The performativity of risk management frameworks and technologies: the translation of uncertainties into pure and impure risks

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Abstract

This article examines the long-term dynamics among a best-practice risk management framework, risk management technologies and the translation of uncertainties into risks by using a longitudinal case study of a large mega-project. We show that the framework and technologies through the visual power of inscriptions and the purifying work of risk consultants as experts establish the boundaries of the forms of uncertainties that are accepted and included as risks. We term the accepted and included risks 'pure risks' and the risks excluded after disagreement 'impure risks'. We also show that the construction of impure risks challenges the predictions of the framework causing a false sense of security for the project objectives, and that the continuous readjustment of technologies, in particular, is necessary to ensure the long-term realisation of these predictions. Finally, this article contributes to the literature on performativity by showing how technologies serve as buffers to shield failing economic frameworks against criticism.

Keywords: risk management, uncertainty, performativity, purification, inscriptions, visualisation

1. Introduction

Over the last three decades, the concept of risk management has become increasingly important for governments and companies alike, transforming the management of organisations and influencing everyday work routines (Hayne & Free, 2014; Kaplan et al., 2009; Power, 2016b). One of the latest developments has been the worldwide application of risk management frameworks and technologies to the management of mega-projects in the public sector. Such projects have acquired an infamy borne from their tendency to go both over time and over budget (Flyvbjerg et al., 2002; Flyvbjerg et al., 2003). As one attempt to temper this tendency, governments have increasingly turned to insisting that risk management frameworks and associated technologies form part of the project management process. So far, however, we know little of the long-term dynamics of such frameworks and technologies (Jordan et al., 2016). How do they help represent and organise 'the work of risk' (Power, 2016a, p. 276)? To what extent do they assist with the broader objective of curbing the years of cost overruns on projects?

This article examines the long-term dynamics of risk management frameworks and technologies related to the translation of uncertainties into risks. Our study is informed by Michel Callon's performativity thesis (Callon, 1998c, 2007; Callon et al., 2009) and Bruno Latour's conceptual work on purification and inscriptions (Latour, 1986, 1987, 1993). The performativity thesis argues that theories, frameworks and technologies produce the worlds that they describe (Callon, 1998b). This concept allows us to approach the construction of risks as the process of making risks more like the prescription of frameworks and technologies. It also allows us to approach the construction of risks as a process in which frameworks and technologies themselves interact with other actors and undergo change. This article thus represents one of the few performativity studies to describe the efforts over time associated with actual-

ising *and* re-actualising an (economic) framework. It contributes to the current debate on risk management frameworks and technologies (Hall & Fernando, 2016; Jordan et al., 2013, 2016; Kalthoff, 2005, 2011; Miller et al., 2008; Power, 2009; Vinnari & Skærbæk, 2014) by revealing the long-term complex dynamics of these for the work of translating uncertainties into risks.

The article also contributes to extant studies on risk experts (Arena et al., 2010; Mikes, 2011) and the visual nature of accounting inscriptions (Busco & Quattrone, 2015, 2017; Jordan et al., 2016; Pollock & D'Adderio, 2012; Quattrone, 2009). We make this contribution by showing the long-term effects of the experts' attempt to define the boundaries of risk construction using a series of interrelated risk management technologies. These technologies enable the production of inscriptions that visualise the criteria for the construction of risks and perform the cognitive boundaries of the risk management participants (Latour, 1986). These inscriptions frame the visual performable space of the practice (Busco & Quattrone, 2015), but a visual performable space that also distorts performance and leads to endless reframing efforts in 'a continuous process of search for perfection' (Busco & Quattrone, 2017, p. 16). Because 'perfection' has already been pre-defined by the framework being relied on, however, this continuous search becomes one in which experts exclude all 'imperfect' representations of risks.

Our study is based on a longitudinal case study of risk management in Denmark. We report findings from the Signalling Programme, a 3.2-billion-euro programme of replacing all railway signalling systems across Denmark. The Signalling Programme is one of the largest and most expensive public projects in recent Danish history. Our overarching interest in this project stemmed from it being the first attempt in Denmark to implement contemporary best-

practice risk management on a large public infrastructure project (Transportministeriet, 2008). It relies on the part of the Project Management Institute's Body of Knowledge framework that concerns risk management, which approximately 40 per cent of all organisations across countries, sectors and industries apply to manage projects (PwC, 2012). Integral to the Signalling Programme is an ambitious and comprehensive IT-based risk management control system. This system combines a series of risk management technologies, including a risk matrix/map, a risk register, as well as Monte Carlo simulations. The Signalling Programme offers a fascinating case through which to study the performativity of risk management frameworks and technologies.

The rest of the article is organised as follows. Section 2 reprises the accounting literature on risk management, with a focus on frameworks, technologies and the construction of risks. Section 3 outlines Michel Callon's performativity thesis and introduces Bruno Latour's conceptual work on purification and inscriptions. In Section 4, we describe our research method. Section 5 presents our case material, which we divide into a range of subsections. Section 6 discusses the implications of our findings and Section 7 concludes the article.

2. Frameworks, technologies and risk construction

In light of the proliferation of risk management, the literature has looked into risk management frameworks, the technologies they promote and the everyday risk work practices. In broad terms, best-practice risk management frameworks, such as COSO ERM or Project Management Institute's Body of Knowledge (PMBOK), build on the promise that organisations adopting them to manage uncertainties will achieve a reasonable assurance regarding the

achievement of their objectives (Power, 2007; Raz & Hillson, 2005).[1] In that respect, the literature has challenged this promise by showing that best-practice risk management frameworks might limit the ability to manage the full range of uncertainties. Miller, Kurunmäki and O'Leary (2008) argue that such frameworks neglect the wider hybrid practices, processes and expertise through which much of the management of uncertainty takes place. Power (2009) supports this view when he argues that the security provided by such frameworks, at best, is limited to certain states of the world and, at worst, is illusory – 'the risk management of nothing' (p. 849).

To elaborate more on these findings, Power (2004, 2007) challenges the conception that risk management should be about operational risk reduction. He argues that the primary purpose of risk management could be to protect the reputation of the organisation against ex post accusations, what he terms secondary risk management. Power et al. (2009, p. 302) argue that 'the adoption of standardized risk management designs has become a benchmark of being a legitimate organization'. Jordan, Jørgensen and Mitterhofer (2013) contribute to that debate by examining the perceived usefulness of the traffic-light-coloured risk matrix for the everyday management of risks. They find that the risk matrix comes to act as a "mediating instrument" (Miller & O'Leary, 2007) which has less to do 'with the increased attention toward early warning signals' (Jordan et al., 2013, p. 156), that is, with operational risk management, and more to do with the adjudication of interests and the building of mutual assurance and confidence.

In examining how the different purposes of risk management affect risk-related work, the literature points to the role of risk management technologies. Jordan, Mitterhofer and Jørgen-

[1] This paper takes a similar approach to risk and uncertainty as prior accounting studies (Arena et al., 2010; Boholm & Corvellec, 2016; Miller et al., 2008) by defining uncertainties as the things we know we do not know and risks as those uncertainties that have been made the object of calculative practices (Callon et al., 2009).

sen (2016) argue that the risk matrix shapes risk work because of its semantic connotations and visual appeal, 'by means of which complex and potentially not well understood processes come to appear simple, imaginable and "manageable"' (p. 1). Hall and Fernando (2016) show that the layout and structure of visual templates for risk assessment can change the focus of risk management to solely complying with codified procedures. Kalthoff (2005, 2011) shows that companies are constituted anew through devices of risk calculation. These findings add to the broader debate on the visual power of technologies for framing the visual performable space of practice (Busco & Quattrone, 2015; Justesen & Mouritsen, 2009; Quattrone, 2009). It has further been shown that such visualisations generates creative tensions that prompts for a continuous search for perfection (Busco & Quattrone, 2017). Pollock and D'Adderio (2012) even show how two-by-two matrices are used selectively to produce a 'beautiful picture'.

Scholars have also examined the work of risk experts in shaping the trajectories of risk management practices. Arena et al. (2010) show that experts promote certain risk rationalities, but also that these rationalities clash with pre-existing management rationales. Mikes (2009) finds that management predilections toward risk assessment are contingent on what she terms calculative cultures. Some organisations dedicate themselves to measurement and modelling and thereby exhibit a culture of quantitative scepticism, while others rely on experience, intuition and judgment and thus exhibit a culture of quantitative scepticism. Mikes (2011) further elaborates on the causes of these cultural trajectories and points to the rhetorical work of experts for segregating the work practices of risk management from other competing and/or complementary fields of expertise. She highlights, among other, the reflexive work of 'facilitating the creation and internalization of a specific type of [legitimate] risk talk' (2016, p. 272).

In summary, the current literature has shown that organisations have come to rely on best-practice risk management frameworks, which, through technologies and the work of experts, come to affect the work practices of constructing and managing risks. It remains largely unknown, however, how organisations translate specific uncertainties into risks and how frameworks and technologies affect – and might be affected *by* – such construction processes over time. It also remains largely unknown how mutual purposes of risk management develop and interrelate over time, particularly how such multiple purposes relate to the visual power of technologies and the work of risk experts. Scholars have therefore also called for further research into 'risk matrices and related risk representation technologies' (Jordan et al., 2016, p. 20) and the relationship between technologies and the everyday 'risk-work' (Power, 2016a).

