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RUNNING TO STAND STILL: EXAMINING THE ROLE OF INFORMATION TECHNOLOGY IN INDUSTRIAL RISK MANAGEMENT

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Abstract

This paper reports the findings of a qualitative study undertaken at Smurfit Kappa Kraftliner. Based on Giddens (1990) and Beck (1999) we examined strategies for risk handling in connection to industrial IT. We found two pervasive problems where, paradoxically, the approaches to risk containment resulted in risk diffusion, rather than containment of risk, throughout the plant.

Keywords: Risk Management, Industrial IT, Risk Containment Strategies

1 INTRODUCTION

Information technology (IT) has grown from being a means of automating data processing to being the critical infrastructure for doing business today. Clearly, more than any other technology IT is judged to be a critical success factor of a business organization in today's global competitive market. While organizations are continuing to invest large sums of money in IT in anticipation of a material return on investment (Willcocks & Lester, 1996) there are doubts as to whether IT investments have proved economically successful at all. Hitt & Brynjolfsson (1996) demonstrated that the relevance of an IT investment should be related to productivity, improved business profitability and value for customers. They argued that IT could have a positive impact on productivity but it is difficult to find an empirical connection between the benefits associated with new IT and higher business profits.

In the day and age of high-risk organizations there is an increased risk awareness – an insight into the consequences of socio-technical breakdowns. This awareness is not based on a blind belief in experts but rather on a more critical view of the idea that experts should have a monopoly in identifying and evaluating risks (Giddens, 1990; Lash et al., 1996). This critical view necessitates, and gives room for, more open and deliberative processes for identifying and formulating risks and the handling of them (Macnaughten & Urry, 1998).

Traditional risk management studies have provided useful analytical and management tools to address the challenge of an IS project and individual organizational settings (see Lyytinen *et al.* (1998) for an extensive overview). However, they fail in describing how and why local risks may escalate from a local to a global scope. Based on a case study conducted at Smurfit Kappa Kraftliner, the aim of this paper is to investigate the role of IT in relation to risk in industrial contexts. Building on the observation that IT can inhibit as well as enable social action (Orlikowski and Robey, 1991) our research question is: what inhibiting and enabling effects does IT have on risk?

The remainder of the paper is outlined as follows: The next section deals with IT risk management as seen through a risk society lens. In section three we present the case, which is later analyzed in section four. We conclude with some lessons learned for both researchers and practitioners.

2 IT RISK MANAGEMENT IN THE RISK SOCIETY

Organizational experts have analyzed the safety performance of high-risk organizations, and two opposing views of safety management systems have emerged. One viewpoint—normal accident theory (Perrow, 1999)—postulates that accidents in complex, high-technology organizations are inevitable. Perrow believes that interactive complexity and tight coupling make accidents more likely in organizations that manage high-risk technologies. Perrow's hypothesis is that, while rare, the unexpected will inevitably overturn any safety system and accidents will eventually happen.

An alternative point of view maintains that good organizational design and management can significantly delimit the likelihood of accidents (Rochlin, 1996; LaPorte, 1996; Roberts, 1990; Weick, 1987). High-reliability organizations are characterized by the way in which they appreciate safety, flexible and decentralized operational decision making, and a continuous learning and questioning attitude. While high-reliability organizations manage systems that depend on complex technologies and pose the potential for catastrophic accidents, they have fewer accidents than industrial averages.

Following Beck (1994; 1999) our society is characterized by a process of reflexive modernization; modernity feeds back on itself, possibly undermining its own foundations. "Risk society" is the metaphor Beck uses to describe the overall direction the society is taking. In the risk society unintended consequences and side-effects often challenge aims of increased control and rationalization, perhaps paradoxically making risk the very result of control and risk management. In the IS literature, only a limited few studies deal explicitly with issues of risk, reflexivity and side effects. Hanseth and Braa (2000) draw on reflexive modernization theory in exploring the role that IT may play. This framework is applied in an analysis of SAP implementation in a Norwegian company

(Hanseth, Ciborra, Braa, 2001) in such a way that events in the implementation process are put in relation to the dynamics of modernity and globalization in general and the side effects that is characteristic for this era in particular.

