

*Heli Tervo*

INFORMATION TECHNOLOGY  
INCIDENTS IN THE PRESENT  
INFORMATION SOCIETY

VIEWPOINTS OF SERVICE PROVIDERS, USERS,  
AND THE MASS MEDIA

UNIVERSITY OF OULU,  
FACULTY OF SCIENCE,  
DEPARTMENT OF INFORMATION PROCESSING SCIENCE

A

SCIENTIAE RERUM  
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*HELI TERVO*

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Viewpoints of service providers, users, and the mass media**

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*Abstract*

Our society relies increasingly on information technology (IT). In such a society, it is important that we, as citizens, trust and are satisfied with services utilizing IT. Unfortunately, IT problems in the use of services are part of our daily lives and, as such, are frequently reported by the mass media. While the information systems (IS) field has studied system and service acceptance, use, threats, and failures, we have found no studies that examine how these IT failures affect the system usage after a failure.

This dissertation addresses this gap in research by studying users' intentions after service degradation related to IT problems and providing a larger view of IT-based incidents in an information society from the viewpoints of the mass media and service providers. In order to do this, a newspaper survey was first conducted to ascertain a concept of the public perception of IT-based problems. Second, qualitative interviews were conducted to reach an understanding of service providers' viewpoints of IT problems. Third, users' attitudes and reactions to service degradation were studied through interviews.

The main results reveal that most of the IT problems visible to society are the same ones that system and service providers perceive to be the most problematic. Our results suggest that, after service degradation, users are eager to use the service again if they receive relevant information. Compensation alone will not satisfy users when the incident creates unpredictability and uncertainty for them. If the system provider does not inform users directly after the incident, they readily rely on the mass media. Information and knowledge thus play a significant role in incidents. However, there are two service types where we found a different type of user reaction. First, telecommunications and computers seemed to be special cases, with more tolerance of problems in general. Second, the tolerance was low with regard to vital services, i.e., services related to children, health, and safety, for example. Nevertheless, in interviews it was seen that in both types of services the effect of real time and accurate information was influential, often more than any other activities in the failure recovery. The results of this study provide new views of IT-based incidents in an information society, as well as insights for service providers to better recover from service degradation.

*Keywords:* failure recovery, information society, IT failure, mass media, public image, qualitative research, service degradation, system use continuance



## **Tervo, Heli, Tietojärjestelmäongelmat informaatioyhteiskunnassa. Palvelun tarjoajien, käyttäjien ja median näkökulma ongelmiin**

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### ***Tiivistelmä***

Yhteiskuntamme on rakennettu informaatioteknologian (IT) varaan. Tällaisessa informaatioyhteiskunnassa kansalaisten tulisi voida luottaa käyttämiinsä palveluihin. Palvelujen käyttäjät kohtaavat kuitenkin päivittäin virheitä informaatioteknologiaan pohjautuvissa järjestelmissä. Media uutisoi usein näistä virheistä. Alan kirjallisuus on tutkinut esimerkiksi järjestelmien ja palvelujen vastaanottoa, käyttöä, uhkia ja häiriöitä. Kuitenkaan IT-palvelujen virheiden vaikutuksista järjestelmien käyttöön ei löytynyt kirjallisuutta.

Tämä tutkimus pyrkii tältä osin täydentämään kirjallisuutta selvittämällä käyttäjien ajattelutapaa ja aikomuksia palvelun heikentymisen jälkeen, ja tutkimus myös hahmottelee laajemman kuvan informaatioyhteiskunnan IT-ongelmista erityisesti median ja palveluntuottajien näkökulmasta. Ongelmien julkisen kuvan saamiseksi tutkittiin ensin sanomalehti uutisia IT-ongelmista. Seuraavaksi selvitettiin haastatteluin palveluntuottajien ja järjestelmätoimittajien näkemyksiä IT-ongelmista. Lopuksi tutkittiin vielä palveluiden käyttäjien mielipiteitä ja reaktioita häiriön sattuessa ja sen jälkeen haastattelujen avulla.

