Optimizing ICT Portfolios in Emergency Management: A Modular Alignment Approach

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ABSTRACT

Today's society is exposed to an increasing number of disasters and large scale emergencies (e.g. earthquake in Haiti, global swine flu, or manmade disasters like the oil spill in the Gulf of Mexico). Information and communication technology (ICT) can help to prevent and mitigate the effects of threatening situations if applied appropriately. In industry ICT governance methods and portfolio management techniques have become important tools to successfully align ICT with business goals. However, the domain of emergency management (EM) has to deal with unpredictable situations, multi organizational collaborations and ad-hoc teams, conditions which make conventional existing methods less useful. Based on a qualitative analysis of several European and Australian EM organizations and government agencies this paper discusses a modular approach to optimize ICT portfolios in Emergency Management organizations in order to achieve strategic ICT alignment.

Keywords

IT governance, strategic alignment, IT value estimation, emergency management.

INTRODUCTION

The increasing number of natural as well as manmade disasters and large scale emergencies has forced emergency management (EM) organizations and related government institutions to become more efficient (Perrow, 2007; Rao, Eisenberg & Schmitt, 2007; Rodriguez, Vos, Below & Guha-Sapir, 2009). Information and Communication Technology (ICT) has been identified as one of the most promising success factors to improve emergency management processes. However, benefits and risks of ICT investments are often unclear to emergency managers and involved organizations (Dilmaghani & Rao, 2009; Rao et al., 2007). Previous research about strategic ICT alignment in public administration has shown that non-commercial organizations respond to a wider set of social, economic and political goals. Thus, they need different approaches since conventional ICT governance methods and ICT portfolio management techniques are of limited use (Di Maio, 2003; Sethibe, Campbell, & C., 2007; Vogt & Hales, 2010). EM organizations do not only deal with non-monetary strategic goals but also have to deal with higher complexity and uncertain or fast changing factors. Although the domain of EM has evolved consistently over time and a number of supporting technologies have been developed, there is lack of suitable methods to realize the benefits of ICT by emergency managers. Hence, we believe they are unable to align their processes and ICT investments effectively and efficiently (Luftman & Kempaiah, 2007; Rao, et al., 2007; Van Den Eede & Van de Walle, 2005; Vogt, Kieth, Hertweck & Finnie, 2010; Weyns & Höst, 2009). Consequently, we formed the following research question:

Research Question: What are the problems of EM organizations when it comes to ICT investments and how can we improve their ICT portfolio in order to enable strategic ICT alignment even in uncertain environments?

To answer this question we analyzed empirical data gathered from surveys and semi-structured interviews in several European and Australian EM organizations and government agencies, and conducted more detailed case studies in two of these organizations in order to analyze their processes and find recurring patterns.

Reviewing Statement: This full paper has been fully double-blind peer reviewed for clarity, relevance, significance, validity and originality.

The structure of the paper is as follows: In §2 we will give a theoretical background on relevant research in emergency management and ICT alignment methods. §3 will describe the methodology which was used to collect and process the data to show scientific rigor of this research. In §4 the paper will present the data and results from the different data collection phases and discusses a prototypical solution. §5 will discuss limitations of this research and give guidance for future research. Finally, in §6 we summarize the findings of this paper.

THEORETICAL BACKGROUND

EM has several stages from planning to review. The most common classification of these phases is: Prevention, preparation, response, and recovery; although there is a floating transition between the phases in reality. For the purpose of this research project we focus on the first two stages; prevention and preparation. They seem to be the most promising phases since timely constraints after an impact will make strategic ICT changes almost impossible.

ICT Governance, Strategic ICT Alignment & ICT Value Management with respect to EM

ICT Governance has inherited much from Corporate Governance and ICT Management, but has developed into a discrete discipline with internationally recognized frameworks and standards such as Control Objectives for Information and Related Technology (COBIT), Value of IT (VAL IT), IT Infrastructure Library (ITIL), ISO20000 and ISO38500 (Bhattacharjya & Chang, 2007; Iannella, Robinson & Rinta-Koski, 2007; Simonsson & Johnson, 2006). Peterson and Van Grembergen et al. suggest that ICT governance should be implemented by a framework of structures, processes, and relational mechanisms in order to be effective (Peterson, 2003; Van Grembergen, De Haes, & Guldentops, 2003). According to Luftman & Kempaiha ICT governance and its related frameworks and methods are enablers of strategic ICT alignment (Luftman & Kempaiah, 2007). Their goal is to enable the transition from a strategic to an operational level without losing the focus on business objectives.