There are two main approaches risk management in IS research: First, a traditional approach to interpreting and managing risk (see e.g. Lyytinen *et al.*, 1998) and second, a perspective on risk inspired by the sociological contribution of Beck (1999) and Giddens (1990) to the debate on globalization. This latter view, ushered in to the realm of IS research by Hanseth (see e.g. Blechar & Hanseth, (2007)) is a view we find useful for the purposes of this paper.

Risk management approaches have traditionally focused their attention on identifying specific sources of risk and then developing management techniques well fitted to control these risks (Boehm 1991; Lyytinen *et al.* 1998). While striving to provide rich analyses for how to deal with risk involved in IS development, these traditional approaches fail to explain why it is increasingly difficult to manage risk. In risk management approaches the nature of risk is considered as being connected to individual projects or individual organizational contexts. To this end, we share Hanseth's concern over the way in which risk is traditionally managed and we agree with his assessment that we need to reconsider risk as a whole (Hanseth, 2000). The expansion and increased integration of systems, within e.g. the paper and pulp industry, creates an increasingly complex socio-technical infrastructure (Blechar & Hanseth 2007) in which new risks may emerge, and new ways of risk management may be needed.

3 CASE

3.1 Generating data

This research is founded on an interpretive epistemology (see e.g Walsham, 1995) and the data in this study has been generated by observation and semi-structured interviews with a range of personnel from Smurfit Kappa Kraftliner and their main IT-vendor ABB. Data has been generated rather than collected in the sense that we do not believe that data relevant for this study are out there, waiting for us to gather them up. Our main goal when designing this study, in terms of methodology, has been to identify relevant data sources from which data can be generated (Mason, 2002)

The selection strategy for the interviews aimed at including as many different perspectives as possible. In a discussion with the IT manager we identified operators, technicians, maintenance personnel and project managers as key categories of employees. Furthermore the IT manager, the Process IT manager and the manager for Maintenance and Projects were interviewed, as well as a representative from their main IT-vendor ABB. All together 12 interviews were conducted over a three day period. After transcribing, we analyzed the data by categorizing the risk issues raised. This allowed us to also discuss and highlight risks of more aggregated, overarching character.

Each interview lasted approximately one hour and was digitally recorded, and later transcribed. The basic epistemological premise behind the choice of method and the selection of actors to interview is the idea that people working in a certain environment possess deep and relevant knowledge and perspective concerning their work, and that an observation of their working environment followed up by an in depth interview yields relevant qualitative data.

The qualitative approach was chosen because of our idea that the relevant knowledge needed to reach our aim, resides primarily with the people actually working in this environment. What constitutes relevant knowledge is guided by the research question, the perspectives of the people with intimate knowledge of the work being done, and our perspective as researchers. Hence we chose interviews as a means to collaboratively generate data.

The observation preceded the interviews in order for us to gain a better understanding of the work being conducted, and the process as a whole. This allowed us to formulate and contextualize the

questions and issues discussed in the interviews, in addition it amplified our chances of recognizing interesting areas and exploring them further with follow up questions. The observation included a four hour guided tour at the plant, and time spent in the control rooms of the operators.

Categorizing is at best a tricky endeavour, as the world seldom fits neatly within strictly defined and clearly separated categories. Still, there are benefits to such an activity and form of presentation. Below we present the result of our study, ordered in the main risk source categories we chose to use. The categories we finally decided on came as a result of a three stage analysis of the data. After transcribing and re-reading the interviews and notes from the observation, we discussed different possible categorizations. By striving for a large degree of theoretical flexibility to ensure that the emergent categories were built on the empirical findings we did not use a formal hypothesis to guide the analysis. We organized the data contextually (Mason, 2002) in order to better be able to identify interwoven parts of the data set.