Päätulokset osoittavat, kuinka yhteiskunnan näkyvimmat IT-ongelmat ovat samoja, joiden kanssa myös järjestelmätoimittajat ja palveluntarjoajat kamppailevat. Lisäksi tutkimustulosten mukaan käyttäjät palaavat herkemmin käyttämään palvelua mikäli he saavat asiaankuuluvaa tietoa tilanteesta. Pelkkä aineellinen korvaus ei riitä silloin kun IT-häiriö luo arvaamattomuutta ja epävarmuutta. Jos palveluntuottaja ei tiedota asiasta häiriön sattuessa, käyttäjät luottavat helposti massamedian tarjontaan. Tiedolla ja tietämyksellä on merkittävä rooli ongelmatilanteissa. Tutkimuksessa löytyi kuitenkin kaksi palvelutyyppeä, joissa käyttäjien käytös oli erilaista. Ensinnäkin tietoliikenteen ja tietokoneiden suhteen käyttäjät olivat pitkämielisiä virheiden sattuessa. Toiseksi taas elintärkeät palvelut, esimerkiksi terveyteen, lapsiin ja turvallisuuteen liittyvät, olivat palveluja joissa virheitä ei juurikaan siedetty. Kuitenkin myös näissä palvelutilanteissa tiedottamisella oli merkittävä rooli, usein jopa merkittävämpi kuin muilla toimilla palvelun korjaamisessa. Tutkimuksen tulokset tarjoavat uusia näkökulmia IT-pohjaisista häiriöistä informaatioyhteiskunnassa ja näkemyksiä palveluntarjoajille häiriöistä toipumiseen.

*Asiasanat:* häiriöstä toipuminen, informaatioyhteiskunta, julkinen kuva, järjestelmän käytön jatkuvuus, laadullinen tutkimus, massamedia, palvelutason heikentyminen, tietotekniikkahäiriö



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I have been doing research with a group of people, and with them I have had an opportunity to gather knowledge from senior researchers and other experts and support from my co-workers in the same situation as PhD students. Thus thanks to the following who have contributed to my work: Dr. Riitta Hekkala, Dr. (*in spe*) Mari Karjalainen, Dr. (*in spe*) Kari Nykänen, Dr. Seppo Pahlila, Miia-Maarit Saarelainen, Hanna-Miina Sihvonen and Timo Wiander. I would also like to thank Professor Jarmo J. Ahonen, who was my former supervisor in the early stages of my research career.

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I owe thanks to my family and friends for tolerating me especially during deadlines. Special thanks I have to give to Sara and David Wojciechowski for helping me with the English language—your contribution for the thesis was huge (and without salary!).

After all, isn't doing research quite simple?

“The problems are solved, not by giving new information, but by arranging what we have always known.”

Ludwig Wittgenstein, *Philosophical Investigations*, § 109

Kuopio, October 2011

Heli Tervo



## List of original publications

This dissertation includes four original research articles, which are referred to in the text by their Roman numerals.

- I Tervo H & Wiander T (2010) Sweet Dreams and Rude Awakening – Critical Infrastructure’s Focal IT-Related Incidents. In Proceedings of the 43<sup>rd</sup> Hawaii International Conference on System Sciences (HICSS ’10), Koloa, Kauai, Hawaii.
- II Tervo H & Wiander T (2010) Failures and Image. In Proceedings of the 18<sup>th</sup> European Conference on Information Systems (ECIS 2010), Pretoria, South Africa.
- III Tervo H & Wiander T (2011) Information Technology Failures: What the Media Says and Managers Know. In Proceedings of the 44<sup>th</sup> Hawaii International Conference on System Sciences (HICSS ’11), Koloa, Kauai, Hawaii.
- IV Tervo H & Siponen M (2011) How IT-Based Service Degradation Influences the Use of Services: A Qualitative Study. Manuscript.

The contribution of Heli Tervo to the articles is the following: Heli Tervo is the primary author in all articles. She planned and coordinated the writing of each paper, and collected the data. She wrote most of each paper based on discussions with and input from Timo Wiander and Mikko Siponen.



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# 1 Introduction

Our society is heavily reliant on information technology (IT). As IT has become more prevalent and all kinds of services utilize IT, users frequently encounter degradation in society's services that can be traced back to IT problems. Today's information society enables the rapid spread of information, and thus people often receive information about failing services in real time. While failing systems cause economic harm (CA Technologies 2010, Zhivich & Cunningham 2009), media coverage can also have a negative affect, such as on the stock market (Cavusoglu *et al.* 2004, Telang & Wattal 2007). In an information society, it is important that citizens are satisfied with the systems and services utilizing IT. To recover from a failure in such an IT society, service providers and designers need an understanding of the effects that a failure can have on service users as well as on society as a whole.

Research related to system failure, threats, risks, and success has been widely carried out in the field of information systems (IS) (*e.g.*, Beynon-Davies 1995, DeLone & McLean 2003, Smith & McKeen 2009). In computer science, however, failure recovery has mostly concentrated on the technical system level. In the fields of business and marketing, there exist studies on failure recovery with human-related issues; however, these include the general aspects of any types of service such as healthcare, hotel, banking, and restaurant services (McCollough *et al.* 2000, Smith *et al.* 1999). In the IS field, there exists research on information systems acceptance (Davis 1989, Lazarsfeld *et al.* 1944, Venkatesh *et al.* 2003), information systems continuance (Bhattacharjee 2001, Limayem & Cheung 2008) and transaction cost perspective (Coase 1960, Williamson 1981). Based on the review of IS literature,<sup>1</sup> it was concluded that existing studies have not explored IT failure situations, especially their effects on system use. Further, the literature lacks studies that examine how IT failures affect actual service use, and the types of failures that influence a user's change of service in different situations.

