THE TEMPORALITY OF FAILURE AND SUCCESS IN INFORMATION INFRASTRUCTURE EVOLUTION

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Abstract:

Information Systems (IS) failure/success has historically been conceptualized in many different ways in IS research. This article aims at filling a gap in existing conceptualizations that reflects the interconnectedness of contemporary IS in digital infrastructures with a special focus on the temporal aspects of failure/success. Empirically the article draws on an on-going longitudinal case study of a global company implementing a SharePoint-based infrastructure. We build on 'installed base cultivation' as a theoretical perspective and concepts denoting how an information infrastructure evolves. The paper contributes by proposing three different types of failures: 1. Failure to combine with the relevant parts of an installed base; 2. Failure to cultivate in terms of replacing modules and/or re-arranging relations between relevant modules; and 3. Failure to cultivate in terms of extending or adding new relevant modules. Additionally, the paper illustrates the shifting pattern of failure and success over time as the information infrastructure evolves. Depending on the time period, the SharePoint-based infrastructure was perceived as: 1. a failure for relevant social groups; 2. both a failure and a success by different relevant social groups; and a success for relevant social groups. The paper compares the findings with current conceptualizations in IS and the temporal aspects of IS-failure is discussed as a means for avoiding dichotomizing between failure and success.

1 INTRODUCTION: FROM IS-FAILURE TO II-FAILURE

In contemporary societies everything from banking services, healthcare, oil and gas production to energy infrastructures have become increasingly digitized. To a larger extent than ever before, individuals and organizations rely on complex assemblies of software and information systems (IS). At the same time, however, development and organizational implementation of such technologies are often associated with *failure*. Only in a small country like Norway, there are numerous well-known IS-projects that have been considered major failures or even outright disasters. A recent attempt estimated to 3,3 billion NOK aimed at modernizing the Norwegian Welfare organization (NAV) was abandoned in 2013 due to "unexpected complexity" – is only one of several examples. Internationally, recent studies estimate that as many as one out of six IS projects in public sector can be considered catastrophic failures (Budzier and Flyvbjerg, 2012). However, there is currently no evidence to suggest that this is not the case also in Norwegian and private companies.

In the field of Information Systems (IS), IS-failure has been an important subject matter over several decades (e.g. Bartis and Mitev, 2008; DeLone and McLean, 1992; Ewusi-Mensah and Przasnyski, 1994; Myers, 1994; Fitzgerald and Russo, 2005; Lyytinen and Hirschheim, 1987; Lyytinen and Robey, 1999; Sauer, 1999; Schmitt and Kozar, 1978; Wilson and Howcroft, 2002). While historically rooted in the engineering challenges of developing software in compliance with specifications, finishing within time and on budget, and ensuring organizational implementation, later contributions have emphasized failure as deeply embedded in dynamic interactions with a wider social and organizational context (Sauer, 1999). In an early contribution following this perspective, Lyytinen and Hirschheim (1987: p. 263) suggested that IS-failure should be perceived as the "*inability of an IS to meet a specific stakeholder group's expectations*". Accordingly, IS-failure is regarded largely as a matter of interpretation from various stakeholders having an interest in the new IS (Myers, 1994).

In more recent conceptualizations, this perspective has been furthered to include key insights on how different relevant social groups[1]' expectations can change over time (Wilson and Howcroft, 2002) and that acts of building trust and mobilizing stakeholders can turnaround previously failed IS projects (Fitzgerald and Russo, 2005). Additionally, current studies also underscore the organizational power and politics in terms of various relevant social groups' narratives and 'war stories' that greatly shape the outcomes of an IS over time (Bartis and Mitev, 2008; Finsham, 2002). Henceforth, collectively, these studies show beyond any reasonable doubt that whether an IS is considered a failure or not, is largely shaped by different relevant social groups' interests, their relations and the particular context of the use of the IS.

At the same time there seem to be a lack of studies encompassing the increasingly complex interconnectedness of IS that shape organizational development, implementation and adoption in possibly new and paradoxical ways (e.g. Edwards et al., 2009; Hanseth and Lyytinen, 2010; Monteiro and Rolland, 2012; Tilson et al. 2011). From this perspective – arguably some key aspects are left out in current conceptualizations of IS failure. Firstly, literature on IS-failure tends to be rather *system centric* in the sense that conceptualizations only cover one project or one single IS. For example, recent contributions like Wilson and Howcroft (2002) and Bartis and Mitev (2008) largely delimit their conceptualizations to include one stand-alone application or IS. In contrast, recent studies of II shows how new successful applications often are extensions build on top of an existing installed-base of systems and practices rather than built from scratch (Aanestad and Jensen, 2011; Grisot et al., 2014; Rolland, 2000). Any new IS needs – more or less, to integrate with other components and systems – socially as well as technically. Consequently, the sources of failures multiply as 'local' usages and technologies potentially have 'global' consequences (Rolland and Monteiro, 2007). Larger numbers of relevant social groups with diverging practices and expectations makes the establishment of common solutions more complex in relation to II compared to the traditional stand-alone IS (Hepsø et al., 2009; Star and Ruhleder, 1996). Secondly, current conceptualizations of IS-failure lack a *temporal perspective,* and hence give inadequate accounts of *when* an IS fails – or the temporal ordering during which failure or success are perceived. A notable exception here is Wilson and Howcroft (2002) who explains how the different relevant social actors' expectations shifted over time regarding an information system in a hospital that in strictly technical terms remained the same. In their case, the system in question seem to follow a downward spiral from perceived success to failure where it is taken out of use in the end after 5 years. Subsequently, the objective of this paper is to conceptualize II-failure with special regard to the temporal aspects of failure/success.