Organizational risks encompass risk issues related to the organizational structure and roles, and to the installed base of technology currently in use at Smurfit Kappa. Personnel related risks are used to describe risk issues connected to the work force, both as a whole and on a more individual basis. Under management related risks we have sorted sources of risk more closely connected to the decision making processes regarding IT use and direction. Finally, vendor related risks encompass risks associated with the relationship between Smurfit Kappa Kraftliner and their IT-vendors.

Other categorizations are of course possible, and would paint a slightly different picture, but the main risk sources would be the same and we believe our way sheds light on some interesting things. We have also chosen to include sources of risks that today are successfully handled by Smurfit Kappa Kraftliner and their employees, in order to make explicit what facilitates this success.

3.2 Smurfit Kappa Kraftliner

Smurfit Kappa Kraftliner in Piteå, Sweden is Europe's biggest kraftliner producer, annually producing 700 000 tonnes of kraftliner used for production of high quality corrugated packaging. Currently some 600 people are employed at the mill and in the R&D department, of whom approximately 200 are shiftworkers.

The use of information technology in production processes has increased every year, and today it's presence is as good as ubiquitous. The responsibility for IT issues at the mill is divided between the IT department and the Process IT department. A rough description of the areas of responsibility shows that the Process IT department focus on IT use in the actual mill, including control systems, process stations, field units, sensors etc, and the IT department focus on administrative systems such as business systems.

The information infrastructure at Smurfit Kappa is becoming increasingly integrated and complex, which means that the borders between the two departments are not clear cut or closed.

3.3 Organizational risks

Systems longevity and spare parts. The life span of systems used in the factory differs, and for the systems with a long life span getting hold of spare parts are today problematic. Smurfit Kappa has a about 60 Contronic P process stations in use today, constituting an important part of regulating the production process. The process stations has been in place since the late 80's and work well. A big problem is however that spare parts to Contronic P no longer are manufactured, and Smurfit's own stock of spare parts are rapidly dwindling. The process stations are being replaced by more modern ones, but at a moderate pace, currently six stations a year, due to the high cost and in order not to disrupt production. When a station is replaced Smurfit Kappa will salvage as many parts as possible in order to boost their supply.

This does not solve the problem of spare parts shortage, as there is no way of telling if the part will actually work in another process station, especially after a year or to on a shelf. Regularly testing the spare parts is not an option used by Smurfit as the risks, and required effort, are too high. There is no way of telling when the spare parts will run out, but the situation today is described by the Projects and Maintenance manager as precarious.

“The big risk I can see today is that if we have a major disturbance, resulting in the malfunction of three or four process stations...we can’t handle a situation like that because we cannot buy enough spare parts to get them up and running again. That means we have to replace them with newer models. An unplanned change like this would require several months of programming activities because the software in newer process station models aren’t compatible with the old...this is a major risk” “and even though we are aware of this, even if we were to get enough money to buy all new process stations, we wouldn’t be able to do it because there aren’t enough people with the right engineering knowledge available. To replace the hardware is much less of a problem, the major issue is configuring the software” (Projects and Maintenance manager)

This kind of risk is likely to be repeated even if the current situation with Contronic P is successfully resolved.

“Looking at the shorter life span of systems, and the rate at which we are able to replace old ones, before we have replaced all of our Contronic P stations, the new system will be obsolete, and we’re back in the same situation again” (Project and Maintenance manager)

Maintenance is another type of organizational risk. Continuous production is paramount to Smurfit Kappa as the cost of halting production is very high. This means minimizing stoppage time is an essential aim for the organization. This poses a challenge for conducting maintenance processes. Every year there is a five day planned production stop (and each month there is a short maintenance stop) during which larger maintenance tasks can take place. The tasks and activities that take place during this week are carefully planned for long in advance in order to make full use of the stop.