The link between ICT and the business is the crucial factor in ICT Governance (Van Grembergen & De Haes, 2009; Van Grembergen et al., 2003). Furthermore, the coexistence between ICT functions and non-ICT functions within an organization is not sufficient and they have to be joined together to gain leverages and achieve the strategic goals (Duffy, 2002; Luftman, 2003; Weill & Broadbent, 1998). According to Van Grembergen et al. there are *"two important elements of IT Governance: value delivery (which is the goal) and strategic alignment (which is the means)"* (Van Grembergen, et al., 2003, p. 18). The IT Governance Institute adds a third element "Risk Management" and a fourth element "Performance Measurement" (IT Governance Institute, 2003). All parts are equally important to balance opportunities with threats when a decision for an ICT project or investment is made. However, performance measurements have special character in public organizations since they cannot be assessed by monetary metrics only. Thus, public administrations use adapted approaches to measure the Public Value of IT (PVIT), e.g. WiBe (Germany), DAM/VAM (Australia), eGEP (European Union), VMM/FEA-PRM (USA), though none of them can cope with unpredictable situations such as disasters (Cresswell, Pardo, Burke & Dadayan, 2007; Dadayan, 2006; Di Maio, 2007). Within the context of disaster management well-functioning and suitable ICT systems can not only save money, they can also save hundreds of lives in an emergency. Thus, it is more than appropriate that ICT is strictly aligned with their strategic goals. In our case the strategic goal is to mitigate and avoid catastrophic impacts of different scenarios and changing circumstances as fast and as efficiently as possible. The value of an ICT system can therefore neither be expressed in Dollars or Euros, nor are PVIT frameworks fully satisfactory; the value of an ICT investment is derived from how well it supports emergency management processes in uncertain environments.

According to Chan alignment is not a static status. It is rather a consistently developed process. *"The ›bringing in line‹ of the IS function's strategy, structure, technology and processes with those of the business unit so that IS personnel and their business partners are working towards the same goals while using their respective competencies"* (Chan, 2002, p. 15). Therefore, we use an adapted definition by Duffy: Strategic Alignment is *"… the process and goal of achieving competitive advantage through developing and sustaining a symbiotic relationship between business and IT*" (Duffy, 2002, p. 7). In the context of emergency management the term *"competitive advantage"* has to be substituted by "optimal support for threatening situations" and the term *"business"* refers to "the duties of emergency managers, authorities, and on-site operations".

Even though organizations within the domain of disaster management have no need to gain competitive advantage, they have a responsibility towards the society to do their best to save lives and critical infrastructures. According to Porter, all actions taken in an organization must add value or they are just wasting money, time and resources (Porter, 2008). Thus, they have to react faster, make better decisions and improve their on-site operations. ICT can help to gain that edge. Technologies such as Emails, Geographic Information

Systems (GIS), Global Positioning Systems (GPS), Business Intelligence (BI), Video Conferences, Workflow Systems, etc. have the capability to assist emergency management teams before, during and after a disaster. However, they need to be managed to provide reliable, secure and appropriate services (Asimakopoulou & Bessis, 2010; Rao et al., 2007; Underwood, 2010; Weyns & Höst, 2009). Inappropriate ICT investments, lack of awareness of technological opportunities, unreliable information systems and slow communication channels can be the cause of casualties and large scale destruction. Therefore the value and the vision of the benefits of ICT have to be clear to Emergency Managers (Dilmaghani & Rao, 2009; Rao et al., 2007).

Related Work

Early investigations of the utilization of ICT governance methods in EM were done by Van Den Eede and Van de Walle. They came to the conclusion that mainstream methods in ICT governance can have beneficial effects in emergency management, but due to the different structures and needs of EM organizations further research is needed (Van Den Eede & Van de Walle, 2005).

Wang & Belardo wrote an article about strategic integration of knowledge management in crisis management. Even though they concentrated on knowledge management they also discussed basic issues and benefits of "strategic alignment" in their paper. They concluded that there is a need for organizations to establish what they really need in order to be better prepared, but the unpredictable nature of disasters is a problem for conventional methods. Thus, in relation to strategic ICT alignment, they concluded that although this is a proven method in business it needs to be determined whether ICT alignment and emergency management strategies will also improve the performance of emergency management organizations (Wang & Belardo, 2005).

