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### Migration of Legacy Systems in New Public Management – the Swedish Rescue Services Incident Reporting System

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## Migration of Legacy Systems – the Swedish Rescue Services Incident Reporting System

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### Abstract

*The Swedish Rescue Services are migrating from an incident report system to a fully-fledged incident learning system. The migration process has been studied under the lenses of organizational learning theories, to identify challenges that can offer advice for future system migration projects. The objectives expressed by the central agency leading the studied migration process aimed at implementing organizational double-loop learning by using the incident reports as enablers to learn from the rescue operation and improve future operations accordingly. In practice this objective has been lost along the way, with the agency focusing more on cosmetic changes, such as terminology, attributes and labels. Meanwhile end-users expressed different and concrete needs, requiring new functionality, process improvements and organizational development. The study highlights the importance of early, active user involvement in the migration process for dual use legacy systems, to avoid losing explicitly articulated high-level objectives, such as improved performance and dual use of the system.*

### Keywords

system migration, organization learning, participatory design

## INTRODUCTION

There is a vast area of studies focusing on the influence that information systems (IS) have on organizational change and how they have the potential to both enable and disable organizational learning (e.g. Pentland 1999; Robey, Boudreau and Rose 2000; Grandon Gill 1995). There are also recent development trends such as e.g. Enterprise Systems, Cloud Computing, Big Data/Hadoop embracing organizations changing ISs. In specific, there are emerging studies on the migration of legacy information systems (LIS) i.e. transforming one type of system into another. LIS are systems that have existed a long time in and are vital to the organization but at the same time are brittle, slow and sometimes with a purpose of use in need of renewal or extension (Bennett 1995; Bisbal 1999).

The Swedish Rescue Services are in the process of migrating their national incident reporting system to an incident learning system. The intention is to change the system from being a documentation of rescue operation-only system, to a lessons-learned system with post-mission analysis capabilities. Enhanced learning is in its turn expected to result in more effective rescue operations that will pave the way for a re-structuring of the rescue organizations. From an organizational learning theory perspective, the process reflects a striving to be able to use the future system for double-loop, deep learning in the organization, and to transfer tacit individual knowledge to team and organizational level (Argyris & Schön, 1978). This study explores the migration process from the double lenses of systems development and organizational learning. It is motivated by the expansion of migration of LISs in our society, with less systems being developed from scratch, and the need to make migrated systems reflect future organizational and user needs while also having to deal with in-built structures and pre-requisites from the past.

### Aim and objectives

This study thus explores the migration process for a LIS in the form of an incident reporting system. The case stands out because the migration process is driven by one stakeholder, with the ambition to include multiple stakeholders' needs. A second characteristic is the migration from a single use system to a dual use, with the introduction of organizational learning as a component in an existing reporting system.

More specifically, the related research objectives include:

- **Systems development perspective:** Identification of pre-requisites, obstacles, and bottlenecks in the current system, suggested improvement measures in the ensuing system and comparison of the identified challenges in the migration process with those common in IS development in general.

- **Organizational learning perspective:** Identification of how organizational learning objectives are envisioned, articulated and put to practice in the migration process, as related to different stakeholders and perspectives.

## BACKGROUND

In this section the relevant study background is described including study context, legacy systems and relevant organizational learning theories.

### The Swedish Rescue Services

According to the Civil Protection Act (SFS 2003:778) the Swedish Rescue Services are divided into services provided by the state and by the municipalities. Each municipality must have at least one rescue service unit, either on its own (commonly a local fire brigade), or participate in a cooperative unit with other municipalities. The rescue service units are supported by a central agency that provides certain competence development services, and coordinates processes for documentation and archiving of rescue operations. However, the agency has no formal decision rights over local rescue service organizations. These rights belong to the municipalities.

The Swedish Rescue Services are currently undergoing an extensive organizational change process involving new learning processes and possibly new organizational structures. The motivations are to a great extent financial – aiming to increase efficiency and reduce costs associated with rescue operations. One assumption that is being questioned is the previous 4+1 principle that implies that a firefighting team of four firefighters and an incident commander<sup>1</sup> must attend every emergency regardless of its type and size.