The window of opportunity to perform maintenance that requires testing of vital parts of the production process is then rather narrow, and only occurs once a year. During the rest of the year maintenance activities primarily focus on making sure the production process doesn’t stop, fixing things that break down, solving problems as they crop up. This is a source for risk as a lot of things identified as “things we should do something about” seldom gets done, things that are not important enough to warrant a place on the five day stop list, and at the same time are not a direct threat to the production.

A third kind of organizational risk is the heterogeneity of the infrastructure. The information systems infrastructure at Smurfit Kappa Kraftliner is heterogeneous and at the same time it becomes more and more integrated. This means that when replacing a part or installing a new system, the task of integrating the new with the old is as important as it is difficult. With the high degree of systems integration even simple tasks like indexing becomes difficult by the sheer number of items to be indexed. Furthermore, every new part must be configured so that it is compatible with what is already there.

This means that even standardized products are challenging to implement. The importance of continuous production makes it important to configure the new part to resemble the one being replaced, no matter what new functionality the new part may offer.

We cannot afford to experiment. We are supposed to be conservative with regards to functionality, because production is what matters. Experiments can be carried out on machines which can be at a stand still for five hours without any consequences. Five hours here cost too much” (Process IT manager)

Collaboration is another risk associated with the organization. When solving a problem, or detecting a potential problem and pro-actively taking appropriate measures, collaboration between different parts

of the work force at Smurfit Kappa is essential. The production process is interconnected which means that problems in one part of the process has consequences for the other parts. Having to restart the process after a complete halt is much more difficult than speeding up after going at half speed.

This is one reason why operators in different parts of the process keep in touch with each other when something happens. To make adjustments along the process line so that it never has to stop. If the boiler is malfunctioning, then the operators at the paper machine can slow the pace of the machine in order to make the pulp currently available last as long as possible – giving the pulp boiler crew as much time as possible to fix the problem.

The collaboration between operators and technicians and maintenance personnel also help significantly shorten the time to locate and solve problems that arise. This is greatly due to the fact that knowledge about the process and process related technology is shared throughout the work force. Paper machine operators have enough knowledge about the technology in their environment to greatly reduce trouble shooting for the maintenance personnel.

Technicians work in small, often ambulating, work groups and make a point of checking in with their fellow employees while moving about, in order to stay updated and maintain the social bonds that helps facilitate the important collaboration. To some extent the collaboration is supported by the information systems, e.g. the intranet, however much is accomplished through the use of telephones and face to face meetings.

Finally, knowledge (management) is recognized as an organizational risk issue. An important challenge for Smurfit Kappa Kraftliner is to be found in how they successfully will be able to manage the knowledge base within their organization. The main part of the work force has worked at the mill for a long time and are very experienced. This experience, and knowledge, constitutes a key factor for handling many of the everyday problems and risks at the mill. Smurfit Kappa runs the risk of losing valuable knowledge if the experience and knowledge acquired over the years is not secured.

In order to do so Smurfit needs to find ways to recognize relevant knowledge amongst their employees, and then devise ways of either formalizing it or make it transferable in another way (e.g. through trainee programs). Some of the knowledge is tacit, making it difficult to spot, let alone formalize. To get an overview of the relevant knowledge presently to be found at Smurfit Kappa is important in other ways as well. It can increase Smurfit's ability to coordinate and put together work groups, and act swiftly if unforeseen events occur.

3.4 Personnel related risks

Significant for Smurfit Kappa Kraftliner today is the homogeneity of their workforce. A large part of the work force at the mill has over twenty years of experience. They know each other well and work together well, which in many ways is beneficial for Smurfit Kappa. However, it also hampers change to some degree. Relationships, attitudes and practices are cemented, often shared and deeply rooted. New perspectives and ideas that challenges the equilibrium can be difficult to implement. When new technology is proposed and implemented there is a tendency to use it the same way as the previous technology.