Dwarkanath & Daconta wrote an article about Service Oriented Architecture (SOA) in emergency management. They concluded that in order to design a SOA for emergency management enterprises, the overlaying governance component needs to be agile and flexible to accommodate the diverse stakeholders and their interests, the different business processes and in order to be successful, it must provide transparency. In their perspective, alignment in emergency management needs special attention but it is hardly achievable with conventional methods (Dwarkanath & Dakonta, 2006).

In 2007 Rao et al. published a paper in the name of the United States Federal Emergency Management Agency (FEMA). They conducted an extensive research project to identify the role of ICT in disaster management. Their findings show that ICT has yet unrealized potential since most emergency managers cannot capture its value for their processes, or ICT systems are designed to ensure day-to-day efficiency rather than for the resilience and scalability that disasters demand (Rao et al., 2007).

Iannella et al. examined the needs and requirements for ICT systems in EM organizations and identified that stakeholders in emergency management are moving towards efforts to define and exploit greater ICT utilization during major incidents. However, in their perspective, "*... emergency management is not a discipline that follows well behaved rules and allows itself to be modelled sufficiently well that all contingencies can be catered for a priori*" (Iannella et al., 2007, p. 1).

Marich et al. examined the inter-organizational ICT governance structure by means of a case study performed at a Medical Emergency Service Agency in California. The aim of their research was to analyze inter-organizational information flow using a standardized framework. They concluded that a shared and standardized ICT governance framework has advantages in inter-organizational information flow between EM organizations (Marich, Horan & Schooley, 2008).

More recently Weyns & Höst picked-up the topic of ICT management and governance and investigated a maturity model for Swedish municipalities in order to measure their ICT dependability in disaster situations. They concluded that there is misalignment between ICT personnel and Emergency Management due to communication problems between the two organizational units (Weyns & Höst, 2009).

In 2010 members of this research project have identified the main ICT issues of different stakeholders from six different emergency management organizations. The findings show that *"Lack of ICT alignment & ICT value methods"* is one of the top unsolved issues in EM organizations and that existing ICT governance methods are barely used by emergency managers since their unrestricted applicability to this domain is questioned (Vogt, Hertweck & Hales, 2011; Vogt et al., 2010).

RESEARCH METHODOLOGY

Starting point of this research was a study on ICT value in public organizations. This research showed that the benefits of ICT are hard to determine in non-for-profit organizations, so the strategic alignment of ICT

investments were suboptimal (Vogt & Hales, 2010). During that research project it became evident that the strategic alignment process in emergency management (EM) organizations is extremely complex and warrants closer examination. However, data from emergency management organizations is often non-public and unpublished since documents can contain critical, sensitive, and confidential data (e.g. evacuation plans in case of a terror threat). Thus, we had to establish personal connections to stakeholders in EM organizations in order to collect primary data. Throughout the initiation phase of this project several European and Australian organizations have been contacted. The research project was presented to build a foundation of trust between the researcher and stakeholders in order to get access to documents and the right to conduct interviews with employees. However, due to non-disclosure agreements with these organizations all findings of the interviews, observations and documentation reviews have to remain anonymous and can only be presented in an abstract form.

In order to cope with the different disciplines and information resources from literature, interviews, and observations, we decided to combine different research methods. Classification of accepted research methods can be done in different ways. However, the most common distinction is between qualitative research, quantitative research and triangulation. We utilized all three scientific approaches in order to tackle the rather complex and multi-disciplinary research project. However, the qualitative approach has provided the foundation of our research since qualitative research methods have become increasingly useful as the focus of information systems research shifts from technological to managerial and organizational issues (Myers, 2008).

The qualitative research conducted was driven by the 'interpretive' approach since it is seen as the most suitable for the purpose of the study. Interpretive research methods in ICT are *"aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context"* (Walsham, 1993, pp. 4-5). Interpretive research does not predefine dependent and independent variables, but focuses on the full complexity of human sense making as the situation emerges (Kaplan & Maxwell, 1994; Klein & Myers, 1999; Myers, 2008).