This paper is structured in the following way. First, in the next chapter we outline our theoretical approach grounded in information infrastructure theory. Then next, we briefly present the methodology used and the case of implementing an enterprise-wide digital infrastructure at 'Bergen Drilling'. In the following chapter we analyse our findings and then in the last main chapter we present a discussion.

[1] The concept of 'relevant social groups' stems from Pinch and Bijker's Social Construction of Technology (SCOT) perspective (Pinch and Bijker, 1987).

2 THEORETICAL APPROACH

2.1 II-failure as failure to cultivate an installed base

Although there is not much literature addressing the issue of information infrastructure (II) failure directly, there are many contributions explaining II evolution that are relevant for discussing what it is and how it can be explained (e.g. Aanestad and Jensen, 2011; Bygstad, 2010; Edward et al., 2009; Ciborra et al., 2000; Grisot et al., 2014; Hanseth and Lyytinen, 2010; Hepsø et al., 2009; Monteiro et al., 2013; Rolland and Monteiro 2007; Star and Ruhleder, 1996). In particular, one stream of research conceptualizing II evolution as installed base cultivation is promising in this regard (e.g. Aanestad and Jensen, 2011; Ciborra 2000; Grisot et al., 2014). II evolution is in this literature perceived as a process where IIs are grown incrementally in a bottom-up fashion by extending or responding directly to what is already in place (i.e the installed base). This approach is particularly relevant for our discussion on failure issues since an installed base is not related to a specific system only, but the way that various systems, information, and practices are interconnected. Additionally, the focus on how an II *evolves* evokes a temporal perspective, and giving an analytic possibility for an II being both a failure and a success at different periods of time.

2.2 Combining with an installed base

The notion of *installed base* has its roots in economic theory of complex networked systems. In this perspective, all technological innovations have to maintain a certain degree of compatibility with an existing installed base, such as stocks of capital goods, skills, and know-how in order to succeed (Antonelli, 1992). Similarly in II theory, the installed base refers to what is already in place of interconnected systems, modules as well as the embedded work practices of different users that are relevant for establishing a new infrastructure. Hence, an installed base is considered highly socio-technical construct. Furthermore, in their early account, Star and Ruhleder (1996: p. 113) argue that an II is always "built on an installed base" and that "it wrestles with the inertia of the installed base and inherits strengths and limitations from that base". Henceforth, an installed base has a certain inertia giving strong impediments for any new II (Hanseth and Lyytinen, 2010) and thus there is a need for a smooth transition from an installed base to establish a new infrastructure (Monteiro, 1998).

In this sense, II-failure is closely linked to *failing to combine a new solution with an existing installed base*. In general, attempts to challenge the installed base with solutions that imply a radical break from the existing systems and practices are often proven at best difficult, if not disastrous (Aanestad and Jensen, 2011; Hepsø et al. 2009; Rolland, 2000; Rolland and Monteiro, 2007). A classic example is reported in Aanestad and Jensen (2011) there the Danish Ministry of Health attempted to implement a Nation-wide interoperable EPR[2] infrastructure aiming at replacing all existing EPR systems with a new standard. More over, the related documentation practices and existing information model were also attempted radically turned around. According to the authors, this radical strategy failed because the project did not take the strong inertia of the current installed base into account. This also illuminates that an installed base is socio-technical *per se* – since any technology in use will be embedded in users' practices and a wider organizational and institutional context (Kling and Iacono, 1989). In contrast, projects and infrastructures that have had a focus on extending and building new applications on top of an existing installed base have proven more successful. For example, Grisot and colleagues (2014), report from a project 'MyRec' in a major Norwegian hospital, and describes in detail how this project developed a modularized solution that maintained "sensitivity to the installed base of clinical practices" (.ibid: p. 211).