#### *The incident reporting system*

A central Swedish Rescue Services' tool for documenting performed rescue operations is the incident reporting system<sup>2</sup>. The system provides templates for common emergencies, and a standardized form for post-hoc operation assessment. When the operations have deviated from normal routines, or when fire fighters have been put at risk, these reports may lead to more detailed incident and response investigations, in this study referred to as in-depth investigations. The incident reporting system has been in use since 1996 and the current version since 2011. Presently about 2 million reports exist in a central database at the agency. The original aim was to use the report system for documentation only. Successively, the report template was expanded to embrace quantifiable fields to be used for statistics and local learning purposes. However, the expected ensuing learning processes did not take place and problems have been associated both with the template as such and the supportive processes.

A major revision of the incident reporting system is currently being performed by a user council at the agency. The migration process has the objective of providing a better report template that can be used to evaluate and learn from the rescue operations, and implement improvements based on the lessons learned. The improvements are aimed at making future operations more effective and high quality. Statistic evaluations may also be used to demonstrate benefits and limitations of new forms of rescue organization, such as more flexible fire fighter-team constellations. The user council consists of representatives from the Swedish county councils, the municipal rescue services and the agency itself and has performed a first needs analysis. Meanwhile, a complementary research initiative/participatory design process has been launched by researchers at a Swedish University, also focusing on how the incident reporting system can be improved and used for organizational learning.

### Migration of legacy systems

System migration is increasingly relevant in an information society characterized by rapid organizational changes and re-structuring. Research has highlighted the migration aspect in relation to legacy systems (LISs). These are systems that have existed long enough to become organizational backbones. They are mission critical and their failure can have serious consequences. At the same time their original purpose and design can become outdated as the organization changes and their interfaces make them difficult to extend and integrate with other systems (Bennett 1995). Change strategies to LISs tend to involve either *redevelopment*, *wrapping* or *migration*. The latter is to move the LIS to a more flexible environment while retaining the original systems data and functionality (Bisbal et al 1999).

The current study is an example of migration of an LIS for incident reporting into an incident learning system, being motivated by efforts for increased efficiency. The majority of documentation of rescue operations revolves around the incident reporting system. The data and documentation functions will remain with the extended system, implying that

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<sup>1</sup> The incident commander (Swedish: Rådningsledare), appointed at each emergency by the Chief Fire Officer.

<sup>2</sup> <https://msb.se/sv/Produkter--tjanster/Inrapportering/Raddningstjanstens-insatser/Nytt-inrapporteringssystem/>

the future system will have double use; incident reporting and learning. The study focuses the organizational, rather than the technical migration process.

## Organizational learning theories

Early work on organizational learning describes different types of organizational learning systems, e. g. distinguishing between *single-loop learning* and *double-loop learning*. The latter is then the learning process in which an individual or organization is able to reflect upon, question, and modify the goals, values, assumptions and policies that led to certain actions. Single-loop learning is more of a repeated attempt at the same problem with no variation of method and without ever questioning the goal (Argyris and Schön 1978). Subsequently, a four stage spiral model of organizational learning (SECI) was developed by Nonaka and Takeuchi (1995) (Figure 1). Their model takes its point of departure in *tacit knowledge* versus *explicit knowledge* and describes a process of alternating between the two of them. Tacit knowledge is then personal, context specific, and subjective; whereas explicit knowledge is codified, systematic, formal, and easy to communicate. The tacit knowledge of key personnel within the organization can be made explicit or *externalized*, and incorporated into new products and processes for later *internalization* in employees.



Figure 1. SECI model developed by Nonaka and Takeuchi (1995) showing how tacit knowledge is made explicit in an alternating process of externalization, internalization and socialization.

Related frameworks describe features of *deep* versus and *surface* approaches (e.g. Biggs, 1987) where, in essence, deep learning is associated with intrinsic motivation and interest in the content of the task, a focus on understanding the meaning of the learning material, an attempt to relate parts to each other, new ideas to previous knowledge and concepts to everyday experiences. Meanwhile, the surface approach is based on instrumental motivation where the task at hand shall be solved, automatically reproducing terms and procedures and viewing a particular task in isolation from other tasks and from real life as a whole. For the purpose of this study, the learning theories presented above have been used in a research model (presented below) guiding the analysis of study results.

