whole research group, I was the second author. However, the data for this chapter are based on my research and I took the lead in writing the methodological and empirical parts while co-authoring the other parts. As the chapters are paper-based, some parts of the individual chapters may seem repetitive (especially the methodological parts). However, each chapter has a specific focus, so I have decided to keep the structure of the chapters in line with the requirements of journals.
Chapter 2

Chapter 3

Chapter 4

Chapter 5
- Presented at: 3rd Ethnography Workshop, January 2015, Lyon, France.
- Presented at: 30th EGOS Colloquium: Reimagining, Rethinking, Reshaping: Organizational Scholarship in Unsettled Times, July 3-5 2014, Rotterdam, Netherlands.
Chapter 6
Willems T. and Van Marrewijk, A. (2017) Building collaboration? From co-location to dislocation, an ethnographic study in a railway control center. Manuscript accepted for Special Issue on Sociomateriality at Revista de Administração de Empresas.

- Presented at: 9th Annual Ethnography Symposium, August 27-29 2014, Ipswich, United Kingdom.

Chapter 7

- Accepted for 33rd EGOS Colloquium: The Good Organization: Aspirations, Interventions, Struggles, July 6-8, 2017, Copenhagen, Denmark
- Presented at: 8th International Process Symposium: Dualities, Dialectics and Paradoxes in Organizational Life, June 16-18 2016, Corfu, Greece.

Other academic output:


**Practical output:**

Workshop ProRail: Evaluation of 19 February Railroad Switch Incidents, November 13 2014, Utrecht, Netherlands


**Blogs for Graduate School VU University:**
Dealing with the review process: The artist and the PhD (2016).

A plea for boring research (and how to make it interesting) (2015).
https://socializingsciencevu.com/2015/11/17/a-plea-for-boring-research-and-how-to-make-it-interesting/

Doubting with the stars – Why doubt is actually constructive for your project (2014).

**Organization:**
Co-organized the 4\(^{th}\) Ethnography Workshop at VU University, in collaboration with EMLYON Business School and Cardiff Business School, April 14-15 2015, Amsterdam, Netherlands.

**Research Funding:**
Research grant Project Management Institute (2015): Learning from inter-organizational collaboration in projects. Awarded: $25,000

Study on inter-project learning at the municipality of Rotterdam (2015). Co-authored research proposal and conducted 10 interviews. Awarded: €10,000