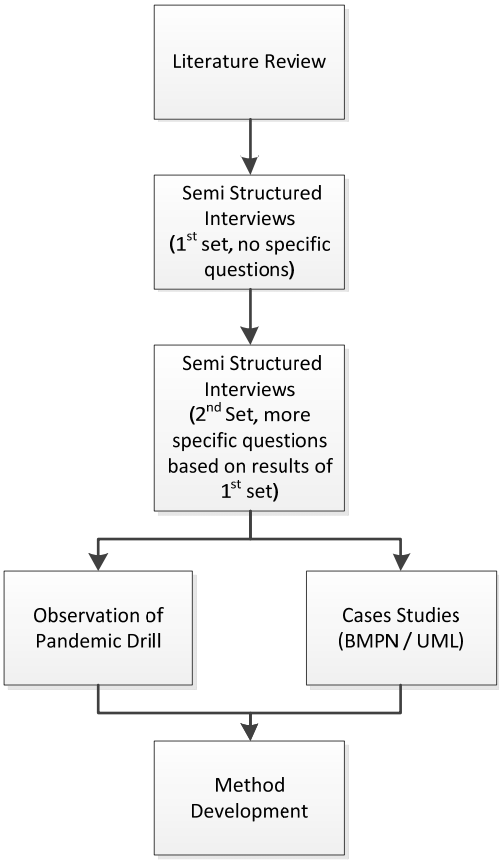

Figure 1: Simplified Research Methodology

The principles of hermeneutics were always used as the research guideline throughout this project phase. The primary motivation to choose an interpretative research approach in ICT is the belief that the understanding of a specific domain is retrieved by language, consciousness and shared meaning. Since hermeneutics is of interpretive nature, fixed criteria and automated calculations cannot be applied to retrieve meaning from unstructured sources (Cole & Avison, 2007; Klein & Myers, 1999).

Data sources were:

- Current literature about the field and secondary data sources (emergency management reports on real situations or drills)
- Observation of a pandemic drill in a large German municipality conducted by several organizations (Government, non-governmental organizations (NGO) and critical infrastructure providers (CIP))
- Semi-structured interviews with different organizations and stakeholders (e.g.: police, fire-fighters, Red Cross, public health departments, key administrational staff and managers of municipalities, federal government, and critical infrastructure providers).
- In-depth case studies in two organizations

All interviews were recorded and translated if needed, relevant sections were transcribed and analyzed by means of NVIVO 8 as the software tool and Qualitative Content Analysis / hermeneutics as the research method (Mayring, 2000, 2002). The data was immediately anonymized to comply with ethical guidelines and non-disclosure agreements. Additionally to surveys and interview techniques we used BPMN /UML tools for the in-depth case studies. We modeled detailed as-is processes utilizing ADONIS / ADOit to get a deeper understanding of the internal processes (Dimitris Karagiannis, 1995; Dimitris Karagiannis & Kühn, 2002).

DATA AND FINDINGS

Previous Findings and Work: A Summary

Following our hermeneutical research methodology the first interviews were rather open and loosely structured. It was our intent to understand the domain of emergency management and their primary ICT issues. Therefore, the initial semi structured questionnaire focused on the general applicability of ICT governance methods an ICT management issues. The questionnaire was conducted in larger municipalities and federal agencies (>1000 employees), large critical infrastructure providers (>1000 employees), medium sized first-responders and related EM organizations (50 – 1000 employees) and smaller first-responders (<50 employees). The survey has identified "Lack of ICT alignment & ICT value method" as one of the Top3 issues in the surveyed organizations (see Table 1).

No.	Meta-Issues/Nodes	Srcs	Rfcs
1	Lack of interoperability of systems	6	52
2	Lack of responsibility for ICT	6	48
3	Lack of ICT alignment & ICT value methods	6	42
4	Lack of appropriate IT service management	6	41
5	Un-improved processes	5	39
6	Fuzzy (or non) service levels	6	38
7	Lack of importance of IT to EMs	5	32
8	Lack of transparency of ICT to EMs	4	30
9	Lack of flexibility of systems	5	28
10	Lack of reliability of systems	6	27

Table 1: ICT issues in EM

In a second step we tried to find the reason why these organizations have trouble to align their technology and estimate the value of their investments. Thus, we conducted a second set of interviews to identify the unique requirements of EM organizations with regards to ICT alignment & ICT value estimation. The questions focused primarily on how ICT investments decisions are made, what factors are they based on, and how these processes perform in the view of the interviewees.

Figure 2 summarizes the findings of this research stage and identified the main ICT alignment issues in EM organizations. As one can see in this figure the issues could be separated into two main sections:

1. Organizational Issues
2. ICT Value Estimation Issues

It became evident, that both issues cannot be thoroughly investigated by the conducted interviews only. Thus, we decided to start more detailed case studies in two emergency management organizations and observe a pandemic drill.