## METHODS

The study was performed as a case study involving documents studies, participatory design methods and interviews.

### Case study

Case studies focus on a real phenomenon, be it, e.g., an individual, a setting, an incident, an organisation, or an IS (Yin, 1994). Case study research often focuses on a single case, but cases can also be replicated in multiple case designs. Often, several data collection methods are used to enhance study validity and reliability. Case studies are generally of an *explorative*, *descriptive* or *explanatory* character. According to Yin (1994), they should include the stepwise procedures of designing the study, conducting it through preparing for data collection and collecting the evidence, analysing the evidence and composing the case study report.

This study was performed in 2012 as an exploratory single case study designed to include the steps as suggested by Yin. The case is the incident report system itself which have been studied by different methods including 1) document studies, 2) workshops based on participatory design methods and 3) a complementary interview. The data gathered was analyzed from systems development and organizational learning theory perspectives. The actors in the case study are the central agency, the fire fighter workers' union and local rescue services representatives, chosen to together provide different perspectives on system vision, administration and end-user needs.

### Document studies

Document studies are the selection of available documents on a topic, which contain information, ideas, data and evidence written from a particular standpoint. In case studies, they are typically applied in the first exploratory phase

as one of many interdependent data sources (Travers, 2001). In this study, a strategic sample of in total twelve incident reports and three in-depth investigations were initially reviewed. The reports come from a local rescue station in south Sweden. They have been chosen by the rescue station fire chief as being representative for incidents and reports at the station, and stem from the years 2007-2012. Each document was analyzed in its own sense and the major results from the analysis were presented at the initial participatory design workshop described below. Further, the researchers analyzed memory notes and two needs analysis reports produced by the central agency user council.

## Participatory design methods

Participatory Design (PD) is a user-centered approach to systems development that puts its major emphasis on active user participation throughout the entire design process. It originated as collaboration between the Scandinavian trade unions and academia in the 1970s but has since been extended and applied also outside its immediate ideological context. Its advocates claim that PD results in better systems than other approaches, since the systems are designed together with the users instead of merely using them as information sources (Bravo 1993). PD uses a range of techniques that are supposed to be easy-to-learn and put low demand on the users' prior knowledge. An example is Future workshops which take their point of departure in users' own work situations. The users are first encouraged to reflect upon their experienced problems and difficulties and then to stepwise formulate first visionary, then feasible (design) solutions to their problems (Ehn et al. 1996).

In the study, two Future workshops were performed following analysis of incident reports. Five user representatives were selected in dialogue with the fire chief (see above), the central agency and a previous research project on learning in the rescue services. The representatives were supposed to together represent system vision, administration and end-user needs in the workshop. This is in line with articulated PD principles of actively involving different organizational levels and perspectives to arrive at feasible system solutions. Two representatives came from local rescue services in two different municipalities; two from the fire fighters' union; and one representing the central agency user council. The two workshops were moderated by two researchers. The aim of the future workshops was to confirm and/or modify the analysis stemming from the incident reports and to identify end-user needs and recommendations for improvement of the current incident reporting system.

## Interviews

Interviewing is a commonly used method to gain understanding of, peoples' experiences, and what meaning they make out of them. In this study, a complementary *semi-structured interview* was applied with the help of an interview guide containing a predefined set of questions covering certain themes (Bernard, 2000). The interview respondent was part of the central agency user council and has worked full-time with the incident reporting system since 2006. The aim of the interview was to complement the workshop results, identifying similarities and differences between the two groups (user council and independent PD group; the documents of the user council was provided by the interview respondent), but also to find out which of the proposed solutions are organizationally and technically feasible.

## Data analysis and research model

The workshops and interview were audio recorded and complemented with memory notes. The workshop data material also included post it notes where the user had written their needs. For the purpose of the entire project a needs specification was produced, based on all data/perspectives analyzed. For the purpose of this study, a research model including constructs both from systems development and organizational learning theory was developed and guided all data analysis. The research model is summarized in Table 1.