A changing of the guards is also looming for the paper mill. The turnover of personnel at the mill has been relatively low, and a majority of the work force has been there for over twenty years. Within the next decade many of today's employees will enter retirement, leaving the organization deprived of their knowledge and experience. Replacing them will be quite challenging for Smurfit Kappa. To handle this risk the organization needs to start in time, addressing the problem of defining and securing relevant knowledge (explicit as well as tacit).

Another risk issue related to personnel is the current dependency on key individuals. The production of kraftliner at the mill has doubled since the mid-eighties, at the same time the number of employees has been reduced by approximately 30 %. The demands and responsibilities on operators, technicians

etc. grow as middle management are being removed. The foremen were removed from the mill in the nineties, now (in the spring of 2007) the production planners will disappear.

The infrastructure is very complex through it's heterogeneity, integration and continuous technical development. This means that replacing people, who for some reason are unavailable, becomes increasingly difficult, and the demands on those who are available are raised. This certainly narrows Smurfit Kappa's room to maneuver, and should be considered a risk.

"For instance, just before coming here I spoke to the manager of another division here at Smurfit. One of my guys has put in for a transfer within the organization, with better hours and less time on call. So, this other manager, under whom my guy will work, asked me when I'm willing to let the transfer go through. If I were to answer truthfully I'd say "in about two years", because that's how long I reckon it will before we have a fully trained replacement for this guy....If he leaves in three months, then we have to cancel a major maintenance project, because we can't replace him."(Process IT manager)

Knowledge (requirements) is also a difficult and important challenge. As indicated above Smurfit Kappa needs to systematically manage relevant knowledge. In addition to the reasons already discussed, this is an important step towards being able to formulate required knowledge for new employees. Doing this is by no means an easy task. Some of the relevant knowledge today is tacit, making it difficult to formulate requirements.

When looking at the work being performed by operators, technicians and maintenance personnel it is clear that they perform complex, demanding tasks that basically corresponds to descriptions of work typically performed by engineers. Recruiting people with the desired skill and not too high demands on wages will be difficult

The final risk issue we have identified and categorized as personnel related is data representation. As automation of the mill increases and new control systems are implemented, the operators interactions with the machines rely more and more on digitalized representations. It is important that these representations adequately translate relevant information about what is happening at the mill.

Today, the operators use the control systems to monitor the performance of the machines. They work extensively with graphs depicting trends, e.g. temperature. By continuously monitoring these graphs they get an overview of the state of affairs in their part of the mill, which allows them to take proactive measures. Built into the control systems there are a large number of alarms, to help the operators recognize a problematic situation.

Operators act in a very information rich environment, and it is important that the data representation is reliable and relevant. If something unforeseen happens, time is often of the essence. Therefore the feedback from the control system needs to be quick and obvious. Not every relevant aspect can be represented in the control system, sometimes depending on the lack of ability to measure or quantify. Therefore operators make use of other technologies to trouble shoot. TV-cameras are strategically placed in places where things sometimes go wrong, places which are hard to inspect otherwise.

When something goes wrong, operators also often make use of their senses to help them locate the problem. Smell, sound, touch are regularly used by experienced operators to detect and fix problems. Experience and knowledge like this is hard to represent successfully in a control system, yet they constitute important tools for accomplished operators.

3.5 Management related risks

The increased dependency on other actors is evident in this case. Smurfit Kappa can be described as an IT dependant organization. IT permeates the organization and constitutes an increasingly complex, integrated installed base, affecting how things are done and where to go from here.

"There are CPUs in everything these days, soon our hammers and cutting pliers are fitted with processing power" (Process IT manager)

This has resulted in an increased dependency on others in order to keep the mill running. The dependency on information technology and the complexity and character of their installed base, has made Smurfit Kappa increasingly dependant on their IT vendors for upgrades, support, trouble shooting and advise. This is problematic because it is not obvious that Smurfit Kappa and their vendors share the same goals all the time. The IT-vendors want to sell products and services to make a profit, and this aim may well collide with Smurfit Kappa's.