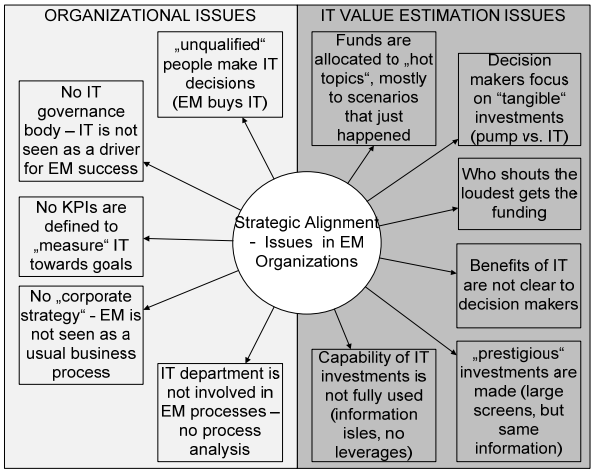

Figure 2: Strategic alignment issues in EM

The selection of the case studies was made on size (> 1000 employees) and complexity (stakeholder in multiple scenarios) of the organization. The reason for this selection was to ensure that all facets of EM/ICT alignment processes can be studied. The decision fell on a large German municipality and a federal Australian Agency. Both organizations can be compared to a certain level since they fulfill similar tasks during a large scale emergency or disaster. They are both embedded in federal structures and have to deal with multiple supporting agencies and organizations during an event. On the other hand, the two organizations differ in terms of possible threats and scenarios (e.g. Tsunami vs. nuclear plant incident), which enabled us to compare and transfer assumptions in order to come to more generally applicable conclusions.

IVEM²: A modular alignment approach

During the cases studies it became evident that a conventional "scenario based planning" is of limited use for an ICT alignment method since Emergency Managers are not able to realize the benefits and risks of ICT investment for such complex and unpredictable processes. Figure 3 / Figure 4 and the following description will briefly explain why.

A "planned scenario" refers to a scenario under perfect or laboratory conditions. As one can see "planned scenario" is a straight process containing fixed subroutines and activities (M1, M3, M7, M11), which can be

similar to the later discussed "modules". Aligning ICT towards such a scenario is quite easy since we can follow well behaved rules and have fixed goals.

In contrast "real scenario" diverges from a "planned scenario" (e.g. different severity of impact, unexpected developments, etc.). Thus, it is quite frequent that subroutines or activities need to be shifted, skipped, or added (M1, M3, M7, M11 vs. M2, M1, M3, M11). As a result the scenario is misaligned to the envisaged ICT strategy.

If we think of multiple possible scenarios (see Figure 3) the EM/ICT alignment process will be an almost impossible task since some goals and processes might compete and the multiple possibilities cannot be anticipated. For example it could be the case that ICT investments are "optimized" for a particular scenario which never happens, but in case of a different scenario the ICT investments are more or less useless.

Instead of the conventional "scenario based planning" we propose a modular approach to tackle the "ICT value estimation" issues identified in Figure 2 since the process analyses in our case studies have shown that most scenarios have recurring patterns (subroutines or activities such as evacuation, search for missing people, supply water, supply shelter etc.), which can even be used in yet unknown scenarios.