[2] Electronic Patient Records

2.3 Replacing and Extending an installed base

Existing literature often emphasize the organic nature of IIs by using concepts like *growing* and *cultivation* in order to describe how IIs evolve organically and incrementally over long periods of time by extending and/or modifying functionality and services (Aanestad and Jensen, 2011; Ciborra et al., 2000; Grisot et al., 2014). An emphasis on cultivation underscores that an II evolves in a distributed manner (Edwards et al., 2009), and that cultivation is not necessarily planned or anticipated in initial projects (Ciborra, 2000). In this sense, cultivation can often be characterized as small experiments involving novel extensions or modifications that typically need further refinement and diffusion among users.

However, cultivation can be directed towards different aspects of the installed base and involve different kinds of actions. For instance, Grisot and colleagues (2014) identify three main aspects of cultivation focusing on the growing a community of users, mobilizing different actors and learning from past experience with implementation. These three different kinds of cultivating all correspond to specific parts of an installed base of existing systems and practices in the hospital. Interestingly, both Grisot et al. (2014) and Aanestad and Jensen (2011) point at modularization of software as a key enabler for cultivating an installed base further. Amongst other things, the modularization strategy opens up for possibilities for experimenting and trying out new modules that later can be dispatched (Grisot et al., 2014). Also, a focus on modularization reduces the complexity and longevity of organizing and coordinating of relevant social actors (Aanestad and Jensen, 2011).

One way of distinguishing between different types of cultivating is to separate the acts of cultivating that are directed towards re-structuring the connections between different modules and systems that make up the installed base – from those acts that are extending it with new modules and systems on top of it. The former can be referred to as *internal replacement* where modules or systems are replaced and their connections are rearranged (Arthur, 2009). The later we can refer to as *structural deepening* where existing limitations of the II is worked around by adding new modules on top of existing ones (Arthur, 2009). Thus, cultivation failure can both relate to failure to replace existing modules and systems as well extending existing ones. An act of replacing or extending the II must not only correspond to various relevant social actors interests (cf. Wilson and Howcroft, 2002) – but must also combine with the relevant aspects of the existing installed base. Henceforth, an II-failure can be related to the failure to cultivate the installed base.

3 CASE STUDY AND RESEARCH METHOD

3.1 Research method

This research is part of an on-going longitudinal case study historically tracing the process of implementing Microsoft SharePoint in a global organization referred to as 'Bergen Drilling'. The case of Bergen Drilling was selected because of our keen interest in digital infrastructures based on software platforms in conjunction with the opportunity to study this in a particular turbulent business environment. In this respect, the case is especially relevant for researching issues of failure/success, because the organization during the last 5-6 years has undergone major organizational changes and subsequent transformations of a digital infrastructure as they have shifted to producing more advanced products and operating more on a global scale than before. This makes an "extreme example" which is well suited for theory development (Eisenhardt and Graeber, 2007). As further argued by Flyvbjerg (2006: p. 13):

> "Atypical or extreme cases often reveal more information because they activate more actors and more basic mechanisms in the situation studied. In addition, from both an understanding-oriented and an action-oriented perspective, it is often more important to clarify the deeper causes behind a given problem and its consequences than to describe the symptoms of the problem and how frequently they occur. Random samples emphasizing representativeness

will seldom be able to produce this kind of insight; it is more appropriate to select some few cases chosen for their validity."

At the point of writing, a total of 15 in-depth qualitative interviews lasting from 1,5 to 2,5 hours have been conducted and transcribed. The interviews were contextual interviews, involving interviewing while observing how the systems were used in the natural context of work whenever this was relevant. Additional 5 more informal discussions have also been conducted while visiting the research site. Here notes were written down shortly after or during the encounters. Collections of relevant documents like a technical overview of the IT infrastructure, IT strategy, and general information of the company have also been part of the analysis. Data analysis has been conducted following open coding and selective coding as inspired by grounded theory (Urquhart, 2013). However, this is not a grounded theory study as we were inspired by current literature on information infrastructures. More over we have used the "temporal bracketing strategy" as suggested by Langley in order to analyse how the SharePoint-based infrastructure has been mutually shaped by context over time (Langely, 1999).

3.2 Case description: Bergen Drilling

Bergen Drilling is a privately owned medium sized company located in the western part of Norway. Currently, the company has approximately 300 employees located at nine different locations in America, Asia and Oceania, including larger offices in Houston, US, Perth, Australia and a HQ in Bergen, Norway. The company has over the past 25 years or so been through a remarkable journey with substantial organization changes, mergers, splits, and collaborations resulting in numerous advanced technological innovations used around the globe by some of the largest companies in the oil and gas industry.