Table 1 Summary of constructs in research model guiding analysis of results

<i>Actor/perspective</i>	<i>Organizational learning types</i>	<i>Systems development/migration</i>
<i>reports, agency/user council, end-users</i>	<i>single/double loop, surface/depth, tacit/externalized - explicit</i>	<i>user needs, improvement measures, organizational pre-requisites and constraints</i>

## RESULTS AND ANALYSIS

The results/analysis is divided according to the three actor/perspectives displayed in the table above: (1) *incident report template and in-depth investigations*, (2) *agency/user council*, and (3) *end-users*. For each of these perspectives, an analysis of related organizational learning is performed and identified system migration improvement measures are presented. The types of organizational learning and system development/migration measures identified from different actors/perspectives are summarized in Table 2.

## Perspective: incident reporting template and in-depth investigations

An overview of the incident reporting template, describing the twelve sections it includes, is provided in Figure 2. In the quantitative parts (field 1-8), the studied templates contain isolated elements such as *number of units on site*, *number of vehicles on site*, *response delay*, and checkboxes for e.g. *no deficiencies in equipment* and *no response delay*. The template also holds a single text field (11) for evaluating the operation. In all the studied reports this field was filled in with either the statement *very good* or contained no information at all.

In the qualitative parts of the report, there are nine pre-defined lines dedicated to the cause of the emergency (field 9) and another nine lines to the description of the course of events in the rescue operation (field 10). The studied templates were filled in similarly and sparsely, in these fields. The descriptions provide e.g. the decisions taken by the incident commander, sometimes with reference to relevant laws and procedures. Field 10 further provides nine lines to describe preventive measures that can prevent this type of emergency (e.g. fire detectors) and nine lines for measures that can improve future rescue operations.

Figure 2. Overview of the incident report template. Headings of its sections are listed in 1-12. A snapshot from section 5 is exemplified.

Several preventive measures are mentioned in the analyzed incident reports. However, response improvement measures are mentioned only in two reports; these describing problematic operations where standard operating routines were not followed. The identified measures are then described in very brief terms. All the three in-depth investigations contain suggestions for improvements of rescue operations. In two of them these are also brief, without specification of how they are to be carried out and by whom, e.g. *work on routines*, *look over routines* and *teach new firefighters this course of events*. The third investigation takes the form of a systemized conversation where the entire rescue team has been interviewed. The conversation illustrates the reasoning and judgments lying behind important decisions, such as entering a building without smoke-helmeted firefighters. This investigation (from 2007) also elaborates on concrete improvement measures that are implementable. However, it can be noted that one of the other investigations (from 2012) refers to the 2007 systemized conversation, pointing out that at that time suggested improvement measures have not yet been carried out.

**Organizational learning:** The template does not, in its current state, contain the necessary contents to be able to provide learning from the rescue operation, neither at individual or organizational level. It is rather a system designed for documentation, where the links between quantitative and qualitative data and causal relationships (e. g. how number and type of resources on the emergency site affected the outcome of the operation) may be used for statistical purposes. The studied reports provide few opportunities for in depth operation analysis and do not make the tacit knowledge inherent in rescue operations explicit to the reader.

The in-depth investigations proved somewhat better in terms of usability of for learning purposes. However, some of the reported shortcomings in them were later identified as erroneous. When discussing one of the reports related to a fire in an apartment claiming victims with the workshop participants, the behavior of the rescue team was found not to deviate from standard procedures, even though the report stated so. Instead, the behavior was rational given the uncertain nature of the current incident and insufficient resources available at the time. This is a clear example of tacit knowledge not highlighted by the in-depth investigations. In the systemized conversation case tacit knowledge was better externalized and related to adequate improvement measures. However, a general conclusion from the analysis is that the learning aspect is markedly subdued in the current incident reporting template.

**System migration improvement measures:** The templates do not provide the opportunity to from a learning perspective report the circumstances that allowed the operation be problematic or run smoothly. This is exemplified in the limited number of fields dedicated to describe and evaluate the response operation and leads to sparse formulations such as *the operation was very good* above. It is not clear what this formulation implies and it raises questions like: *what is 'very good', compared to what?* There are many ways to improve the current incident reporting system but a first required step would seem to build in somewhat more comprehensive report possibilities.