3. Callon's performativity thesis and the concepts of purification and inscriptions

To make sense of the dynamics of risk management, we rely on Michel Callon's performativity thesis (Callon, 1998c, 2007; Callon et al., 2009) and Bruno Latour's conceptual work on purification and inscriptions (Latour, 1986, 1987, 1993). Callon's performativity thesis posits as a starting point that economics (or a statement in general) 'performs, shapes and formats the economy, rather than observing how it functions' (Callon, 1998b, p. 2). In contrast to earlier perspectives on performativity, which stress the linguistics of performative utterances (Austin, 1962) and their socio-cultural contexts (Bourdieu, 1998; Butler, 2010), Callon stresses the importance of material assemblages (Callon, 2005, 2007). MacKenzie (2006), for example, demonstrated that when financial traders came to perform market prices, besides establishing certain beliefs and relations, this performation was caused by the 'incorporation [of theories] into algorithms, procedures, routines, and material devices' (p. 19).

To elaborate on the performativity thesis, Callon proposes the intertwined concepts of *framing* and *overflowing* (Callon, 1998a). To define framing, Callon relies on Goffman's (1974) concept of frameworks: 'The frame establishes a boundary within which interactions… take place more or less independently of their surrounding context' (Callon, 1998a, p. 249). Callon, again referring to Goffman, further stresses the dual nature of the framing process. On the one hand, the frame 'presupposes actors who are bringing to bear cognitive resources as well as forms of behaviour and strategies which have been shaped and structured by previous experience' (1998a, p. 249). On the other hand, interactions do not only depend on the commitment of the actors themselves, but are also rooted in the outside world in various physical and organisational devices which are themselves contained 'within an institutional framework… which helps to ensure their preservation and reproduction' (1998a, p. 249). In relation to performativity, framing thus directs attention to the ways in which human as well as non-human actors are adjusted and readjusted – or what Ferraro, Pfeffer and Sutton (2005) describe as the linguistic, organisational and technological conditions created to make theories 'come true'.

Callon (1998a) introduces the concept of overflowing to define connections which transgress the boundaries of the frame and affect actors 'who [either] benefit or suffer' from them (p. 256). In MacKenzie's (2006) terms, overflowing corresponds to the concept of counter-performativity: 'the use of a theory or model making economic processes *less* like their depiction by economics' (p. 56). In contrast to economists, who define overflowing as accidents – the unfortunate by-product of economic activities – Callon (1998a) considers overflowing 'the rule' and thereby framing the 'fragile, artificial result based upon substantial investments' (p. 252). Callon (1998a) further argues that overflows are caused by the very same elements which make up the framing process and that 'without this incompleteness, [the frame] would in fact be wholly ineffectual' (p. 252). Overflowing represents openings onto wider networks

to which they give access, which to some degree destabilises the framing process but without which 'it would not be feasible to add value locally' (p. 255). Overflowing thus directs attention to the often-unexpected dynamics of making theories 'come true'.

Technologies, which are among the elements that make up the framing-overflowing process, are active mediators that can 'transform, translate, distort, and modify the meaning or the elements they are supposed to carry' (Latour, 2005, p. 39). This means that technologies designed to realise a statement can cause 'other worlds to proliferate in reaction to that performation' (Callon, 2007, p. 323). They possess no inherent properties but are 'caught in a process of coevolution' (Callon, 2007, p. 329): they are 'not the source of an action but the moving target of a vast array of entities swarming toward it' (Latour, 2005, p. 46). In so far as they also produce visual representations of locale entities, like figures, matrices, diagrams and maps; they are further *inscription* devices (Latour & Woolgar, 1979). Such devices are particularly powerful because they enable the mobilisation of an even larger number of potential new allies and because they perform the cognition of human actors (Latour, 1986, 1987).

The concept of *purification* refers to the active processes of turning statements or ideas that were once controversial or devalued into acceptable and unchallenged constructions or facts (Latour, 1993) and thus relates to the performativity thesis. This concept has the benefit of emphasising the active translation work of experts to 'provide faith to accounting systems and to settle controversies with sceptical and resisting groups' (Christensen & Skærbæk, 2010, p. 524). Power (2003) has emphasised that purification might only suppress controversies – that experts might not actually settle them – which resembles what Callon (1998a, p. 262) terms hot situations, where even experts 'can do nothing' and are 'forced to deal with non-specialists'. In contrast, Callon (1998a) introduces the concept of cold situations to describe

situations in which experts can be called on, and agreement regarding ongoing overflows can be swiftly achieved. In both hot and cold situations, however, a flow of adjustments is necessary to continuously reframe overflows and ensure the performativity of the theory/statement.

In this article, we draw on the performativity thesis to examine how a best-practice risk management framework becomes part of the practice it facilitates – or more specifically how technologies, humans and other elements are configured and reconfigured over time to actualise the predictions of the framework. The concepts of framing and overflowing highlight the complex, long-term dynamics and unexpected effects of translating uncertainties into risks, while the concepts of purification and inscription enable us to examine the work of experts and the visual power of technologies more specifically. In summary, we are guided by the following question: How are uncertainties translated into risks, and what is the role and effect of risk management frameworks and technologies, particularly over long periods of time?

4. Method

This article continues along the path of 'telling interesting stories' (Law, 2009, p. 142) by drawing on an empirical case study (Latour, 2005). The case study method allows us to trace the relations and dynamics between the human and non-human actors involved in the construction of risks. In the words of Latour (1996), this method allows us to describe the 'generative path of any narration' (p. 374) and thus to track the associating work of actors 'to catch up with their often wild innovations' (Latour, 2005, p. 12). As mentioned earlier, we examine the Danish 3.2-billion-euro mega-project called the Signalling Programme. We have followed the Signalling Programme for approximately 12 years, from 2005, when the project started, to 2017, when a seven-year-minimum delay was announced.

We use a collection of documents, observation studies and semi-structured interviews as our main empirical sources. The documents comprise more than 160 written documents totalling more than 1,000 pages, of which the oldest documents date back to the late 1990s, when discussion of risk management emerged within the Danish public sector. The documents include investment and decision reports, project and risk status reports, consultancy reports, investment proposals, government white papers, meeting agendas, lists of risks and more. The first author also had full access to the IT-based system, which was where risk information was kept; collected conference presentation materials; and maintained email correspondences with key actors of the practice. In sum, this empirical source enabled us to reconstruct the actions and events that make up the project and to understand the forms of uncertainties that was constructed and approved as risks and included into formal risk status reports.

To more fully understand what takes place during the *process* of translating uncertainties into risks, we also rely on observation studies. The first author carried out 41 observation studies for approximately four years from mid-2010 to mid-2014. The observations allowed us to follow the actors 'in action' (Latour, 2005, p. 128) while the participants were constructing the actual risks and to witness the controversies that arose during this process. The observation studies were carried out at various types of risk meetings and workshops, which were where the majority of the risks were identified and assessed. Table 1 lists the observation studies. More than 70 different human actors were observed – including risk consultants, project managers, the programme director, suppliers and more – constructing approximately 530 risks. Observations of everyday work practices among project and operational managers were also undertaken, but we discontinued these observations, as the managers spent little time on risk-related work tasks relative to other tasks. The observation studies were organised as non-

participant studies. More than 300 pages of extensive field notes were taken during the four-year period.

Table 1: Observation Studies

#	Type*	Year	#	Type	Year
O-1	Risk Meeting	2010	O-22	Risk Forum	2013
O-2	Risk Meeting	2010	O-23	Risk Sharing Meeting	2013
O-3	Risk Meeting	2010	O-24	Risk Forum	2013
O-4	Risk Meeting	2010	O-25	Risk Approval Meeting	2013
O-5	Risk Meeting	2010	O-26	Risk Approval Meeting	2013
O-6	Risk Meeting	2011	O-27	Risk Status Meeting	2013
O-7	Risk Meeting	2011	O-28	Risk Meeting	2013
O-8	Cross Risk Review Meeting	2011	O-29	Risk Status Meeting	2014
O-9	Risk Meeting	2011	O-30	Risk Meeting	2014
O-10	Risk Meeting	2011	O-31	Risk Status Meeting	2014
O-11	Risk Meeting	2011	O-32	Risk Meeting	2014
O-12	Risk Meeting	2011	O-33	Risk Meeting	2014
O-13	Risk Meeting	2012	O-34	Risk Meeting	2014
O-14	Risk Meeting	2012	O-35	Risk Forum	2014
O-15	Risk Workshop	2012	O-36	Risk Forum	2014
O-16	Risk Meeting	2012	O-37	Cross Risk Review Meeting	2014
O-17	Risk Meeting	2012	O-38	Risk Meeting	2014
O-18	Risk Workshop	2012	O-39	Risk Meeting	2014
O-19	Risk Meeting	2013	O-40	Risk Meeting	2014
O-20	Risk Forum	2013	O-41	Risk Forum	2014
O-21	Risk Meeting	2013			

** Risk Forums are status meetings held among the risk consultants of the practice.*

Our final data collection technique was to conduct 24 interviews with actors like risk consultants, the programme director, civil servants and project managers. The purpose of the interviews was to get an understanding of the actions and events of the project and the work practice of managing risks from different perspectives. In specific cases, the purpose was also to get feedback from the observed meetings concerning controversies, debates and the like. The interviews were semi-structured, which allowed the interviewees to provide their own accounts of whatever they found relevant while (mostly) staying within the subject of risk management. As the interviews had no predefined length, the interviewees had time to communi-

cate their own understanding of risk management, as well as to follow their own ideas and express their own frustrations for as long as they wanted. Each interview typically lasted between one and two hours and was recorded and transcribed. The interviewees were also given the opportunity to receive the transcript afterwards, to allow them to validate the content and which enabled us to formulate follow-up questions. Table 2 comprises a list of the interview participants.