Bergen Drilling's main focus over the last years has been to produce various advanced drilling equipment to international oil and gas companies. A recent development is a new system for drilling safer and faster taking into account the uncertain conditions typically experienced in deep-water wells with problems of controlling pressure and stability of the well construction. The new system frequently presented as "the Flagship" of the company, has recently been patented and tested by a major international oil and gas company. The company assembles the Flagship locally in the small village in Norway and then ships it off to customers in one of the many steal cage containers that are stacked all around the HQ building with all the necessary equipment. In addition, an experienced team of drilling and production engineers is provided for helping the customer with setting up and testing the equipment at the local oilrig. These operations are usually organized in projects with a manager located in Norway.

3.3 Case narrative: Implementing multiple versions of an SharePoint-based infrastructure

In order to have better control over documentation as well as improving collaboration both within departments and across countries, the managing director of IT located in Bergen, Norway decided to implement an enterprise-wide system based on Microsoft's SharePoint 2007 software platform:

> We had something called [Xerox] DocuShare [for document management] – that was vividly referred to as Docu-Scare and was definitely not working according to the intention. Nobody could find anything there, it was not properly customized and implemented in the organization, and thus it tended to be used as a file server. There was a total lack of competence on it – and as usual everybody was busy with external projects and customers… [We] decided to implement SharePoint [2007] instead and hired a consultant. He was a competent consultant – and had knowledge about the special features and architecture of the product. We wanted to have a new intranet, team-sites and document management based on SharePoint. It was also the initial idea to integrate existing niche systems for supporting maintenance [of offshore oilrigs] (IT director)

Launched together with the Office 2007 package, SharePoint 2007 is a part of Microsoft's digital ecosystem fully integrated with Outlook/Exchange server email and the Word text editor. The sophisticated integration with other systems already part of the current installed base in Bergen Drilling made SharePoint attractive from both a technical and economical perspective. After some experimenting with SharePoint 2007 in the internal IT-department, a project was established in late 2009. The project was expected to be finished within 4 months with two consultants, one internal developer from the IT-department and the IT director as a project manager.

In contrast to the initial plans and expectations the project proved to be far more time-consuming and complex. In particular, the search functionality provided out-of-the-box in SharePoint 2007 was not considered appropriate for the organization. Since much of the documentation regarding drilling equipment and technical drawing typically are used across projects, searching was vital for engineers and project managers. In addition, as a side effect of the overwhelming number of metadata – documents were not always categorized correctly making them hard to track down through simple navigation. The out-of-the-box search feature in SharePoint 2007 required additional customizing in order to index and crawl documents in a PDF-format, which most technical documents and drawings were. The project therefore decided to get hold of a third party software module in order to improve searching. Through a process of searching for and experimenting with different alternatives, the project finally settled on “Lightening tools for SharePoint 2007”. Still, to the project’s surprise, irrespective of the new powerful search features the new infrastructure did not gain a critical mass of users.

In 2010, the Quality Assurance (QA) director was not content with the current way of managing digital documents regarding procedures for installing equipment on oilrigs and other technical documents. Thus, as a product owner of the project, he decided to structure documents according to a newly defined comprehensive meta-data structure. This strategy was in contrast to the existing information architectures found on file servers, an archive system for technical documentation (PDM), and DocuShare the existing document management system that was more structured in hierarchies of folders. Especially engineers and project managers did not concur with this radical new way of organizing digital content in the SharePoint-based infrastructure for, according to them - very good reasons:

> Well, there are lot of metadata for tagging – but not the right ones for my use. In our procedures we are supposed to do a risk assessment, so we produce a report there risks are analysed. And, then in the system there is no tag for ‘risk assessment’ or for something other relevant, so it typically gets tagged as a ‘report’

As this quote from an engineer working with following up quality and safety issues in projects indicates, the initial launch of the new infrastructure in 2010 did not manage to mobilize users for the new infrastructure as many continued to use existing systems, and various kinds of workarounds flourished.

However, 6 months after first introducing the new infrastructure to the first users, the project decided to migrate to a new version of the SharePoint platform (SharePoint 2010). This version came with the FAST search engine and hence made the recent purchase of the Lightening tools for SharePoint 2007 obsolete. The initial regime around meta-data was also re-designed to a more relaxed structure, and henceforth made more flexible for a wide variety of users and contexts. As the QA director underscored, “[Our] initial understanding was that SharePoint was like manna falling down from heaven that could be used to construct anything … but at least we have learned that it is not so easy”. The project struggled to migrate to the new platform, and after spending some 3 months in doing so, the official project was eventually stopped by the steering committee. The main argument was that the project had spent way more money and time than anticipated, and they had now succeeded in putting together a new infrastructure that at least technically was up and running. Thus in a classical sense, the project would have been condemned a failure at this point in time (late 2010).