## **Perspective: agency/user council**

According to the central agency interview respondent, there is a clear purpose of the incident reports – to document the rescue operation and provide a basis for statistics. In addition, the reports' future extended purpose will be to also embrace organizational learning. The user council is currently focusing on a major revision of the incident reporting template. This goes beyond the adjustment of text fields and checkbox clarifications to include building in prerequisites for evaluation of the rescue operations, according to the respondent. The respondent views the future incident reporting system as going further than organizational memory and becoming an organization lessons learned system that is linked to other documents about the incidents available at the local rescue services' ISs. The respondent further deemed it possible to estimate rescue operation effectiveness and quality on the basis of the incident reporting system, e.g. if it contained a checkbox for “*goal achieved*” from where to measure fulfillment of pre-defined goals.

Meanwhile, what will actually be revised in the report template are mainly related to the template quantitative parts including such things as variables, terminology, definitions, attributes and labels, the agency respondent stated. A similar pattern is seen in the agency user council work. The council has provided seven regional seminars where needs from users in relation to the future report have been collected. The memory notes/needs analysis from these seminars include substantial perceived organizational processes and learning needs, e.g. “*need for training on new incident reporting system*”, “*alternative ways of documenting decisions*”, and “*improved information flows in rescue services organizations*”. However, the agency's own analysis of the same documentation revolves around statistics. For instance, it is stated in the memory notes that:

*Overall, it was difficult to make the participants identify needs for new variables for statistical analysis; this may be explained by the current set of variables fulfilling most needs for statistics. Another explanation may be that few of the participants are active in their organizations' analysis work. This means that the [...] seminars were necessary but not sufficient [...] and that the question of statistical needs should be passed on to politicians and to managers in the rescue services.*

Further, the short-term plan for the migration process is only to provide built in opportunities and pre-requisites for organizational learning in the template itself– not to provide the supportive processes. To build these processes are up to the local fire rescue services/municipalities themselves, according to the agency respondent.

**Organizational learning:** The analysis shows that the current migration of the incident reporting system, in part dedicated to double-loop organizational learning with operation increased efficiency as possible outcome, in reality does not provide such enablers. The supportive processes are left out and in the template itself, improvements focus predominantly on cosmetic changes relating to terminology, attributes and text fields. It is believed that such changes will improve the capabilities of calculating statistics based on incidents and to measure goals and efficiency of operations. This can be categorized as superficial learning aimed at getting the best possible constellations of response operations (e.g. team and equipment) based on figures while not capturing the experience and tacit knowledge underlying such successful constellations. It can also be defined as single-loop learning since it reflects an attempt to learn from operations using the same background data and methods as before; only refining the data.

**System migration improvement measures:** The agency respondent pointed to the increased possibilities to collect data for the report that technical developments can bring, e.g. with the introduction of smartphones and high-speed cameras. The respondent also pointed out that the report template needed a more dynamic and flow-oriented content as compared to current more flat version. Unnecessary clicks, ambiguous definitions and irrelevant questions need to be removed. As regards actual implementation of improvements measures for operations, it is the local rescue services that are responsible according to the central agency respondent. Here, they would need a joint IS to handle improvement measures, to perform follow-ups and to appoint responsible key persons.

## **Perspective: end-user**

In the participatory design workshops, the participants unanimously called for an improved incident reporting template. They deemed the current electronic template version as complicated, counter-intuitive, and not interfacing well with the surrounding ISs. As an example, if the checkbox for “*deviations from plan*” is crossed, the user is automatically transferred to another part in the template, enforcing 10-15 minutes of extra work, according to one respondent. This extra labor contributes to a tendency to report only deviations that have exposed the rescue personnel for risks and where important routines or laws have been violated. In relation, several participants claimed that an improved reporting system needs to focus not only on deviations, but also on learning from good examples. One respondent exemplifies with a story from a recent rescue operation:

*When [the incident commander] during a fire in a night club took the decision to evacuate a nearby hotel this decision eventually turned out to save several lives.*

The referenced decision was based on the fact that the incident commander had led an operation at the very same night club earlier, and knew that it was not secured from the spreading of fires. It was a decision based on personal experience that had not been incorporated in the incident reporting system. At the same time many rescue operations



progress according to plan with no deviations –neither good nor bad. Is it then feasible to devote efforts on detailed reporting, or to suggest improvement measures? Which incidents are candidates to learn from and how can we define criteria for this? How can we decide which cases should reach all the way to the national level and which can reside at the regional level?” How is the customer perspective accounted for, i.e. how can the emergency victims provide their perspectives on the rescue operation performance? These were all questions posed by respondents at the workshops.