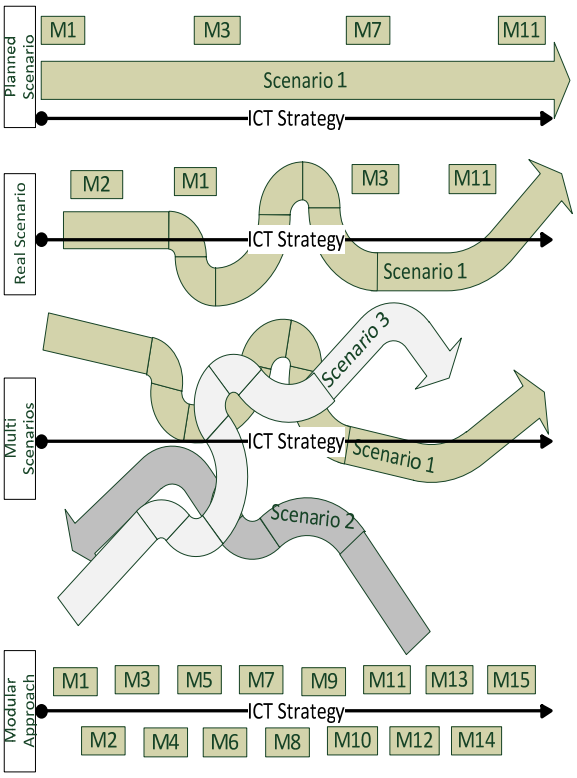

Figure 3: Scenario vs. modular process

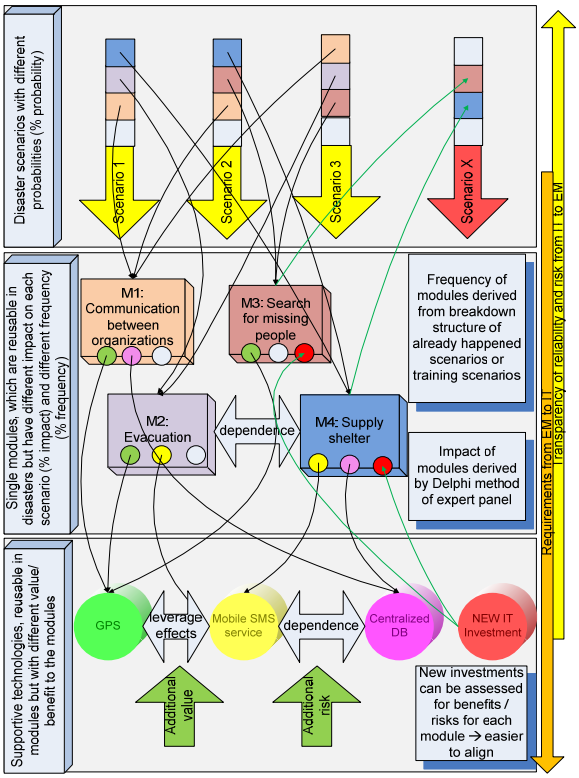

Figure 4: Modular approach

The modular *"ICT Value Estimation Method in Emergency Management (IVEM²)"* as shown in Figure 4 enables us to build a hypothetical ICT portfolio and prioritize investments according to their benefits and risks, in order to gain maximum process value from EM critical ICT Services and build an optimized IT investment portfolio. The granular breakdown structure enables EM organization to handle smaller and more manageable packages, which makes it easier for ICT and EM personnel to anticipate the benefits and risks of used technologies. As a result this would increase trust in and value realization of ICT investments.

In a prototypical model we applied an adapted and enhanced version of the "Community Value Estimation Method" (CVE), which is based on the Analytical Hierarchy Process (AHP) and has been successfully tested in a large municipality to align ICT projects with community values (Vogt & Hales, 2010). AHP is a decision support method to simplify complex decisions and make rational decisions. The AHP-Method is "hierarchical", because the criteria which are used to solve a problem are in a hierarchical order. Elements of a hierarchy can be divided into groups, to refine and simplify the decision-making process. It is "analytically" because it describes and analyses the constellation and dependencies of the particular problem and it is a "process" because it follows a defined and repeatable procedure. Therefore AHP supports decisions in teams to find joint solutions while it provides transparency of the process and minimized inconsistencies in decisions (e.g. A > B, B > C, but C > A).

It enhances "gut decisions" by a qualitative weighting based on pairwise comparative decisions (Thomas L. Saaty, 1987; T. L. Saaty, 1990).

The following influence factors are relevant for our method; simple examples are used to explain the process:

1. Probability of a particular scenario (P), derived by AHP pairwise comparisons (or alternatively by statistics)
2. Impact factor of a module/pattern for a known or possible scenario, derived by pairwise comparison (MI)
3. Impact factor of an IT service for each module, derived by pairwise comparison (SI)
4. Impact factor of a technology for each IT service, derived by pairwise comparison (TI)