Table 2: Interview participants*

#	Title	Affiliation	Year
I-1	Risk Manager	Signalling Programme	2010
I-2	Senior Risk Consultant	Consultancy Company X	2010
I-3	Head Project Manager	Signalling Programme	2010
I-4	Programme Director	Signalling Programme	2010
I-5	Civil Servant	Ministry of Transport	2010
I-6	Head Project Manager	Signalling Programme	2010
I-7	Senior Project Consultant	Consultancy Company Y	2011
I-8	Head of Finance	Signalling Programme	2011
I-9	Project Manager	Signalling Programme	2011
I-10	Budget Consultant	Consultancy Company Z	2012
I-11	Head of Safety	Rail Net Denmark	2012
I-12	Senior Risk Consultant	Consultancy Company X	2012
I-13	Civil Servant	Ministry of Transport	2012
I-14	Civil Servant	Ministry of Transport	2012
I-15	Risk Manager	Train Operating Company	2013
I-16	Risk Consultant	Consultancy Company X	2014
I-17	Project Manager	Rail Net Denmark	2014
I-18	Head of Secretariat	Signalling Programme	2014
I-19	Governance Manager	Consultancy Company Q	2014
I-20	Risk Consultant	Consultancy Company X	2016
I-21	Senior Risk Consultant	Consultancy Company X	2016
I-22	Risk Consultant	Consultancy Company X	2016
I-23	Consultant, Owner (Former Programme Director)	Consultancy Company W	2017
I-24	Program Risk Manager	Rail Net Denmark	2017

** The titles and affiliations reflect those held at the time we conducted the interviews.*

In summary, the three techniques allowed us to trace the human and non-human actors that circulated the practice of risk management and to cross-validate our findings (Latour, 2005, p.

129). These actors were neither preselected nor predefined when we began the examination, but included based on our network tracing only the actors who (or that) did something: the mediators. This tracing included both human actors, such as the project managers, and non-human actors, such as the IT-based system. This choice made it possible for us as observers to remain faithful to Callon's (1986) three methodological principles: agnosticism (that we as analysts should remain impartial), generalised symmetry (that we explain conflicting viewpoints in the same terms) and free associations (that we allow actors equal opportunities to express their own conclusions) (Callon, 1986, pp. 200-201). In accordance with these principles, we listened to the actors first and sought not to privilege any viewpoints; then, together with the other sources, we reconstructed the actions and events as they unfolded.

5. The performativity of risk management

This section presents our case material. It begins with an examination of the broader network of relations that brought the Signalling Programme into existence and the major actions and events that make up the risk management practice. It then continues by telling the story of the dynamics associated with making the translation of uncertainties of risks more like the predictions of the implemented framework and technologies. It ends with a short epilogue.

5.1. The Signalling Programme and its risk management practice

In February 2009, the Signalling Programme came into being when the Danish Parliament decided to grant 3.2 billion euros to Rail Net Denmark (the state-owned organisation that manages the railways infrastructure) to replace all existing signalling systems (Transportministeriet, 2009). Rail Net Denmark had recommended the total replacement of all signalling systems by 2020–21 with two new dedicated, state-of-the-art ones. It was a 'rock solid business case if you want train operations', as the programme director explained (#I-4), with 'sub-

stantial economical and operational benefits' (Banedanmark, 2009, p. 10). The Signalling Programme was established, with its own separate project organisation managed by a programme director. It was further divided into seven subprojects and a series of support functions, including risk management. It employs 120 persons on average, about one-third of whom are full-time employees and two-thirds of whom are consultants (Banedanmark, 2008a). The Danish Ministry of Transport (MoT) monitors the project and reports progress to the Parliament's Transport Committee.

The Signalling Programme was the first large Danish public construction project subjected to a formal requirement of risk management (Transportministeriet, 2006, 2008). In 2006, the Danish Ministry of Finance (MoF) found that large Danish public-sector construction projects ended up with cost overruns of 29 per cent, on average, due to inadequate budget and control practices (Finansministeriet, 2006). The MoF consequently decided to reform these practices, starting with large projects within the jurisdiction of the MoT. This modernisation programme came to be known as the New Budgeting Method and introduced, among other elements, the requirement that organisations carrying out large projects had to implement risk management arrangements to ensure that project objectives would be met (Transportministeriet, 2006, 2008). The MoF also mobilised Professor Bent Flyvbjerg's work on reference class forecasting, which the British government had implemented a few years before (Finansministeriet, 2006). The Danish Parliament endorsed the New Budgeting Method on October 24, 2006, which was two days before it approved the Signalling Programme for more detailed project planning.

Rail Net Denmark operationalised risk management (Banedanmark, 2008a) in the period between October 2006 and December 2008. The National Audit Office (NAOD) had only a few

years earlier criticised Rail Net Denmark's management accounting and risk management practices (Rigsrevisionen, 2002, 2004, 2005). Rail Net Denmark therefore contracted Rambøll A/S, which was part of a larger consultancy conglomerate on the project, to assist them (Banedanmark, 2008a). In guiding this operationalisation, Rambøll and Rail Net Denmark relied on the PMBOK framework. The PMBOK stresses the traditional best-practice generic processes of risk management, which included a series of tools and techniques to support these processes (see PMI, 2004, Chapter 11). Consistent with PMBOK, Rambøll also developed a risk management plan and an IT-based risk management control system (Banedanmark, 2008b). In February 2009, with the approval of the project's proposal, the Danish Parliament also approved the operationalisation of risk management (Transportministeriet, 2009). Later that year, Rambøll organised the first risk workshops and meetings with project-related actors.

In the years between 2010 and 2015, Rambøll established regular risk meetings with the project and operational managers and the supplier managers and produced bi-annual risk reports for the MoT which showed risk management progress. In the beginning, the majority of these project-related actors were positive about risk management, but slowly concerns emerged as they started to realise that some of their propositions of risks were excluded. In the spring of 2012, this development culminated as the average expected cost overrun (defined as the value-at-risk), which risk management was supposed to decrease, exploded by approximately 50 per cent. The consultants adjusted the IT-based system by introducing new risk vocabularies and a new graphic user interface. They also allocated three more full-time risk consultants, adjusted the roles and responsibilities of project-related actors and developed a risk construction guideline. In the following months, the consultants managed to reduce the value-at-risk, but new and different concerns had emerged among the project-related actors. The MoT also

intensified their monitoring efforts by requiring risk reports on a quarterly rather than a bi-annual basis.

In October 2015, Rail Net Denmark announced that the Signalling Programme had missed a milestone related to the testing of the new signalling systems and was running a year to a year-and-a-half years behind schedule. Soon thereafter, the CEO, CFO and programme director resigned (Banedanmark, 2015). In October 2016, the new management announced that the entire Signalling Programme would be delayed for two years and that extra costs of 500 million euros were expected (Banedanmark, 2016). The risk consultants started working on more and new adjustments to the IT-based system, but the frustrations with risk management had grown and project and operational managers showed little commitment to risk work. Some of the risk consultants even started to question the ability of risk management to prevent disasters. In the beginning of 2017, the entire content of the IT-based system was scrapped, the consultants resigned and Rail Net Denmark employed their own manager to re-establish the practice. Figure 1 summarises this subsection and shows the major actions and events of the practice.