However, it was not the template itself that was considered most problematic. Rather, the participants engaged in discussions on the process surrounding incident reports, and the problems and bottlenecks that connected to it. A major obstacle defined included lack of time and motivation. The workshop participants claimed that the current incident reporting system has a one-sided focus on the incident commander. According to current routines, the incident commander returns to the rescue service station after the rescue operation is completed and fills in the report alone. It is difficult for him or her to remember everything and have the competence and motivation to do it with adequate quality and sufficient level of detail. Sometimes, the commanders pile up several reports and fill them in months later, making it almost impossible to remember all the details.

It was claimed that the local rescue service personnel do not see a clear purpose with the reports, nor a recipient. The end-users stated that nobody ever reads the report with the potential exception of the appointed incident investigator at the local rescue station. Feedback to the operation participants may be sent via e-mail but are not always read by them. The end-user respondents lack systemized feedback. They claim that potential experiences and suggestions for improvements are not integrated in training or transformed into implementable measures since there are no individuals appointed as responsible. The reports, in fact, just end up as elements in a central agency database:

*If you don't even get the new gloves you asked for, the motivation is negatively affected.*

Both the central agency, the local rescue service chiefs and the municipality officials must provide better and systemized feedback on the reports, according to the participants. As for collaboration and distribution of experiences from rescue operations, the local rescue teams have good opportunities for reflection. But experiences are seldom spread to the other teams at their own fire station, even less to other rescue services. Also, the reporting system lacks information about what other response organizations contribute in the operation, it is only noted whether they participate in the template. This makes improved collaboration difficult.

Also, the Swedish Rescue Services has to deal with entirely new threats, such as people attacking firefighters, placing gas bottles in the vehicles, and traps in arson fires. Since the organization until now has been (as compared to many other countries) relatively spared from such threat situations they are not yet documented and reported. The future incident reporting system needs to incorporate threats, according to the end user respondents. Also, the Swedish Rescue Services needs to investigate health risks and long-term effects on firefighters that are exposed to toxins and other contamination hazards. Today, the organizations keep no track records on these matters, making it difficult to prove cause and effect in the case of a firefighter developing diseases over time (which in turn reduces their chances of being economically compensated by the insurance companies). Further, two of the workshop participants claimed that the current response time, as being defined in the current incident reporting system, does not include preparation or recovery time. This may give an insufficient perspective on the operation and firefighter work time as a whole:

*For instance, when the rescue team has witnessed a suicide and failed to talk the person out of it, team members may be very psychologically affected and the recovery time is much longer than in “ordinary” cases, and when this is not documented, the response time and work time as a whole is not calculated or displayed properly.*

**Organizational learning:** The type of learning the end-users request seem long-term and based on cases, experience and lessons identified. This reflects a depth and double-loop oriented learning perspective where you explicitly articulate tacit knowledge and successively go from individual, to team to organization and back for internalization in new individuals. At the same time, the respondents are aware that there are hindrances for such learning in the own organizational culture. For instance, there is an unwillingness to report one's own operations in negative terms, they claimed. An example mentioned is an apartment fire where everybody knew that things went wrong but nobody did anything to provide learning from the incident:

*We know that things went wrong so there is no need to advertise it.*

**System migration improvement measures:** Concrete improvement suggestions thus concerned the incorporation of threats in the incident reporting system. The workshop participants also wanted checkboxes in the report indicating 1) exposure to contamination hazards, 2) preparation and recovery time, 3) operation success factors, and 4) potential for learning/usability for training purposes. Further, they agreed with agency perspective on a more dynamic, flow oriented form of the incident report template. They suggested that it should be possible to select pre-defined alternatives and thereby receive a specialized version of the report depending on the experienced incident situation. The choice of alternatives should be made stepwise and interactively, making it possible to create a flow and dig deeper into the learning parts of the report, if the situation requires. They also agreed on the potential of technical developments. Some rescue services bring high-speed cameras to the emergency site, and the respondents thought that these could be connected to the template. Using existing communication technology at the push of a button on the site

was seen as a possible method to complete parts of the incident report automatically, leaving the commander with the responsibility of reviewing, adjusting and completing the report before submitting it to the reporting system.