This dissertation addresses these challenges by exploring IT-based failures in the present information society from the viewpoints of service providers, users, and the mass media. In this study, *users* mean any people using any kind of *services* in our society, for example, bank customers, or patients in hospitals.

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<sup>1</sup> For example, leading journals such as MISQ, ISR, JAIS, EJIS, and main databases, such as ACM Digital Library, IEEE Xplore, LNCS, and ProQuest databases

*Service providers* are those providing society's services. *Incident* in this study is defined as any kind of *service degradation*: i.e., the user faces a situation where the service is not appearing as expected. For example, the train stops between stations or the web pages of an online store are down. *IT-based service degradation* or *IT-based service failure* means a situation when a user has faced service degradation/failure and the relation to IT is either direct or indirect. Online shopping is a service where the relation to IT is seen directly, where on the other hand, electricity supply is a service where the relation to IT is not necessarily seen directly by the user but is a part of the service behind the scenes. In this study *mass media* covers daily newspapers.

The study was carried out as follows. First, a newspaper survey was conducted to find the types of IT-based failures which exist in an information society from the mass media's perspective, since these are the incidents that citizens most often face and which have the most effect on them. Two qualitative interview studies were then conducted: the first aimed to reach an understanding of the service providers' viewpoints of IT problems within the society, the second to determine users' attitudes and reactions to and after service degradation based on IT problems. In practical terms, this study benefits service providers and designers, since they perceive how both the media and users see their services, especially in the event of a failure or service degradation.

The study is divided into four articles: Article I discusses what our society's focal IT-based incidents are from the viewpoint of the mass media. Article II, based on information in the mass media, presents one significant IT failure event and its consequences to customers, the service provider, stakeholders, and society as a whole. Article III gives the viewpoints of service providers and system constructors on focal IT-based problems. Finally, Article IV describes how service degradation caused by IT problems affects the use of services and determines the most significant issues affecting users' decisions to continue using the service.

The rest of the thesis is organized as follows: Chapter 2 introduces the research methods and the settings of the study. Chapter 3 introduces the four articles, their research motivation, and main results and contributions. Chapter 4 concludes the thesis with discussion on study limitations, contributions and future work.

## 2 Research approach and data collection

This thesis uses qualitative and interpretive research approaches. While quantitative research asks “what” and “how much,” qualitative research asks “why” and “how,” aiming to find an in-depth understanding of the studied phenomenon. An assumption in interpretive research is that access to reality is through social constructions such as language and shared meanings (Myers 1997). Interpretive research aims to examine the context of the phenomenon as well as the phenomenon affecting and affected by the context (Myers 1997).

On modes of analysis, we relied on a grounded theory tradition (Glaser & Strauss 1967, Strauss & Corbin 1990) and content analysis (Berelson 1952, Neuendorf 2005). Content or textual analysis is a research tool that examines the presence of words, phrases, concepts, or themes within texts. Characteristics of the message may be analyzed and interpreted by breaking down the contents of texts into meaningful units of information.

Grounded theory is an inductive type of research. The target is to develop a theory that is emerging from systematically gathered and analyzed data. It is an iterative process and there is a continuous interplay between data collection and analysis. (Myers 1997).

Grounded theory was designed for research domains with little theory and for studies on phenomena in new situations with a high probability of unexpected factors (Glaser & Strauss 1967). Research methods relying on predetermined problems may prevent researchers from identifying real problems (Glaser 1992).

The use of an inductive and qualitative study is justified, since the study does not test whether an existing theory explains the phenomenon; rather, it investigates a new phenomenon that has not been studied to date. A newspaper survey and two sets of interviews were conducted with the aim of collecting rich data sets that best represented the present information society. A summary of the studies and research methods used is presented in Table 1.

Articles I and II are based on data for 2008 collected from the seven largest daily newspapers in Finland and thus represent an extensive point of view of the mass media in Finnish society. The newspapers were reviewed to find articles related to IT problems both in systems and services utilizing IT. The newspapers were reviewed in the library and the articles copied to create a data set of 923 news items for the year in question. The searches were not conducted from electronic databases, since not all the papers were available electronically; also, it was impractical to cover all words or phrases journalists may have used when

reporting on IT-based problems in services. The final data set comprised 530 news items related to IT incidents in Finnish society. We excluded items from abroad, since the Finnish media cannot cover all international IT-based incidents. Also, Finland is an interesting society in which to study IT-based problems because it is a progressive society built heavily on IT. News items on general IT problems—*i.e.*, those with no special focus—were also excluded, since by studying incidents that actually occurred we were able to achieve a realistic view of our society’s visible and actual IT problems, which can affect the attitudes of citizens and the economy of a society.