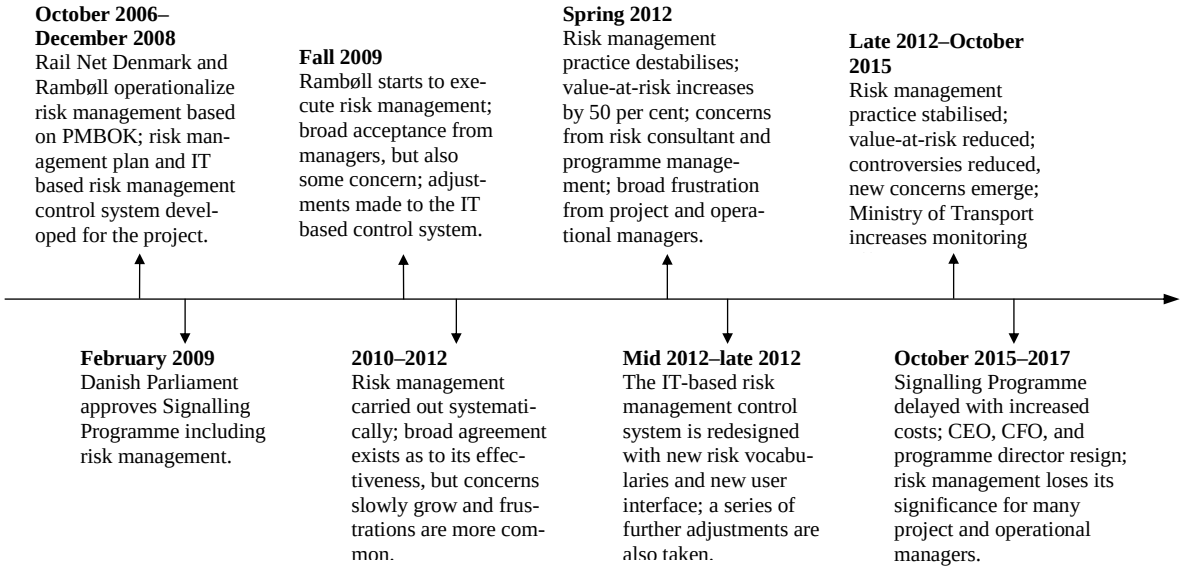

Figure 1: The Signalling Programme's risk management: major actions and events

5.2. The predictions of PMBOK: framing the construction of risks

> When we decided how we wanted to construct the practice, we agreed that we would follow PMBOK to define our risk terminologies. We just didn't want people to question our understanding of risk management. (Senior Risk Consultant, #I-2)

To understand what happened between October 2006 and December 2008, Rail Net Denmark and Rambøll managed to frame the practice of risk management. As the risk consultant states, the PMBOK was mobilised so they could avoid all sorts of discussions concerning the 'right' framing of the practice. The PMBOK predicts that project organisations will improve their 'chances of success over a wide range of different projects' by adopting this framework (PMI, 2004, p. 3). The PMBOK was thus broadly consistent with the MoF's and MoT's New Budgeting Method, to which Rail Net Denmark and Rambøll also referred on numerous occasions (Banedanmark, 2008a; Rambøll, 2007). The PMBOK had further served as the basis for certifying more than 100,000 professionals (PMI, 2007), which means that the PMBOK represented an even broader network of experts and brought its own purification to risk management.

The PMBOK came to affect the risk consultants' definition of the language for the practice and conditioned how other actors were to think and talk about risks. The consultants defined risks as an 'uncertain event or condition that, if it occurs, has a positive or negative effect on a project's [risk] objectives' (Rambøll, 2007, p. 26). They further defined these project risk objectives as project costs, project time, train punctuality, benefits and Rail Net Denmark's reputation towards the MoT.[2] Finally, they defined risk management as 'to increase the probability and impact of positive events and decrease the probability and impact of events adverse to the project' (Rambøll, 2007, p. 1). In this sense, consistent with the PMBOK, the consultants framed the boundaries of the forms of uncertainties that the actors were to think and talk about as risks, namely as probabilistically measurable events with effects on project objectives. The consultants therefore also excluded other forms of uncertainties like those associated with the long-term effects of the project, which included, for example, train service safety and systems maintenance, or those uncertainties with effects on other entities than the project itself.

The risk consultants also relied on PMBOK to define the organisational arrangements of the practice, including the roles and responsibilities of project actors. The consultants defined project managers and their teams of operational managers as 'risk owners' (specialists); and themselves – or anyone appointed as such – as 'risk experts'. The risk owners were described as responsible for the identification, assessment, response planning and management of risks, while the risk experts were described as responsible for the organisation and facilitation of risk workshops and meetings, the analysis of risks, the monitoring and reporting on the status

[2] While PMBOK prescribes the 'classic textbook' usage of cost, time, and quality as objectives, which corresponds to Rail Net Denmark's usage of cost, time, and punctuality; Rail Net Denmark and Rambøll added 'benefits' (potential positive effects on later operations) and 'Rail Net Denmark's reputation towards the MoT' on their own. As this article goes on to show, however, Rail Net Denmark and Rambøll ended up dropping the latter two objectives. They also excluded safety because another support function handles such matters elsewhere.

of the practice and the further development of the practice. The risk consultants also defined which of the PMBOK's tools and techniques that had to be applied. The consultants mobilised the cause-and-effect structure for risk description and documentation, the known probability and impact matrix (the risk matrix) for risk assessment and Monte Carlo simulations for value-at-risk calculations. The risk consultants then ultimately wrote down their definitions into a document called the risk management plan, which they circulated to the programme's management.

The consultants lastly defined the technological arrangements of the practice by developing a comprehensive risk management control system based on Microsoft Access. The purpose of the IT-based system was to register all risk-related information, allocate risk owners to risks, generate lists of risks, calculate the value-at-risk and generate progress charts (value-at-risk bar charts) usable for reporting risk status. In examining the structure of the IT-based system, the system came to reflect the PMBOK's definitions, tools and techniques. In other words, the IT-based system translated the words and templates of documents into a hands-on ready-to-use physical and visible technology. It was a computer programming translation of the words of the PMBOK into codes, categories, menus, boxes and fields that could be used on risk workshops and meetings to visualise the framing and guide the distributed cognitions and interactions of the participants. Figure 2 shows the main visual interface of the system. The textboxes show how the fields, boxes and menu options relate to the process of constructing risks.

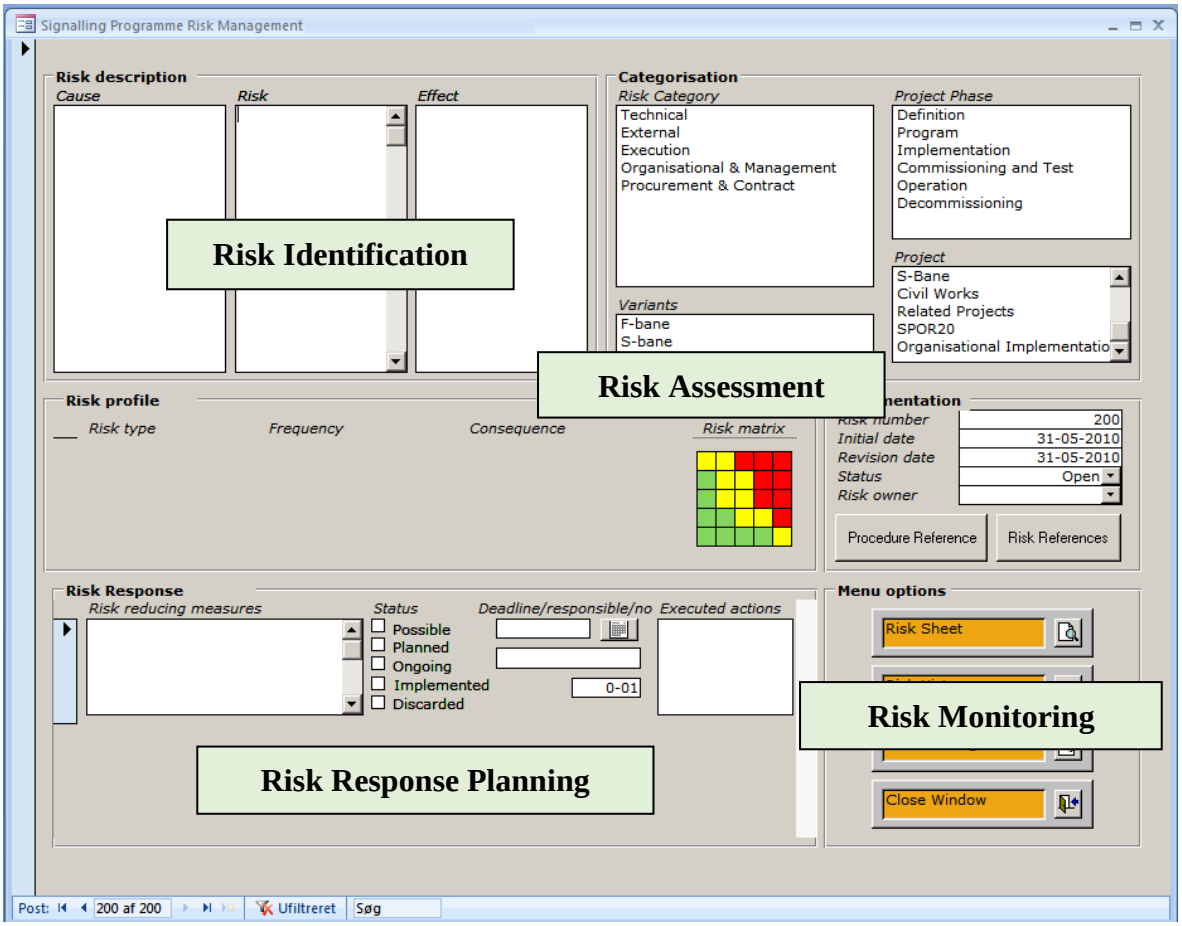

Figure 2: Main visual interface of the IT-based system year 2007

In February 2009, the Danish Parliament approved the Signalling Programme and granted Rail Net Denmark the 3.2 billion euros required to execute the project without any questions asked about the framing of risk management. To understand this apparent straightforward decision, the purifying work of experts in defining the linguistic, organisational and techno-logical infrastructure needs to be stressed. This framing built on PMBOK which – through its status as a firmly established professional tool – brought its own purification to the process. This was also consistent with the MoF's risk management modernisation programme which provided the broader institutional framework needed for the risk consultants' 'laboratory work'. Thus, within the first two years of the project, the consultants developed and imple-

mented the arrangements necessary to actualise the predictions of the risk management programme.