Other improvement suggestions concerned feedback and transferal of mission experience. For instance, the incident reports could be sent to certain central agency units for transformation into development and training implementations, e.g., the agency could provide quarterly experience transfer events based on interesting reports received recently. Similarly, at local level it was suggested that experiences were discussed at work place meetings, supported by computerized visualizations and simulations. The workshop participants also thought that the incident commander should become more of a team leader and collect broader documentation from his or her co-workers, by getting the group perspective in short (5-10 minutes) briefings, before the report is filled in. Several participants further claimed that much of the quantitative data in the report (e.g. GPS tracks) should be distributed to the benefit of other response organizations, and to city and traffic planning experts.

The workshop participants agreed that measures need to be sanctioned at the management level; that key persons should be identified and appointed as responsible for the implementation, and that, a high quality incident report system with key arguments that are shared among the right organizations is a prerequisite for the distribution of experiences. It is essential to be able to show in the report that what happens in one municipality can happen in another and then convince the right persons to spread experiences and counter-measures to the response organizations in these municipalities. They also agreed that improvement and organizational learning work must take place within current financial or personnel resources in the rescue service organizations.

Table 2. How the different actors/perspectives embrace learning and system migration improvements measures respectively.

<i>Actor/perspective</i>	<i>Organizational learning type</i>	<i>Systems migration improvements measures</i>
<b>Reports</b>	none/little	extended template allowing for richer descriptions
<b>Agency/User council</b>	statistic based; superficial; single-loop	cosmetic: attributes, fields, terminology; only template
<b>End-users</b>	case/experience based; depth; double-loop; externalization of tacit knowledge	template and process: new content and functions; support for motivation and systemized feedback

## DISCUSSION

Dekker and Jonsén (2007) studied the incident reporting system at three municipal rescue service units, with the aim of developing the system for learning purposes. Their major findings were that the most fundamental prerequisites for learning from experience were lacking in the rescue organizations. Above all, trust, mutual respect and a feeling of being allowed to participate were found missing in the studied services. The researchers concluded if the experiences are not taken further, all reports are of little use. In other contexts of incident learning systems Mahajan (2010) emphasizes the need for regular and detailed feedback to engage practitioners in the loop of reporting and learning from incidents. Cookea and Rohleder (2006) discuss organizational barriers to report incidents and suggest training and reward systems to overcome them.

This study, to a large extent confirms these findings. The current migration of the Swedish incident reporting system takes place in a rapidly changing organizational environment experiencing financial cutbacks, increased demands for efficiency and entirely new threats and requiring more flexible and sometimes smaller team constellations than the current 4+1 principle. It is evident the central agency level have some conflicting interests compared to the local firefighters (end-users). One central conflict concerns different stakeholder perspectives in the incident reporting system design process relating both to learning types and concrete systems migrations issues. Other concrete obstacles found in the reporting process related to missing trust and an unwillingness to report things that did not go as planned, for fear of reprimands. A central idea behind the system migration was to extend the incident reporting system for dual use of incident reporting/documentation and evaluation/learning. In reality, it seems that the system will remain an incident reporting system. Introducing systemized feedback and reward systems may play parts in steering the migration process in another direction.

### The incident reporting system from an organizational learning theory perspective

Within organizational theory, Senge (1997) claims that double-loop learning requires such things as *systemic thinking*, *shared vision* and *team learning*. The vision of an extended incident reporting system to be used as one basis for organizational efficiency improvements is a clear central organization-driven aim to achieve double-loop learning. However, in practice this process has been lost somewhere on the way. Similarly, the SECI knowledge transfer model developed by Nonaka and Takeouchi (1995) describing the interaction processes between *tacit* and *explicit knowledge* was later extended to embrace a third dimension described as *Ba* (Nonaka, Toyama and Konno 2000). *Ba* is meant to represent the shared context without which shared knowledge cannot exist. In the current case, it is obvious that externalizing tacit knowledge—which is the fundament for far-reaching organizational learning - will not take place if development of the incident reporting system does not take another direction. It is also evident that a lack of *Ba*,

contributes to the preservation of status quo, as demonstrated by the system view conflicts between the central agency and the local rescue services. The issue of responsibility is another potential shared context conflict in which the central agency and the local organizations want each other to take overall responsibility for increased organizational learning.