On the other hand, at this point the project had established 5-6 so-called ‘superusers’ that had been given extensive training in customizing and using the new SharePoint-based infrastructure. This team of superusers together with a developer from the IT-department continued to fine-tune the SharePoint-based infrastructure long after the project had been officially stopped. This spurred some unanticipated innovations during 2011. For example, small applications were made for improving workflows and implementing verification procedures for technical drawings, order lists and other official documentation. This was supported by a newly established Document Control Centre (DCC) with the responsibility of managing all official documentation in projects, correspondence with suppliers of parts as well as how documents were stored on the new SharePoint-based infrastructure. The manager of the DCC also made a substantial effort in training and persuading project managers all around the world and engineers to adopt and use the SharePoint-based infrastructure according to the new work procedures and standards for documentation. The Manager explains her challenges:

> We tried to collect all documents in SharePoint – that was our aim. Then, we discovered that the SolidWorks drawings [technical drawings of drilling equipment stored in the niche IS SolidWorks] in the [new infrastructure], so now the policy is to keep them in SolidWorks, but the corresponding technical documents and the documents from suppliers are to be stored in SharePoint. But, then the engineers argue that some projects there is a need for having both the drawings and the procedures stored at the same place. Here we lost the battle. And as long as we are still establishing [the new infrastructure] – it is difficult to tell them to move from one system that works to the new [infrastructure].

The upshot here, is that the new SharePoint-based infrastructure did not support storing CAD drawings, and the engineers are then using this as an argument for continuing storing all documentation in the old SolidWorks system. On the other hand, the manager of the DCC wants the engineers to store some of the documents on the new infrastructure in order to have overview of all documents from suppliers.

The superuser responsible for quality in projects together with the developer from the internal IT-department took the initiative to design an application for systematically managing information about operations on oil wells. In the past, following up offshore operations had been done with an excel sheet, but as the superuser explains in detail this changed:

> [Previously] we did not have any tracking of our operations – how badly or good do we perform? There was no way we could know what equipment experienced re-occurring problems and how many hours of non-production we had… So with a helping hand from the IT people and use of Google, we found out how to do it [develop the RUN database]…. Here you see [pointing at the screen] – it is interesting to recognize that we had some hours of non-operational time for the last 18 months. And they all happened after a lot of activity had been conducted towards these wells. And both times in Canada. Looks as if there is a correlation. This is a kind of insight we did not previously have. So we got something out of the system [the SharePoint-based infrastructure].

Building on the capabilities of the new SharePoint-based infrastructure and their experience, superusers and the IT-department collectively managed to customize a new application by extending the existing system. Over time, this implied a shift in current work practices of at least project managers since a prerequisite of the new application now widely in use across the Norwegian-part of the organization, was exactly a quite detailed tagging of reports and information. Other users also acknowledged this as they explained to us, that over time, took it for granted that SharePoint requires meta-data – otherwise it will not work. Consequently, during 2012 the new SharePoint-based infrastructure gained momentum and more and more user communities started using it for various purposes.

During the summer of 2012 the company was sold, and split into three parts. The SharePoint-based infrastructure was then migrated from one network domain to a new network for what is now Bergen Drilling. In this process the various departments were also changed. These radical organizational changes also had large consequences for the digital infrastructure. The new organization re-organized so that the system that contained all the user access information had to be updated, and various integrations between existing systems had to be re-programmed, as well as some new systems were added. For the SharePoint-based infrastructure this introduced problems in that integrations stopped working and users' had to find new work arounds as one project manager explains:

> As for now [January 2014] it [the SharePoint infrastructure] does not make my work more efficient – rather the contrary. For example, when we upload documents here [Pointing on his screen to show how this is done] it is very cumbersome. Although I put documents into the project-specific site, I still need to add that [A name of a major oil and gas company] is the customer for all documents. I also would have wanted the system to be integrated with Navison [the accounting system] as the current solution demands me to contact a colleague in order to get the right project number." (A project manager located partly in Australia and Norway)

Finally, in late 2013 Bergen Drilling decided to establish a new project in order to implement further improvements in the infrastructure. Amongst other things, a migration to SharePoint version 2013 as well as integration between the PDM and the SharePoint-component of the infrastructure.

4 ANALYSIS

4.1 Combining with the relevant aspects of the installed base

Backed by 'industry best practice' as argued by consultants and the QA director's vision of increasing control of digital documentation, an approach to radically move away from the existing installed base was pursued. However, the installed base of existing interconnected systems, digital information, and work practices comprised a powerful inertia – even in a fairly small organization like Bergen Drilling.

Firstly, the organization had a system called DocuShare where official documentation as contracts, documentation of purchases of parts from different suppliers, and all project documentation were stored and organized. The new SharePoint-based infrastructure did not connect to DocuShare, and users had to upload one and one document manually from DocuShare (and other sources). Like this, it failed to offer a practical transition from the installed base to the new infrastructure (cf. Monteiro, 1998). Secondly, most of the technical documentation of the drilling machinery developed by Bergen Drilling as for instance procedures for installing and operating as well as the technical CAD drawings were created by engineers using SolidWorks and stored in a system called PDM according to a specific information architecture. Hence, in early 2010, the first attempt at implementing the SharePoint-based infrastructure did not account for the existing installed base like many other studies have showed would be preferable (Aanestad and Jensen, 2011; Grisot et al., 2014; Hanseth and Lyytinen, 2010; Rolland, 2000).