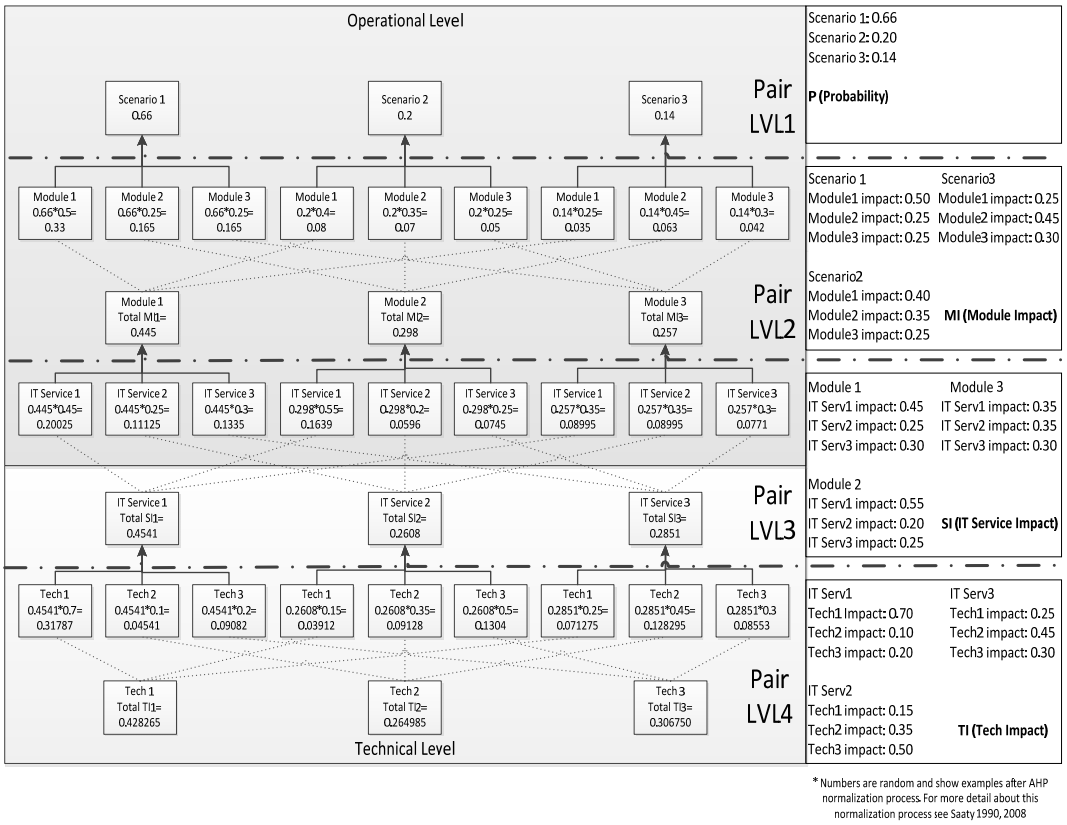

Figure 5: AHP Process

The "Total Impact" of an IT technology can therefore be calculated and a technology investment to improve the desired IT services would be prioritized as follows:

1. **TECH 1**, with an impact factor of 0.428265
2. **TECH 3**, with an impact factor of 0.306750
3. **TECH 2**, with an impact factor of 0.264985

To calculate the numbers shown on the right side of

Figure **5**, we utilize sliding-scales for each pair-wise comparison, these are scaled from 1 to 9 either side, whereas 1 marks the neutral point which means that both goals are equally important and 9 marks that this goal is extremely more important than its opposite. E.g. if "Module 1" should be favoured very strongly (7) over "Module 1" it must be marked as follows:

"Module 1" 9 - 8 - (7) - 6 - 5 - 4 - 3 - 2 - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 – 9 Module 2"

The total technological impact factor (Total TI) will allow us to rank ICT services and / or technologies according to their value to the EM process. To build an optimized portfolio EM Organizations will have three options:

1. *"Total TI Threshold"*: This is only interesting for EM organizations which have either no budget constraints. They can define a threshold and invest only in those projects which have a minimum TI factor.
2. *"Cost/Benefit"*: This is mainly interesting for EM organizations, which have to justify their investments. However, this will force them to know the costs for each proposed investment (ITCost).
3. "*Maximum Budget*": This will be most interesting for those organizations that have a fixed budget. However, two more variables must be known: First, the cost for each proposed investment (ITCost) and second their maximum budget for ICT investments (MaxBudget). In second step the portfolio can then be optimized according to these constraints.

It can therefore happen in option 2 & 3 that projects of lesser TI will be given priority over projects with higher TI since their cost/benefit factor is higher

Besides clarifying "gut decisions" a major advantage of this AHP based method is that every EM organization can adjust the level of complexity towards their capabilities and needs. Large EM organizations with many ICT projects and a more complex process structures can add extra hierarchies if needed and divide the decision process in "technical" and "operational" level. Consequently, the method will become more accurate because decisions are made by experts in the field and the increased granularity is more precise. However, the initial setup of the method will become increasingly complex the more hierarchies are added. Smaller EM organization can simplify the hierarchical structure and pairwise comparison and use only those elements which are appropriate (e.g. merge ICT Services and Information Technology hierarchy in

Figure **5** since in smaller organizations ICT services are often associated with particular technologies [e-mail → e-mail server]). Since these smaller EM organizations have usually less technological projects in line and processes are not that complex this should be a reasonable action that would not alter the results too much.