The systemic conversation identified in relation to one of the in-depth investigations was the one found most useful in learning from experience. Here deep learning was enabled when parts of an operation were put together to understand whole and transfer it to other real life operations. The conversations also relate to the notion of the importance of systemic thinking above (Senge, 1997). Systemic conversations exist in the Swedish Rescue Services today but they are not that common. It seems necessary to complement the incident reports with a group perspective, providing the views and reasoning behind actions not only of the incident commander but by the entire team, as a basis for externalization and transfer of experience to other parts of the organization.

### **Visions and user needs in migration of legacy systems**

Handling of LISs is an emerging research area where most studies still focus on describing the characteristics of the systems and how they can be changed from a technical perspective (e.g. Bisbal 1999). At the same time, the ever growing presence of LIS in need of renewal in our information society demands that this perspective widens to embrace also organizational aspects. This study did this by addressing the migration process for an LIS in the form of an incident reporting system ultimately motivated by demands for organizational increased efficiency. The study implies that the migration process pre-requisites, problems and bottlenecks identified are much similar to those experienced in systems development in general. In user-centered design approaches such as PD, the need for users to be actively involved in the design process from the very beginning to the end-product, has repeatedly been pointed out (e.g. Pilemalm et al 2006.; Bravo 1993). Later similar notions have been incorporated in newer development approaches such as e.g. Business Process Reengineering and agile methods. Studies have further shown how top organizational strategies and visions often substantially differ from concrete user needs and how management may fear losing control over the design process and of ISs promoting decentralization of power (Pilemalm et al 2001).

In this case, the central agency actually initiated a user council consisting in part of rescue service representatives and collected data from users at regional seminars. Nevertheless, the practical migration work came to focus on terminology and quantitative data to be used for statistical purposes. The user council expressed surprise when the users at the seminars could not relate to needs for statistics but instead focused on organizational development needs. A motivation behind PD and newer user-centred approaches is that they reduce the risk of unreflecting built in of existing organizational structures and technical solutions in the new systems. This risk seems even more evident as to migration of LISs, since the systems will most often retain their original functions together with new extensions, implying dual use. This inherent complexity calls for the active involvement of end-users from the very beginning of the migration process.

### **CONCLUSION AND FUTURE WORK**

In this study, central organization initiated migration of an LIS used for incident reporting into an incident learning system has been explored from both a systems development and organizational learning perspective. The study demonstrated conflicting interests between the central agency leading the migration work and the end-user fire fighter representatives. While the former focused on refining template attributes, quantifiable data and statistics the latter expressed entirely new needs, system functionalities and supportive organizational processes. Bringing organizational learning theories into the incident reporting case show that this conflicting view on the system can be related to a similar conflicting learning perspective; single-loop, superficial learning based on existing data items using known methods versus double-loop, deep learning based on cases, experience, lessons learned and new methods and supportive processes. In the current project, PD work will continue in the direction of incorporating end-user needs in the system emerging needs/requirements specification and communicating and negotiating them with the central agency and the system supplier. A supportive process will be further developed in detail and suggested to the agency.

The study implies that migration of LISs encounters much the same problems as in general system development projects, and that the risk of missing carrying out migration objectives in practice is evident, even though they are clearly expressed in theory. In fact, migration of LISs is even more challenging, since it inhibits aspects of achieving a balance between existing and new system functions, and between dual use areas. In the current case, it seems that the dual use system objective will actually not be implemented at all, if end-users are not more heavily addressed and involved in migration work, using the proper methods to capture user needs. At a general level, the study thereby calls for extensive involvement of all stakeholders affected by an ensuing system migration. Future research should address the organizational aspects of the migration process in more detail, including also studies of implementations of the extended systems.

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