This first attempt also illustrates that failure is not only related to one specific system or project, but it is rather a *failure to combine with the relevant aspects of the installed base*. These 'relevant aspects' are the systems and components of the existing installed base that are in one way or another important for the relevant social groups that need to combine and connect with the new infrastructure.

It was not before the Document Control Centre (DCC) was established to provide a *gateway* between the installed base of SoildWorks and PDM, and the surrounding practices of documentation, the new SharePoint-based infrastructure became bootstrapped and widely adopted throughout the organization. According to existing studies this establishing gateways can be an important strategy for overcoming an installed base (Hanseth, 2001; Hanseth and Lyytinen, 2010). In this case, however, the gateway is not only a software module, but also new employees working in the DCC. This strategy also ensured a pragmatic balance between different relevant social groups who had different interests and practices. This was a solution that the QA director, engineers and the project managers could live with – although it was not considered an optimal solution by any of them.

4.2 Cultivating by replacing modules and by adding new modules

Cultivating took many different forms in relation to various IS and the global infrastructure in Bergen Drilling. Above all, the IT-department was working continuously with scripting, coding and deploying small software modules, and re-configuration of systems in order to keep the II functional. Internal IT architects and developers predominantly did this work. Grounded in theory presented above (e.g. Arthur, 2009; Grisot et al., 2014), we illustrate two different forms of cultivating related to whether the new SharePoint-infrastructure was perceived as a failure or success by different relevant social groups.

Firstly, the new SharePoint-based infrastructure was cultivated through *replacing* existing modules and *re-arranging* their relations. This was both SharePoint-related components and other components like the Active Directory (AD) – a component for identifying users and giving access to various IS in the wider infrastructure. This kind of cultivation was often required for mobilizing different relevant social groups for adopting the new infrastructure like in the example of the search feature in SharePoint 2007 that was replaced. However, this particular replacement did not effect project managers overall perception of failure. Replacing existing modules was also frequently done when new versions of SharePoint or other IS were deployed in the infrastructure. Based in our case study we argue that this cultivating is often necessary for introducing new functionality and services on top of an infrastructure. In many cases this type of cultivating does not give any new functionality *per se,* and hence it is often fairly invisible to end users, and in turn often does not directly affect the failure/success perception of many relevant social groups.

However, since these acts of cultivating often are an architectural prerequisite for adding further functionality they can have large consequences over longer periods of time. For example the decision to develop a script for transferring user information from the HR-system to the AD turned out to have large consequences for the SharePoint-based infrastructure when the company was split into three separate units. At first, this cultivation improved the SharePoint-based infrastructure in that it gave the users the correct access according to their role in the organization. After the split however, this was a source of frustration since the script stopped working. This example illustrates also the increasing complexity of the new infrastructure as it evolves and the temporality of it being conceives as failure or success.

A second type of cultivating is related to *adding and/or extending existing modules* on top of the infrastructure (cf. Grisot et al., 2014). Various smaller extensions were developed on top of the SharePoint-based infrastructure by utilizing the built-in capabilities of SharePoint 2010 software platform. In terms of failure/success this kind of cultivating turned out to be *essential for the bootstrapping* of the new infrastructure (cf. Hanseth and Lyytinen, 2010). Especially this was important in order to increase the adoption among project managers. It is also important to note that these extensions were conducted after the official implementation project was shut down. Arguably, the absence of the formalities of a project experimenting with the SharePoint-based infrastructure became less time-consuming as it involved a fewer number of relevant social groups. Also because the SharePoint 2010 software platform was already a part of the new infrastructure, it was relatively easy to design and configure new applications on top. This is comparable to the modular implementation strategy advised by Aanestad and Jensen (2011).

4.3 Was the new infrastructure a failure or a success – or both?

The first question that comes up is of course; To what extent was the SharePoint-based infrastructure at Bergen Drilling a failure or a success, and why?

Wilson and Howcroft (2002) claims that this is also a question of for *whom* the new technology is a failure or a success. This argument is highly relevant also in the case of the SharePoint-based infrastructure in Bergen Drilling. Clearly, the new infrastructure was perceived as more successful by project managers, administrative personnel, and QA managers, than by engineers who mostly used CAD tools like SoildWorks and PDM. Then again, not all project managers perceived it as successful. In particular those managers who were located in Azerbaijan and Australia, and working on a communications network with lower bandwidth did often find it too cumbersome to work with. On the other hand, the new infrastructure was portrayed a huge success at the actual workshop floor where the drilling equipment was constructed both by those who worked there and others. Here the new infrastructure was used to coordinate different teams and for distributing technical documents used in the construction of the drilling machinery.