In larger EM organizations, it might not be enough to calculate the technological impact (TI) factor in order to prioritize investments and spend money and resources for them. As Figure 4 shows there might be dependencies, leverage effect and risks associated with some technologies or services. Currently these cross-impact and leverage effects are not implemented in IVEM². However "cross-impact add-ons" are in development. Future versions of IVEM² will enable us to incorporate dependencies, leverage effects, and risks. However, following our modular approach these "add-ons" will not be mandatory (e.g. for small EM organizations) but we are certain that they will have positive side effects and should be considered to strengthen the method.

LIMITATIONS AND FUTURE RESEARCH

The domain of emergency management is small and not well researched in terms of ICT. Additionally, most EM organizations and CIPs have sensitive data and are reluctant to make them available to outsiders. As a result this research is based on a limited number of organizations, which made it difficult to collect large sets of data. Because of this, one can argue that our results are not generally applicable to all EM organizations and CIPs. However, we tried to minimize these shortcomings by incorporating a maximum of variety of EM organizations and an international setting. Nevertheless, all case studies and interviews revealed rich information, which enabled us to get do an in-depth analysis. We believe that this was more valuable than hundreds of online surveys, which would only reveal basic statistics.

Because of their critical functions research in EM organizations is often limited to a prototypical stage, including our project. We tried to make our interviews and tests as realistic as possible by working closely with experts in the field but one must be aware that the received results may differ in real-life situations. Even though we have promising results with the modular approach, it will take time to evaluate the method in a real scenario.

A major problem is still the interdependence of some modules to other modules (e.g. "evacuation" has a correlation to "supply shelter") and some technologies to other technologies (e.g. a GIS system relies on a reliable network). Currently we are investigating towards a "leverage cluster" approach by the means of cross-impact methods, which will enable us to tackle this problem. However, this attempt is still in its infancy and we need to find out if it will have significant or only minor impact on the portfolio ranking.

Nevertheless our alignment method addresses most of the identified "ICT evaluation" and alignment issues in EM organizations. The researchers are fully aware that strategic ICT alignment is already a difficult topic in for-profit organizations and might never be fully achieved there or in EM.

Future research should also consider analyzing the organizational structures in depth. During our research we found evidence that EM organization have shifting organizational structures. As a result, responsibilities of ICT

assets and ICT decision vary depending on whether the organizations are in an emergency or not. We believe that this could be the second important source for misalignment (cp. Figure 2), a point we could not fully cover in this paper. Moreover, we encourage other researchers to follow us and help to design a more holistic ICT governance framework for EM organizations.

CONCLUSION

The domain of emergency management is a neglected but vital research area in our lives. In case of a disaster or large scale emergency we depend on the performance and expertise of EM organizations. However, our research has shown that the domain of emergency management is in its infancy with regard to ICT and its governance. Time is a crucial factor in an emergency – seconds can decide over life or death. ICT can give EM organization that edge if systems are used appropriately. Strategic ICT alignment of ICT systems and an improved ICT portfolio management approach can have a positive impact.

One finding of this research was that in particular the issue of strategic ICT alignment and ICT value estimation seems to be a problem for all researched EM organizations due to the unpredictable character of emergencies. In the view of emergency management experts and ICT managers of these organizations existing ICT governance frameworks and ICT value estimations methods fail to cope with their needs. Our findings show that we should foster adapted ICT governance methods in emergency management organizations in order to improve and support their efforts by developing tools and guidelines that enable them to realize value and benefits of their ICT investments and therefore utilize these technologies more effectively and efficiently

During case studies in large EM organizations detailed as-is process models have shown that the conventional "scenario based approach" is of limited use since it is too complex and inflexible. Therefore, the paper proposes a new EM/ICT alignment method based on a modular approach, which can deal with uncertainties and enables EM organizations to estimate risk and value of ICT investments more easily.

In our point of view the proposed modular approach is a very promising attempt to enable strategic alignment in uncertain environments such as emergency management. Its modular character suits the demands of Emergency Management organizations. We even believe that due to the straight forward use of AHP even non tech-savvy Emergency Managers will be able to use our modular approach. Thus, IVEM² might be a way to enable an emergency management organization to pursue "sustained ICT alignment" without losing the flexibility to adapt to fast changing circumstances.

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