Securing continuous production is paramount at Smurfit Kappa, so they strive for control and equilibrium. IT-vendors and the information technology industry develop new tools and systems at an increasing rate, products they want to sell. Spare parts go out of production and stock, education and support are hard to come by if you use old systems and technologies.

The tactics employed so far at Smurfit Kappa aim at upgrading only when necessary, and making a huge effort in integrating the new part as seamlessly as possible. This often means that functionality offered by the new part, or system, is not put to use.

Time to implementation is becoming a risk issue more than before. The cost of investing in new systems or conducting major maintenance projects is usually high and, given the timeframe offered by the narrow windows of opportunity to implement the changes, time consuming because they need to be planned out in great detail. The IT or Process IT departments plan for these changes, and then apply for project funding. If the requested funds are granted, planning and preparation are conducted within the departments in order to as rigorously as possible make sure the changes won't hamper production.

The time frame from initial plan to implementation is often in the region of twelve to eighteen months. A trend in recent years has been that the point in time for the decision to grant the funds needed is moving closer and closer to the suggested implementation date, making time for testing and preparation shorter. This is considered a risk as the time and resources needed to properly prepare for integrating new entities in the infrastructure grow in step with the increased complexity of the installed base. This way, Smurfit Kappa becomes even more dependant on the few people available who have the knowledge required to successfully carry out such projects.

The way in which management view IT-related issues is also important. Developing and maintaining the information technology at the mill is, because of it's complexity and ubiquity, an expensive and continuous activity. How IT investments in IT and maintenance needs are viewed by the people deciding how to allocate resources, is important. Unless they can see a good reason for investing heavily in e.g. a new control system, the resources making it possible would in all likelihood not be made available.

This certainly is a challenge for actors at different levels at Smurfit Kappa, to express their need in a way that leads to adequate funding. This can at times be difficult, especially when they themselves have no wish of changing or replacing a functioning part, but feel forced to do so because the supply of spare parts are all but emptied. As the manager for Maintenance and Projects puts it:

"It's really difficult to ask for money to replace something that works fine...I mean, how do you explain to someone that we have to make huge investments in something that will, if we are lucky and work hard, work exactly the same as our current system. When you speak to the vendors they agree that the new product probably won't add any value to our process, but that there of course are new possibilities. In other words, we cannot really say we ever will have a return of investment, our production will not get better, the quality will not improve. Our only argument is safety reasons, risks. But, of course, there are no models for determining what the risks are for the system, at best someone has looked at a component. The only thing we know about new systems is that they take quite a while to break in so to speak, there are a lot of problems. How do you explain this to the management?"

3.6 Vendor related risks

When and how to choose direction in IT-related issues is a major concern for the organization. The rate of technical development is high, and the structure of the market has changed over the last decade

or two. When Smurfit Kappa invested in the Contronic P system in the mid-eighties, the vendor Hartmann & Braun was one among many. Like many of the smaller vendors, they were subsequently taken over, and Contronic P merged into ABB's product portfolio.

For some time big vendors like ABB or Siemens built every part of their products themselves and stocked up on spare parts. The increased standardization of information technology parts has facilitated outsourcing of parts of the production and today ABB rely on third-party vendors to supply them with parts to their products. This has had an effect on the rate of development, where new functionality and features are part of the everyday life of e.g. a control system.

New standards emerge frequently and it is very difficult to know when it is time to switch, or what path to choose. Smurfit Kappa are, by earlier choices, tied to ABB's product family, but even within a certain vendors portfolio, bad choices can be made. Three years ago Smurfit decided to invest in a certain control system, sold by ABB, because it was compatible with their Contronic P process stations. After replacing the control system in one operator room, ABB announced that they would focus their efforts at another control system in their portfolio. Soon support became hard to get, ABB technicians skilled at the system Smurfit bought very hard to find – unless you happened to live in Germany.