However, the failure or success of the new infrastructure at Bergen Drilling cannot be fully understood based on solely examining the diversity and interests of the relevant social groups. A key issue illuminated in the findings of the case study is the alternating of failure and success over different periods of time. Similarly, the Wilson and Howcroft (2002) study show a downward spiral there the Zenith system was first conceived as a success, and then eventually left off as a complete failure by the entire organization. In the case of the SharePoint-based infrastructure we see a more complex picture. What is going on here is more of a *pronounced altering*, often in a cyclic manner, between failure and success. At specific periods of time, there are also fragments of failure and success occurring simultaneously across different relevant social groups and situations of use. At first in 2010, many relevant social groups portrayed it as a complete failure, and then in 2012 after cultivating it further the new infrastructure is by the same actors considered highly successful in supporting their work and the global organization as whole. But after a major re-organization in 2012, some actors argued it was a disaster while others still tend to describe it in more positive terms. These findings suggest that it is hard to answer the notorious "*failure or success*" question without looking at it from a temporal perspective. An important question regarding complex digital infrastructure then is: *when is II-failure/success?*

5 DISCUSSION

5.1 Three types of II-failure

Based on our study we identify three different types of II-failure that collectively conceptualize some key aspects of II-failures in organizations. Firstly, a focus on "*failure to combine with the relevant parts of an installed base*" differs in several ways from existing conceptualizations in the current IS literature. This focus directs the attention to how existing systems and practices have implications for how the new infrastructure is established and to what extent relevant social groups will perceive this as a failure. In contrast, much of the recent literature on IS-failure only focus on the political process of different – often conflicting relevant social groups without relating the discussion to the aspects of an installed base.

For example, in a very relevant interpretive case study, Fincham (2002) describes establishing a new digital infrastructure in the Bank of Scotland. In this paper, IS-failure is conceptualized as *organizational process*. Although giving a nuanced and insightful account on the process through narratives, issues of installed base is absent in the discussion. Leaving out the installed base risks removing the complexities of such processes, and influences from other systems and projects on the involved actors' perception of the new infrastructure. What we are arguing here, then, is not that a focus on failure as organizational process is wrong in the sense that the analyst will not be able to assess the extent of failure/success, but that the existing installed base of interconnected systems and practices that shape this effect would remain invisible. As for Lyytinen and Hirschheim's (1987) seminal concept of *expectation failure*, relevant social groups would surely have expectations that are at least partly connected to the installed base.

As seen in the Bergen Drilling case the way that the new infrastructure is *combined* with the installed base is likely to have a profound influence on failure/success and what relevant social groups who perceives an II as failure or success. Bartis and Mitev (2008) use the concept of *cultural fit* to explain a similar facet in their case study of an electronic work time registration (WTR) system. The authors argue that the notion of cultural fit helps to explain why the IS failed as it, amongst other tings, "neglected the incentives inherent in the worker's jobs…" (ibid. p.121). What a focus on II-failure can offer is to avoid discriminating between culture one the one hand and technology on the other hand, and also bring the issue of how 'new' technologies fit with 'old' technologies to the table. To this end, conceptualizations that account for the role of an installed base would be an attempt at theorizing the IT-artifact (Orlikowski and Iacono, 2001). As shown, the role of a technology's specific form, function and materiality is currently still predominantly absent in existing studies on IS-failure.

Secondly, a focus on "*failure to cultivate in terms of replacing modules and/or re-arranging relations between relevant modules*" also differs from current conceptualizations. Studies on IS implementation and related discussions of IS-failure are often biased towards the actions and consequences that occur during the lifetime of the official project (e.g. Boudreau and Robey, 2005). A focus on how an II evolves over time is important, since it opens up the possibility for having different consequences over time and thus also different perceptions of failure/success. Initial failure is not always a bad thing – and as argued by Sauer (1999) sometimes a prerequisite for success. Certainly this seems to be the case for II in organizations like Bergen Drilling. Sometimes part of an II needs to be replaced in order to enable new changes. A failure to do so can as illustrated by Thomas Hughes (1987) *reverse salients* – components that hold back further developments and innovation. Again, as far as we are concerned this is not evident in existing literature on IS-failure.