5.3. The actualisation of PMBOK: The translation of uncertainties into pure risks

In the years between 2009 and spring 2012, which corresponds to the period between the political approval of the project and the signing of the contracts, Rambøll's risk experts actualised the predictions of PMBOK and made the 'world' of risk construction more like its dictates. The actualisation took place in the various risk meetings and workshops organised by the risk consultant (cf. #I-1, #I-2 and #I-4). In this period, 250 propositions or reassessments of risks were observed, which all ended up matching the criteria the consultants had established (#O-1 to #O-16). These 250 propositions and reassessments were all described using the cause-and-effect structure; colour-graded on the risk matrix; given risk ownership; categorised according to type, variant, subproject and project phase; and had risk reducing actions listed. As the above information had to be recorded by the IT-based system – and only that information – all uncertainties that ended up accepted as risks were therefore only those that had been constructed to match the fields and boxes of the system, or what we term the pure risks of the practice.

The following interaction among a risk consultant, an assisting manager, a head project manager of one of the seven subprojects and a senior railway operations and management consultant illustrates the translation of uncertainties into pure risks. The interaction is representative of the 250 propositions and reassessments. It took place at the beginning of a regular risk meeting for one of the subprojects and lasted several minutes. We have broken it down into

two passages, one dealing with the description of the risk, the other with the assessment of the risk.[3]

> 'I have a new risk I would like to include', the senior railway operations and management consultant says. He explains that the train operating companies (TOCs) are responsible for developing the operational guidelines for their train drivers, but that they are not going to be ready on time. 'So, this is just stakeholder management', the assisting manager states, while the risk consultant types into the IT-based system's risk description field what the project's consultant says, which is visible on a projector canvas. 'It's much more complex than that', the head project manager says. He explains that the problem relates to the segregation of duties between different public agencies. He argues that this can lead to a complete traffic breakdown. The risk consultant, who has been typing something into the risk cause field, now asks the participants to comment on the following text: 'TOCs are responsible for issuing and getting approval for the operational rules for their staff (drivers, shunters, etc.)'. The head project manager and the project's consultant broadly agree with this, but the project's consultant argues that the sentence does not capture the complexity of the discussion. The project's consultant asks the risk consultant to continue the sentence by adding, at a minimum, the following clause: '…these rules must be ready, however, before early deployment scheme'. The risk consultant adds the text. He also writes 'delays and increased costs' as the text into the risk effect field. There are no comments from the other participants. (#O-3)

This interaction illustrates how the head project manager and the senior railway operations and management consultant, despite their combined experience and technical knowledge about the project, did not end up with their proposed risk description. The interaction shows that the risk consultant, equipped with the IT-based system, frames and purifies the description of the risk.[4] In the interaction, the actors begin by discussing the nature of the uncertainty (TOCs not preparing guidelines on time), its causes (the complexity of public administration), and its effects (potentially, a complete breakdown in train traffic). The consultant ends up not capturing the subtler dimensions of the discussion, however, but only what fits the system's case-and-effect structure. He simplifies the discussion about stakeholder management and

[3] The remaining aspects of the risk response planning, documentation and categorisation were also carried out, but because they largely transpired without much debate, we do not mention them.

[4] We cannot rule out the possibility that personal relations and feelings affected certain constructions of risks. But because we observed the same outcome across 250 constructions of uncertainties as risks involving more than 70 different people, we argue that the findings go beyond personal relations and feelings.

reduces the potential effect of a traffic breakdown to 'delays and increased costs'. The interaction continues:

> 'So, let's move to risk assessment', the risk consultant says and checks the categories of 'cost f-banen', 'time f-banen', 'cost s-banen', 'time s-banen', and 'reputation'.[5] The senior railway operations and management consultant replies that the probability for 'time s-banen' and 'cost s-banen' should be set to 'highly likely' (20 to 65 per cent). He argues that the TOCs' guidelines need to be finalised by the end of the year to avoid delays and additional costs. He continues: 'For f-banen, we will have one more year until early deployment'. He argues that the probability for 'time f-banen' and 'cost f-banen' should be set to 'likely' (5 to 20 per cent). He also insists that the risk consultant checks the 'reputation' category as 'highly likely'. The two consultants debate the assessments for some minutes, but the risk consultant eventually checks the boxes accordingly… The risk consultant: 'Okay, so what will the consequences be?'. The project's consultant says that consequence for 'time s-banen', 'cost s-banen' and 'reputation' should be set to 'high' (6–12 months; 20–40 million euros; significant degradation in credibility) and that consequence for 'time f-banen' and 'cost f-banen' should be set to 'moderate' (3–6 months; 20–100 million euros). The risk consultant challenges these assessments several times. In the end, the project's consultant and the head project manager decide to lower the consequence assessment of 'reputation' from 'high' to 'moderate'. The risk consultant selects the corresponding categories and says that the risk is now 'red' for the two 's-banen'-assessments and 'yellow' for all others, referring to the risk map with the mouse cursor. The risk consultant saves the changes to the system. (#O-3)

This latter part of the interaction shows that the head project manager and the senior railway operations and management consultant ended up performing the risk assessment according to the layout of the IT-based system. These two actors assessed the risk according to the pre-existing project objectives, the assessment categories and the probability and impact matrix.[6] The actors did discuss whether the consequences of the risk had to be assessed as high or moderate, but they never once discussed the relevance of the categories themselves. The risk consultant even selected the assessment categories to be used without getting any reaction from the head project manager and the project's consultant. The risk consultant equipped with

[5] F-banen is an acronym for the main and regional lines and s-banen for the Copenhagen mass transit system.
[6] In this example, the actors did not comment on the benefits and punctuality objectives. The exclusion of these objectives (and Rail Net Denmark's reputation toward the MoT) became increasingly frequent during this period.

the IT-based system therefore limited the many ways the assessment could have been conducted.

These two parts of the interaction show how the IT-based system became a mediator, which through visualisation facilitated a productive approach to the construction of risks, but also, simultaneously, limited this process by framing the participants' cognitions. In this sense, the physical visualisations of the IT-based system, which the participants are confronted with, adds to the purifying work of the risk consultants. In subsequent interviews with different project managers, the actors explained, further, that they knew they had to match their proposed risks to the categories (#I-3, #I-6 and #I-9). The observation studies also confirm that participants in the meetings usually look closely at the projector canvas, follow the movement of the mouse cursor, and watch what the risk consultants type (#O-1 to #O-41). Equipped with the IT-based system, the risk consultants had therefore managed to shape the construction of risks.

In a last step to actualise the predictions of PMBOK, the risk consultants reported the progress of their work monthly to the Signalling Programme's management and bi-annually to the MoT for monitoring purposes. In making these reports, the risk consultants relied on the IT-based system's Monte Carlo simulations to graphically inscribe the development of risk management into a bar chart showing the programme's value-at-risk. Figure 3 shows this visual inscription for the replacement of the regional lines' signalling systems. It shows that the value-at-risk dropped from approximately 1.3 billion euros to 300 million euros (or 1.5 billion to 350 million euros for the entire Signalling Programme). In 'reading' this bar chart, the MoT and the programme's management explained that they were sceptical about the numerical values, since all of the assessments relied on project actors' best judgements (#I-13, #I-14).

Interestingly, they still argued that they could take the relative development over time as a valid indicator of risk management progress. In summary, during this period, the risk consultants, the programme's management, and the MoT managed to actualise the predictions of the PMBOK.

5.4. The overflowing of risk management: emerging concerns and impure risks

In the period between 2009 and 2012, the technological arrangements that had made risk management valuable had also been conduits for overflows. In the beginning, these overflows primarily related to managers expressing concerns about their new role as risk owners (#O-1 to #O-5; #I-1 to #I-6). Some managers expressed concern that they had to produce reliable assessments, particularly concerning the benefits and reputation categories, while others found that the practice was impeding other job responsibilities (#I-1; #O-1 to #O-11). Over these three years, however, the IT-based system also became subject to concerns as managers started to realise that the system prevented some of their proposed risks from being included. We observed that the risk consultants excluded approximately 120 propositions or reassessments of risks by visually confronting the actors who proposed them with the layout of the IT-based system (#O-1 to #O-16).[7] These risks can be termed impure risks to denote that they were still considered as risks for some actors – and thus not just something uncertain – but still excluded for not fitting the IT-based system and thus the framing of the PMBOK framework.