Had Smurfit Kappa decided on the other control system within the ABB product family, things would have been rather different. Now they are faced with yet again having to seriously consider changing technological direction, at a large cost.

The coordination of knowledge is a vendor related risk. The competence needed to conduct maintenance, go through with replacing components and systems or handling unexpected situations are in part to be found at the IT-vendors. In the case of Smurfit Kappa it is very important that people with the right kind of knowledge are located in the vicinity, because the cost of a stand still is quite high and many problems require that you are present at the mill to be able to handle. Therefore they have opted to as much as possible keep this kind of competence in the organization.

They cannot cover all their bases, so it is important for them to coordinate their efforts with people from their IT-vendors, especially when time is a critical factor. This means that it, besides from knowing where to turn for help in a certain situation, is important to establish areas of responsibility between Smurfit Kappa and their vendors.

4 DISCUSSION

The aim of this section is to analyze and discuss the empirical material, exploring in detail the dynamics of risk generation. Building on the idea of the risk society and the side-effects characteristic for this age we will focus on the seemingly paradoxical idea of how risk management decisions in fact generate new risks. The overall the aim of this paper is to investigate the role of IT in relation to risk in industrial contexts. In an effort to achieve this aim we have, in the previous section, identified a number of risk categories. In this section we will explore these in more detail, and examine in some detail the way in which risk diffuses throughout Smurfit Kappa Kraftliner's organization.

4.1 Running to stand still

Looking at the different risk categories presented above a pattern is beginning to emerge. The paramount concern for Smurfit Kappa is to maintain continuous production, and it is in this light certain things and situations seem problematic or risky. Continuous production hinges on Smurfit Kappa's ability to achieve infrastructural equilibrium, successfully handling unexpected events and side effects. This is becoming harder and harder as the heterogeneity of the installed base increases, as does the dependency on other actors (e.g. with regards to spare parts, development of new standards or technological innovation). The effort and knowledge needed to keep production running smoothly is

ever increasing, and it is in no way certain that the strategies employed at Smurfit Kappa to handle short term threats to production will aid them in the long term.

4.2 Risk diffusion by means of a risk containment strategy

Risk containment is a key concern at Smurfit Kappa Kraftliner. Industrial IT is seen as a risk object and the infrastructural characteristics is downplayed and resisted heavily as it could enable risk to be spread throughout the organization. Perhaps paradoxically, then, the very strategy that aimed at containing risk became the means by which risks were diffused.

The risk management literature did not make inroads until scholars recognized that the relationship between risk management efforts and risk diffusion was more complex than was depicted in traditional risk management literature. In particular, Hanseth (2001) has explored in some details the side-effects of risk management efforts.

The way in which risk was contained was through a non-use approach. Even though there existed an industrial IT infrastructure at Smurfit Kappa Kraftliner it was not used to its fullest. The aspect that was systematically resisted in the infrastructure was the integrated aspects. The infrastructure was not integrated to the degree it could have been in order to delimit risk diffusion.

The system design was deliberately decoupled in order to increase safety, but as a side-effect of this the possibilities for predictive risk management were undermined. There is currently a risk management capability at Smurfit Kappa Kraftliner that can be characterized as reactive, i.e. a capability that has to do with acting upon risks as they have become a reality. By contrast, the possibilities for a predictive risk management capability can only be explored by relying on the IT infrastructure that was resisted.

4.3 Risk diffusion by means of an isolationist approach

The non-use strategy described above, carried out by carefully adapting new components to mimic the old, has resulted in a highly idiosyncratic infrastructure. The effort, and intimate knowledge of the installed base, needed to implement change is ever increasing, leaving Smurfit Kappa to heavily rely on a few key people. These are today almost exclusively to be found within the organization.

Using an isolationist approach like this in order to contain risks that threaten continuous production in the short run results in a situation where Smurfit Kappa is increasingly vulnerable in the long run.