An II-perspective on failure/success	***Examples from the case***
Failing to **combine** new solutions with the relevant parts of a socio-technical installed base: - Failing to provide connectors from the new to the old and vice versa - Failing to establish gateways - Failing to mobilize relevant social actors in relation to the installed base	- Failing to combine with the DocuShare system, PDM-system and current practices for technical documents. - Succeeding to establish a gateway between the new SharePoint infrastructure and the installed base in terms of the Document Control Centre.
Failing to **replace** existing modules as part of an installed base and/or reorganize their connections.	- At first failing to replace existing modules stemming from previous versions of the SharePoint platform. - Failing to replace the PDM as a storage for project documentation.
Failing to **extend** a socio-technical installed base with new modules and/or reorganize their connections.	- The SharePoint infrastructure was successfully extended with new functionality for tracking well operations.
The **temporality** of failing/succeeding to combine, replace and extend the installed base.	Depending on the time period, the SharePoint infrastructure was perceived as: - a failure for relevant social groups, - both a failure and a success by different relevant social groups, and - a success for relevant social groups

Table 1. Mapping of case and concepts of II-failure

A third aspect of conceptualizing II-failure is "*failure to cultivate in terms of extending or adding new relevant modules*". Cultivation is often a response to what users' considers as discrepancies with current solutions or work practices. Extensions and modifications can in this context be referred to as *work arounds* that are necessary for combining new functionality with an existing installed base (cf. Pollock, 2005). Subsequently, this can explain why this type of cultivation is often – but not always, has a positive effect on how relevant social groups perceive II. Interestingly, in the case presented by Wilson and Howcroft (2002: p. 246), the authors underline, that "success and failure were legitimately ascribed to the same system over time". This is an important finding and illustrates the necessity to focus on how relevant social groups shape perceptions over time. Nevertheless, it is also possible that the additions and extensions that at first are perceived as a success, over time can lead to failure as this increases the complexity of the II. This evokes the role of architecture in II evolution, which is becoming increasingly important in enterprise-wide II-evolutions where numerous IS are typically interconnected (e.g. Bygstad, 2010; Grisot et al., 2014). This later perspective on the role of architecture or architecting is currently not discussed much in existing IS-failure literature.

5.2 Beyond the dichotomy of failure/success: a temporal perspective

As argued in recent literature, the theme of IS-failure is highly socio-technical and complex and needs to be treated with a more nuanced grasp (e.g. Bartis and Mitev, 2008; Fincham, 2002; Wilson and Howcroft, 2002). Simple taxonomies of what is success and what is failure – or the assumption that an IS could either be defined as a failure or a success, have largely been falsified in recent studies. Investigating the temporal aspects of IS and digital infrastructures is an important part in this – as relevant social groups are not stable in their perceptions of technologies. Neither are the technologies that undergo continuous cultivation of different forms and of different aspects of the installed base. From a perspective of installed base cultivation as outlined above, an II evolves over longer periods of time. Obviously, the Internet infrastructure is entirely different now compared to 20 years ago, 10 years ago and even one year ago. The upshot then, is to analyse how relevant social groups perceive success or failure over time.

Partly, the temporal issue in researching IS-failure in organizations is a *methodological challenge*. IS research has to stay for a longer period of time or revisit old sites in order to get better informed about the evolution of IS in organizations. This point has recently been articulated by Williams and Pollock (2012: p. 2) who argue that "[rather] than study technologies at particular locales or moments that we should *follow them through space and time*". In light of their own experiences with revisiting a previous case of a 'successful' enterprise system implementation producing the familiar workarounds allowing existing practices to flourish, now some years later "had all but disappeared and that practices and processes across the university had now mostly become aligned with those originally embedded within the ERP templates" (.ibid: p. 4). Especially, this is important for technologies like large-scale enterprise-wide II as we obligingly have attempted to illustrate – at least partially, in this short essay. However, temporality is also a theoretical question (Butler, 1995; George and Jones, 2000). For example, George and Jones (2000) argue that temporal aspects should have a larger saying the theorizing in organizations, and hence also for themes like IS-failure. For example, do different forms of cultivating occur in a rhythmic or cyclical fashion? And, how are the past, future and present represented in existing perceptions of failure/success? When is an II likely to perceived as a success by certain relevant social groups? Highly relevant themes and research questions are almost endless.

6 CONCLUSION

This paper has attempted to conceptualize information infrastructure failure. In so doing, we have tried to fill a gap in the existing IS-failure literature, which we have argued does not account for the interconnectedness of current IS and digital infrastructures. In this paper we have argued that there is a need for not only methodologically – but also theoretically, adopt a temporal perspective in studies of failure/success. Especially, in the case of II that can evolve greatly over time. In a modest attempt to fill this gap, this paper based on a case study of a global company, has proposed three types of II-failure that shed light on why an II-fails (or succeeds). Furthermore, this conceptualization we argue, also explains how an II can at some point be defined a failure while at a different point in time defined as a success.

Needless to say, this paper also has its limitations. First, future case studies of II-failure should aim at being even more longitudinal as II typically evolves over decades. Second, future research should focus on various forms of cultivating II and their shaping in a wider context. Third, attempts should be made to theorize the temporal aspects of IS-failure in a more detailed way.

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