The following interaction illustrates the exclusion of a proposition of a new risk. The interaction took place during a risk meeting after a project manager had suggested that the new signalling system on the regional lines could bankrupt small train-operating companies:

[7] We also observed the exclusion of a small number of risk propositions without disagreement. Consistent with our observed actors, we treat such proposed but excluded-by-agreement risks simply as uncertainties.

> ‘What do you mean?’ the risk consultant asks. The project manager explains that the new signalling system requires that the operators invest in proper train communication hardware. He continues and explains that the small operators might not have the necessary capital to make the investment and thus might not be able to operate. ‘They will not survive’, he states. The risk consultant replies that this situation relates to the operators’ objectives. ‘It’s out of scope and irrelevant for us’, he adds and explains the purpose of the practice by using the mouse cursor to show the cause, risk, and effect fields within the IT-based system on the projector canvas. The project manager looks frustrated and gazes around the table. The others look down and seem to ignore him. The project manager adds that, if the train operating companies do not survive, this may turn out to be a problem for the people using trains to commute to and from work. He says this might all turn out as one big media scandal, which may threaten the programme. The risk consultant says he knows nothing about that and ends the discussion. Nobody says anything. (#O-2)

This interaction illustrates how the project manager’s proposed risk of small train operators not being able to survive was found to be impure, as the proposition did not fit the IT-based system’s cause-and-effect structure. The IT-based system had been developed around the PMBOK’s project-focused objectives, which meant that a potential risk threatening other entities’ objectives were ‘out of scope and irrelevant for us’, to use the words of the risk consultant. In a discussion immediately following, the risk consultant explained that this kind of ‘sorting’ was necessary to ensure the effectiveness of the risk construction process. The project manager, however, was frustrated with the situation and ended up hurt by the framing. To understand this suffering, as a head project manager explained, the project managers had to deal with these risks on their own without receiving the necessary resources (#I-9). In addition to the beneficial effects of the IT-based system for enabling the effective construction of risks, the system was therefore also a conduit for overflows that sometimes hurt and frustrated managers.

The project managers’ way of dealing with their concerns about the IT-based system was further limited as they were not allowed to establish their own risk management practices (#I-9,

#I-12). Such practices were only loosely defined and drew on simple technologies, like post-its or paper sheets, but they included '*our* risks, the subprojects' risks, those that *we* find important' (#I-9). Whenever the programme's management learned about such practices, it closed them down for undermining the IT-based system (#I-12). In consequence, many impure risks were left unmanaged. When asked about the amount of these, another head project manager explained: 'Yes, I have many of those. Yes!' (#I-11).

In the spring of 2012, the concerns and frustrations gained new heights as the IT-based system started to generate rapidly increasing value-at-risk calculations, which culminated with a 50 per cent value-at-risk increase. The Signalling Programme's management had recently signed the last of the contracts with the main suppliers, whom the risk consultants had enrolled in the practice as risk owners on terms similar to those of the project and operational managers. In collaboration with the project and operational managers, these actors started to propose risks, which fit the structure of the IT-based system, but which the risk consultants believed were 'parts of larger already-included risks' (#I-12). The consultants unsuccessfully tried to manage these proposals by elaborating on existing risks and thus avoiding having to add new risks with new assessments that would increase the value-at-risk. A risk consultant explained:

> We have a problem, a real problem. Now that we have so many new risks coming in, we can now see that the risk value is increasing, which is because we are adding so many new risks. But we have trouble managing; we are having a lot of trouble managing; because we don't think it should be increasing. We believe it should be going down… It is something process-like, technical-like going wrong, and we do not have a solution for this yet… So far, we have been able to explain this development to our CEO, who receives our monthly reports, but we cannot report this to the MoT. We *need* to do something about this. (Senior Risk Consultant, #I-12)

This statement shows that the risk consultant attributes this situation to something 'process-like, technical-like' with the IT-based system and not the prediction of the PMBOK. In fol-

lowing this prediction, the risk consultant claimed that the value-at-risk had to be decreasing, but because the opposite was taking place and because the MoT expected decreasing value-at-risks, the system had to be malfunctioning and "something had to be done". By mid-2012, the concerns and frustrations with the IT-based system were therefore no longer limited to the project and operational managers' concerns with the inclusion or exclusion of risks. The risk consultants and the programme's management had also become concerned with the IT-based system, particularly how the value-at-risk progress would look for the broader network of actors. In addition to co-producing the conditions for the actualisation of the PMBOK prediction, that is, framing the construction of the risks and the visualisation of risk management progress, the IT-system had been a conduit for overflows which distorted these very same predictions.

5.5. The reframing dynamics of stabilising PMBOK's predictions

In the years between 2010 and 2012, the risk consultants had already on several occasions attempted to manage the emerging concerns among the project and operational managers. The consultants had spent many hours teaching the roles and responsibilities of risk owners to the managers (#I-1). In agreement with the programme's management and the MoT, the consultants had also stopped demanding assessments on the two objectives of benefits and reputation and was now strictly relying on the three remaining objectives (#I-12, #I-16). The largest – and most expensive – reframing effort was the reprogramming and redesign of the IT-based system from a Microsoft Access-based platform to an Internet-based platform. Figure 4 shows the new main visual interface. It largely resembles the earlier main interface (see textboxes), but with two crucial differences: 1) the risk 'tags' feature (to which we return shortly as this was only added after a second redesign, but see the upper-left and right corners of the figure),

and 2) that managers could now access the system on their own using any computer, tablet or phone.

In the beginning of 2012, the redesigned system was launched, which according to the risk consultants was a success because the new system could be 'used more flexibly by the project managers' and thus had reduced the need for risk meetings (#I-12). In the months that followed, however, the risk consultants realised that the new reframing efforts had led to new overflows in the form of the drastically increasing value-at-risk calculations. In responding to this development, the consultancy company and the programme's management held a crisis meeting and quickly decided to allocate three additional risk consultants. These consultants were to yet again carry out risk meetings, carry out risk management status meetings and develop a set of risk construction guidelines. Further, the major suppliers were each told to appoint a risk spokesperson to coordinate their risk efforts, and the seven subprojects each had to appoint a project risk manager to monitor their risk efforts more closely (#I-16; #O-22).

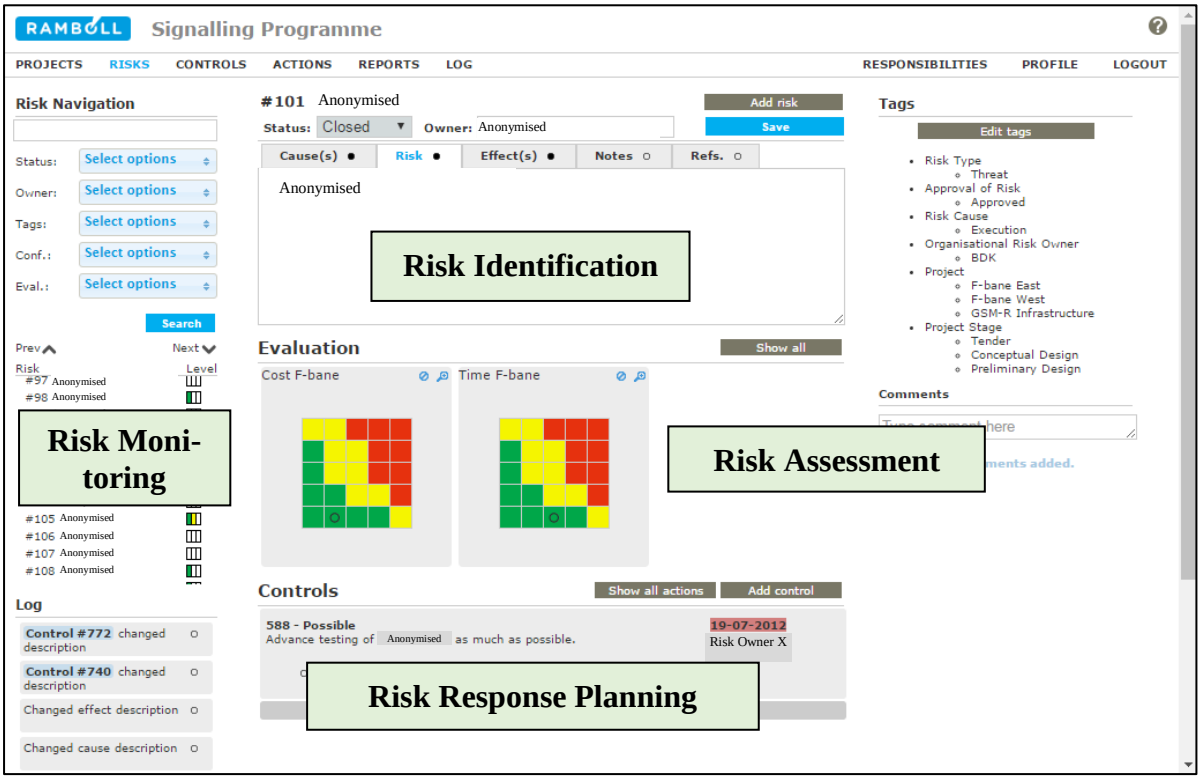

Figure 4: Main visual interface of the IT-based system year 2012

While the major reframing efforts helped to ensure that risk propositions were again taking place in formal meetings, and consistent with the framing of the practice, the value-at-risk – which according to the framing of the practice, should decrease (#I-12) – was still increasing. In continuing the reframing of the construction of risks, the consultants equipped themselves with elaborate linguistic categories that extended the boundaries of their judgements. The consultants divided the concept of risk into 'overall risks' (those that affect the overall project's objectives), 'sub-risks' (those that only affect the individual subprojects' objectives), 'risks under review' and 'approved risks'. The consultants further had programmers revise the system for a second time by adding these new concepts into the IT-based system's visual interface as the before-mentioned tickable tags and by restricting the risk owners from accessing them. These tags allowed the risk consultants to include risks during meetings as items visible within the system (by tagging 'overall risks' and 'approved') while at the same time exclud-

ing them from Monte Carlo simulations (the technique used to produce the value-at-risk calculations).