Highly reliable organizations actively prepare for the unexpected, and the isolationist approach does not cater for this. The flexibility to outsource operational and safety authority to vendors in response to unexpected conditions is thus important because the vendors hold an in-depth system knowledge necessary to make the rapid decisions that are essential for maintaining a highly reliable organization.

Our study illustrates well how Smurfit Kappa are torn between keeping the competence indoors on the one hand and effectively finding relevant competence for the task at hand on the other. Building on the idea of the risk society and its side-effects we argue that an isolationist approach to risk management is bound to fail in effectively containing risk. On the contrary the side-effect of such a strategy is the diffusion of risk throughout the plant.

4.4 The dialectics of change

Taken as a whole, our findings support the idea of the dialectics of change during IT implementation and use. Van de Ven and Poole identified the dialectic motor of organizational change, which emphasizes a “pluralistic world of colliding events, forces, or contradictory values that compete with each other, for domination or control” (Van de Ven and Poole, 1995, p. 517). This dialectic interplay between two or more opposing entities was the basis for Robey and Boudreau’s (1999) proposed “logic of opposition” to explain the diversity of organizational consequences of information technology.

Looking at our case, the toggle between risk and safety reflect the signs of dialectic forces: old memory and new knowledge combined in unusual ways as people cope with new systems that they only partially understand, and risk and safety as concepts that each defines the other; we can only understand safety in contrast to risk, and vice versa. Over the years this has been a fruitful relation in the process industry and looking at Smurfit Kappa Kraftliner it has shown the characteristics of a high reliability organization for years. With the advent of new IT immersed in everyday life in the factory, however, new risks emerge. The pace of change needed to keep up with these new risks is seemingly overwhelming. Smurfit Kappa Kraftliner are effectively 'running to stand still' in order to keep up with the new risks ushered in by new IT. As illustrated in this case a new safety regime has emerged at Smurfit Kappa Kraftliner that does not sufficiently build on the dialectics between risk and safety. In fact, the key move to keep risks at bay has been by the 'non-use' approach. The risk containment approach and the isolationist approach are responses to the challenges raised by new IT in terms of risk.

Not only is this damaging for innovation and productivity, it also fails in accomplishing the very thing it aims at: safety. The risk management approach that has emerged at Smurfit Kappa Kraftliner can be labelled as an *undialectical dialectics*, to borrow a phrase from Heller (1999). The fruitful dialectics between risk and safety has now become unproductive, in order to design a manageable pace of change.

5 CONCLUSIONS

In this paper, we have investigated the role of IT in relation to risk in industrial contexts. Based on a case study conducted at Smurfit Kappa Kraftliner we analyzed and discussed how new risks were generated and diffused.

While risk management approaches have traditionally focused their attention on identifying specific sources of risk and then developing management techniques fitted to control these risks (e.g. Lyytinen *et al.* 1998) we are concerned with the way in which risk is traditionally managed since traditional approaches fail to explain why it is increasingly difficult to manage risk. In traditional risk management approaches the nature of risk is considered as being connected to individual projects or individual organizational contexts. To this end, the approaches used by Smurfit Kappa to manage risk paradoxically have side effects that result in diffusion rather than containment of risks. Based on Giddens (1990) and Beck (1999) we have explored this in some detail and identified two pervasive problems in this setting.

We have shown how the reactive non-use approach employed by Smurfit Kappa leads to risk diffusion and also hampers the possibility of them employing predictive risk management. The isolationist approach is shown to contribute to the diffusion of risk and increase the amount of effort needed to regain equilibrium.. As a result of the undialectical dialectic risk management approach, Smurfit Kappa are running harder and harder to stand still.

Our contribution to research is an examination of risk as it is played out in an industrial setting with particular emphasis on how risks are diffused throughout the plant. While risks are pervasive throughout today's society they are arguably particularly pressing in the pulp and paper industry, since any production stop will have huge damaging effects on the profits. Our key recommendation to practitioners is to be aware of these problems and work across organizational boundaries in order to handle them.

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