In the years between 2013 and 2015, the IT-based system provided the conditions necessary for the risk consultants to continue to produce decreasing value-at-risk inscriptions and for limiting the concerns of the project managers, the operational managers and now the supplier managers. Simultaneously, however, the IT-based system was yet again a cause of overflows, this time related to the new way of including or excluding risks using the four tags. The following interaction demonstrates this overflowing. It took place during a risk meeting between five people: two risk consultants, an end-to-end manager (a management representative with the authority to tag risks), the head of safety and a safety manager. One of the two risk consultants had just opened an earlier proposed risk related to the alignment of operational concepts, system definitions and functional requirements onto the projector canvas and all of the participants were looking at the new IT-systems visual interface:

> End-to-end manager: 'This assessment is unrealistic. It's way too high'. Head of safety: 'Okay, but then please make another assessment – and argue for it'. End-to-end manager: 'We're working on an operational concept here, so I can't see how it can take a year in delays'. Head of safety: 'This risk needs to be solved by X [a group of managers], but, so far, this group is very far from having the competencies to actually do something about this'. The end-to-end manager looks outraged: 'I completely disagree.' Head of safety: 'How would you assess it then?' End-to-end manager: 'Low, one to three months, unlikely, 1 to 5 per cent'. Head of safety: 'That's ridiculous!'. The first risk consultant: 'That's far from the present assessment'… The head of safety stresses that he cannot approve a reduction that moves it out of the 'red area'. The end-to-end manager gets angry: 'I just have to check that it will not be included'. The first risk consultant backs him up. The head of safety clearly gets angry now. He almost yells, arguing they have to approve the risk because they will need executive attention and actions taken right now. 'I will *not* be responsible for not having flagged what I see as our most apparent risk!', he says… In the end, they agree to disagree, and the first risk consultant saves the changes by tagging them 'under review' (rather than 'approved'). (#O-28)

This interaction shows how the risk consultants used the IT-based system's 'tag' of 'under review' to exclude the proposed risk despite the fact that the two safety-related managers disagreed with the decision. In their opinion, the consultants should have tagged the proposition as 'approved', but because they failed to convince the end-to-end manager, the proposition ultimately ended up tagged as 'under review'. It was thus evident that, despite the beneficial effects of the system for the risk consultants and the end-to-end manager, the system simultaneously ended up hurting the two safety-related managers. The interaction also illustrates how, with the reframing of the IT-based system, the risk consultants developed a very subtle and advanced mechanism for including or excluding risk propositions. These propositions were only partly included within the system. That is, they were *visible*, as if they had been accepted, but exactly because they had not been accepted (i.e., tagged as 'approved') they were found impure. In this period, more and more risk propositions were excluded using this tagging mechanism.

In the period after the October 2015 announcement of the one to one-and-a-half year delay and the resignation of the CEO, the CFO and the programme director, the overflowing became more pervasive. Together with the last two to three years of risk proposition exclusions, the announcement and the resignations led the project managers, operational managers and supplier managers to largely stop using the IT-based system (#I-24). Some of the consultants themselves even started to question the ability of risk management to prevent disasters (#I-20), and the MoT were concerned to the degree that they strengthened their monitoring efforts. The consultants continued undeterred to reframe the risk management practice – this time by relying on PMBOK to develop a more advanced visualisation technique called the tornado diagram – but the overflows prevailed.[8] In the beginning of 2017, Rail Net Denmark

[8] This paper will not go further into these reframing efforts. The tornado diagram represents a visualisation technique that allows the value-at-risk calculation to be correlated with the relative importance of the individual

ended its collaboration with the risk consultants, employed their own risk management expert and ended up scrapping the content of the IT-based system. The PMBOK and the IT-system themselves, however, were praised. As the new risk expert said: 'This time, we just have to do it right' (#I-24).

In summing up the developments that took place during these years, the risk consultants and the programme's management carried out a stream of apparently unending adjustments to re-actualise the predictions of the PMBOK framework. These adjustments were all mediators that were used to stabilise the construction of risks and reframe emerging overflows, but they also produced new and quite unexpected overflows which distorted and transformed the very meaning they were supposed to carry and prompted even further adjustments to be made. In particular, the IT-based system and its changing visualisations proved productive for settling overflows, though this was always temporarily and led to new overflows, requiring new adjustments. In these procedural framing-overflowing dynamics, the project managers, operational managers and supplier managers *as well as* the programme's management and the consultants all gained a temporarily effectual *and* at times hurtful approach to risk management.

5.6. Epilogue

In January 2017, the National Audit Office of Denmark (NAOD) announced the findings of an investigation into the delays of the Signalling Programme. The report criticised both Rail Net Denmark's management and the MoT's supervision of the programme (Rigsrevisionen, 2017). In particular, the NAOD highlighted that the MoT had known about the problems beforehand without informing the Danish Parliament. In November 2017, Deloitte, whom the MoT, Rail Net Denmark and the MoF had contracted to review the project, concluded that the

(pure) risks and then graphically shown with the most impactful risks at the top of a bar chart (thus forming a tornado). The latest edition of PMBOK recommends tornado diagrams for quantitative risk analyses (PMI, 2013).

project was going to be subject to further delays of up to seven years. The Signalling Programme moreover had to be downscaled to avoid additional delivery problems. The Deloitte report is fascinating in many respects, not least for its conclusion that 'risk management has been too low a priority' (Deloitte, 2017, p. 5).

6. Discussion

The following section has been organised into three subsections: 1) the performativity of frameworks and technologies and the construction of risks; 2) the visual power of risk management inscriptions; and 3) the power and effects of consultants as risk experts.

6.1. The performativity of frameworks and technologies and the construction of risks

This article represents one the few studies to show that theories such as those mobilised by frameworks are neither true nor false descriptions of a pre-existing world, but that they bring that world into being through the framing and actualisation of a series of arrangements (Callon, 2007; Ferraro et al., 2005). Hall and Fernando (2016), Miller et al. (2008) and Power (2009) evince that best-practice risk management frameworks might paradoxically fetter the abilities of organisations to manage all uncertainties. Our article adds further empirical depth to this theoretical insight by showing that the PMBOK framework ended up performing various linguistic, organisational and technological arrangements of the practice, which limited the ability of the project, operational and supplier managers to construct risks. Following Callon (1998a), however, without this incompleteness, without framing the boundaries of risk construction, the participating actors would not have had an effectual approach to risk management. This limitation thus had the additional effect of sustaining the processes of constructing risks or, put differently, frameworks of risk management can still be *useful* for risk

management purposes, despite their apparent limitations for the ability to manage all forms of uncertainties.

In focusing more on these purposes, Power (2004, 2007) and Jordan et al. (2013) stress that risk management has less to do with the practicalities of operational risk management and more to do with broader organisational processes such as legitimation and confidence building. Our article contributes to the extant literature by showing that frameworks can enact the simultaneous coexistence of multiple purposes or realities of risk management. The project managers, the operational managers and the suppliers primarily used risk management for operational purposes, to propose risks that were relevant for them to meet the project's objectives. In contrast, the risk consultants and the programme's management were more concerned with producing a value-at-risk bar chart that accorded with the predictions of the PMBOK. In understanding the broader role of the PMBOK, it enacted two different realities of risk management. These realities clashed on several occasions, leading to the series of adjustments made by the consultants as they sought to stabilise the PMBOK's 'promised' world of greater chances of project success. During this process, the risk consultants and the programme's management were largely able to maintain their 'reality'. Overflowing continued to emerge, nevertheless.

The IT-based control system with its assemblage of technologies was crucial to actualise and re-actualise the world of PMBOK. It transcended the role of a mediating instrument (Jordan et al., 2013) or a risk representation device (Kalthoff, 2005) that enabled the construction of risks. It was an active mediator (Latour, 2005) that also distorted this process and led to unexpected effects, most prominently, the exclusion of certain risk propositions which for the project-related actors were material uncertainties. Interestingly, the IT-based system became the

target of the frustrations with the construction of risks; this meant that the PMBOK remained free of criticism. Our article contributes to the broader range of performativity studies (e.g., Callon, 2007; Dambrin & Robson, 2011; Ferraro et al., 2005; MacKenzie, 2006; Tryggestad, 2005). It shows that technologies serve as buffers to shield (economic) theories or frameworks against competing views, thus strengthening the enactment of that theory's particular world. This is a key insight from our paper: how technologies preserve failing models.

Our finding that technologies, like the IT-based system, are part of the process of performativity serves to problematise their usefulness for auditing purposes (Jordan et al., 2013; Power, 2013; Power, 2016a). The IT-based system enabled the defensive production of audit trails by allowing the 'riskwork to be checked' (Power, 2016a, p. 280). The system, for example, would be used to generate status reports to the MoT, which allowed the project to 'pass [short term] decision gates' (Jordan et al., 2013, p. 168). In the periods between these reports, however, the IT-based system underwent adjustments that changed the conditions of the recording of risks, like the four tagging categories, which provided a subtle mechanism to include or exclude risk propositions. Such changes make technologies like an IT-based system (or any risk register) problematic, even potentially useless, for later project audits and ex-post inquiries. The amount of judgment that goes into assessing uncertainties – which includes uncertainties that cannot be made calculative with any statistical reliability (Keynes, 1937; Knight, 1921) – contribute further to this problem. When decision makers, like the MoT, the MoF or politicians, rely on theories like the PMBOK, which reflect mainstream economics that considers overflows and reframing as exceptions, the corollary might be the creation of a false sense of security for the project objectives.

6.2. The visual power of risk management inscriptions and their devices

Scholars have recently begun to examine the visual nature of accounting technologies and inscriptions (e.g., Busco & Quattrone, 2015, 2017; Jordan et al., 2016; Justesen & Mouritsen, 2009; Quattrone, 2009, 2015). Their central argument is that the power of technologies owes less to the conveyance of knowledge content and more to the visual nature of the inscriptions they produce. Notable examples include two-by-two matrices (Pollock & D'Adderio, 2012) and strategy maps (Qu & Cooper, 2011). These technologies become 'narrative systems of visual representations' that both stimulate and organise the work around them. As Busco and Quattrone (2015, 2017) remind us, visualisations that are always in-tension and performative. In our article, the IT-based system visually framed the performable space of the practice. This system confronted the participants visually with the boundaries of the practice by showing them the fields, categories and maps, which comprised the risk construction criteria. It was a technology for both *inventory*, the classification of knowledge in spaces, and *invention*, the generation of new knowledge. It was a 'maieutic machine' (Busco & Quattrone, 2017) *par excellence*.

Building on the studies described above, this article shows that technologies' visual inscriptions not only stimulate and organise the work around them, but also themselves undergo change through the process of engagement. The IT-based system was more than an assemblage of visual representations that enabled the users to build their own plots (Busco & Quattrone, 2015; Czarniawska, 1998). It also had its own distributed plot as a state-of-the-art PMBOK-risk management control system – and was even part of the larger government modernisation programme. We see the importance of visualisation when the PMBOK's definition of perfection came under threat – for example, when the value-at-risk rose, which would have disproved its predictions and opened the door to political turmoil. The visualisations were reframed to promote a cognition – "the search for perfection" – consistent with the PMBOK's

predictions. This provided a way to maintain a 'beautiful picture' (Pollock & D'Adderio, 2012), apparently unproblematically, when in fact, the system, following Busco and Quattrone's (2017) evocative word play, was both 'intension' and 'in-tension'. In turn, this led to new overflows and a seemingly 'unending reframing to perfect risk management' (Vinnari & Skærbæk, 2014, p. 516).

Our article extends the insights of Jordan et al. (2016) by showing that the power of risk matrices/maps extends beyond their interdiscursive appeal. Our argument is that the visual and physical presence of the matrices and maps played a critical role in the risk meetings and workshops. Our findings show that the risk matrix's six categories of interdiscursive appeal (iconicity, semantic motivation, metaphoric extensions, ambiguity, isotopic relations and isomorphic relations) came to perform the construction of risks. When overflowing began to emerge, however, the consultants could not rely on discourse or talk alone – that is, the development of new risk vocabularies. The consultants had to *visually* change the interface of the IT-based system and *physically* apply the new interface to the meetings and workshops before they could provisionally settle the controversies. During these meetings, the consultants would physically point to the visual interface of the system whenever controversies emerged. Building on the findings of Kalthoff (2011), who primarily attributes strategies of 'undoing calculations' to discursive manoeuvres, we demonstrate that such discourse has to be inscribed in technologies, or materialities more generally, to undo calculations.

6.3. The power and effects of consultants as risk experts

The visual power of the IT-based system was closely related to the work of the risk consultants as the risk experts of risk management. It is well established that risk management comes to be formed by risk experts through their boundary-defining work (Mikes, 2009, 2011), as

well as through the rivalry between different groups of experts, such as accountants and specialists (Arena et al., 2010). This article extends these findings by showing how consultants, as risk experts, purified the construction of risks over time by mobilising a series of mediators, which led to the production of pure and impure risks. Building on the work of Arena et al. (2010), who point to the ability of experts 'to carve out a space for risk management', we argue that the broader network of actors brought into existence by the MoF and the MoT 'carved out that space' for them. In combination with the reliance on the PMBOK, which brought its own purification to risk management, and the audit reports from the NAOD, which problematised the accounting practices, the MoF and the MoT provided the consultants with the broader institutional framework needed to ensure their framing and preserve their technological inventions.

The risk experts furthermore performed both quantitative enthusiasm *and* quantitative scepticism (Mikes, 2009, 2011) or what can be termed, paraphrasing Callon and Law (2005), a 'qualculative' approach to risk management. The risk experts required that the risk owners quantified their risk assessments according to the five (later three) project risk objectives and that Monte Carlo simulation was applied to calculate the value-at-risk. These assessments, however, relied on the risk owners, using their best judgement and experience, which means that the practice ended up combining the qualitative as well as the quantitative. This was, moreover, consistent with the PMBOK framework. In this sense, the risk consultants helped to make the PMBOK 'pervasive and dominant in [the] everyday discourse of understanding' (Ferraro et al., 2009, p. 671). This pervasiveness was well captured by the newly appointed risk expert after the project had incurred delays and increased costs and after the CEO, CFO, programme director and the risk consultants had resigned: 'This time, we just have to do it

right' (#I-24). The risk expert thus stressed the problems of implementing the PMBOK, not PMBOK itself.

This article contributes to actor-network theory in two ways: One by developing our understanding of the power of experts for the cooling down of emerging 'hot situations'; and, two, adding to our understanding of the performativity of (economic) theories (Callon, 1998a). The risk consultants delineated the boundaries of the construction of risks and were able to contain, albeit only temporarily, the recurrent stream of overflows that emerged. It required costly investments, but through these investments – particularly through the power of the new IT-based system's visualisations – they managed, again temporarily, to re-actualise the predictions of the PMBOK. Paraphrasing Mikes (2016), they attempted not to '[open] the door to dissonance and conflict' (p. 263), but to '[keep] that door closed'. This finding points to the need for consultants to take on a more complex and advanced role as risk experts. It indicates that experts simultaneously co-produce the conditions for both stabilisation (the construction of pure risks) and destabilisation (the construction of impure risks). This renders the successful performativity of frameworks and technologies an unending endeavour. It also shows that experts are not necessarily confined to doing nothing in hot situations, but can actually do something when they engage with non-experts.

7. Conclusion

Through the examination of a case study of a multi-billion-euro mega-project, this article has examined the long-term performative dynamics among a best-practice risk management framework, technologies of risk management and the translation of uncertainties into risks. The project's risk management practice was organised around the well-known PMBOK

framework and an IT-based risk management control system programmed according to the PMBOK.

The article argues that the PMBOK framework and the IT-based system performed the construction of risks through establishing the boundaries of the forms of uncertainties that were accepted and thus included as risks. The accepted risks are labelled 'pure risks', conversely the excluded risks are labelled as 'impure risks'. In explaining the dynamics of this framing, our article demonstrates that the IT-based system became a conduit for overflows, which actualised the prediction of PMBOK but also distorted that very same prediction. This dynamic occurred because the IT-based system generated concerns and frustrations from managers, who were troubled by having risk propositions excluded for being impure. In attempting to manage these emerging concerns, the consultants, who were operating the system, carried out a continual stream of readjustments. In association with the PMBOK framework, they mobilised an entire series of mediators, such as inscriptions, which allowed them to purify the construction of risks. This process was always provisional. The IT-based system, in particular, became key to purification because the risk consultants could visually frame the performable space of the practice.

That the implementation of risk management is a complex, paradoxical and uncertain process is a central finding of this paper. Consequently, we suggest that more studies should pursue this line of enquiry. There is much to be learnt about how other projects and/or organisations construct risks. Similarly, it is fruitful to explore potential conflicts *within* consultancy companies, particularly during hot situations, where blaming can emerge. A valuable direction for future research may be in examining the performativity of economic theories within the contexts of blame distribution more specifically (Skærbæk & Christensen, 2015). The examina-

tion of how risk management interrelates with the broader conditions for managing projects and the ability to deliver projects according to budget, time plan and specifications is also something that merits further attention. One should be reflective about the effects that (economic) frameworks and technologies as mediators produce, their assumptions and their usefulness for ensuring the success of projects and the everyday work of risk management.

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