**Table 1. Summary of studies and research methods used in the thesis.**

Article	Research Question	Research Methods Used
I: Sweet Dreams and Rude Awakening – Critical Infrastructure’s Focal IT-Related Incidents	Society’s most visible IT-based incidents	Newspaper survey, content analysis
II: Failures and Image	How IT failure affects the organization in question and society as a whole – an example based on information on newspaper data	Newspaper survey, content analysis
III: IT Failures: What the Media Says and Managers Know	Service providers’ and system constructors’ viewpoints on focal IT-based problems in their systems and services	Semi-structured interviews, an adapted version of the grounded theory
IV: How IT-Based Service Degradation Influences the Use of Services: A Qualitative Study	How service degradation based on IT problems affects the use of services and what are the most significant issues affecting users’ decisions to continue using the service	Semi-structured interviews, an adapted version of the grounded theory

In terms of research methods, Article III is based on interviews. With qualitative in-depth interviews there is a possibility to achieve deep understanding of significant issues and gain a richer picture of a respondent’s point of view (Denzin & Lincoln 2005). Managers of organizations mentioned in newspaper articles that were having problems based on IT were chosen to be interviewed. In

total, 25 managers were interviewed from these organizations, which operate in various economic sectors, both public and private, including service and system providers. Semi-structured interviews (Myers & Newman 2007) were used to obtain information on how service providers and system constructors see the main problems with IT both in our society and in their systems and services. The interviews were conducted in 2009 and 2010 and were recorded and transcribed.

For Article IV, 21 citizens from both genders, different ages, different educational backgrounds, and different cities were interviewed. The interviewees were acquaintances or acquaintances' acquaintances of the interviewer, thus comprising an opportunistic sample. The interviews were based on scenarios derived from the newspaper data set. By combining and extracting similar news stories and sorting them on their visibility, 16 different scenarios were chosen in five fields: transport, telecommunications and computers, banking, services, and healthcare. Thus, the most prevalent and visible incidents were the basis for discussions in the interviews. By basing the interview questions on actual reported IT-based incidents in our society, we were able to obtain user reactions to service degradation based on IT failures in the present, real life information society. The data were collected with semi-structured interviews in order to ascertain citizens' opinions of what affects the usage of the service after service degradation. The interviews were conducted in 2010 and were recorded and transcribed.

The newspaper data set was analyzed by means of content analysis. The data set was categorized by codes or keywords found in the news items and types of incidents. The analyses of interviews relied methodologically on the grounded theory tradition. For the interview analyses, an adapted version of the grounded theory (Sarker *et al.* 2001) was used. The method has three different phases:

1. *Open coding*. In open coding, the text is analyzed line by line to find codes (as in content analysis).
2. *Axial coding*. In axial coding, the study continues by classifying the codes or building categories (as in content analysis).
3. *Selective coding*. In selective coding, one main category is chosen and linked to the other categories. In this phase, connections and interdependences are revealed, thus creating new data.



### **3 Introduction of the articles**

This doctoral thesis consists of four articles, which are referred to in the text by their Roman numerals. This chapter of the thesis briefly summarizes the research motivation and main results and contributions of each article. Research methods used in these articles are discussed in Chapter 2 of this thesis.

#### **3.1 Article I: “Sweet Dreams and Rude Awakening – Critical Infrastructure’s Focal IT-Related Incidents”**

##### **3.1.1 Research motivation**

Our society is increasingly utilizing IT and IT services. This increase in services using IT is also most likely to increase the IT-based problems that face the citizens of our modern information society. This is expected, not just because the number of IT services is increasing and it is difficult to design error-free software (Lyu 1996), but also because the number of users of IT services is increasing. Such IT incidents have also received more and more interest from the mass media, who periodically report on such incidents. However, the mass media can be seen to reflect only one viewpoint of IT-based problems in society, and are mainly concerned with critical infrastructure incidents such as failures in public transport or the crash of a bank’s IT system. The media reports on problems that concern a large number of people or problems that are too serious to be hidden and so become transparent to the society (Bieman 2006). With this in mind, it is important to determine what the most visible problems in our society are and what kind of public image the mass media gives these problems since, as previous studies have shown (Cavusoglu *et al.* 2004, Telang & Wattal 2007), media images of IT systems can affect stock markets, for example. However, we find no studies that have examined society’s most visible IT problems.

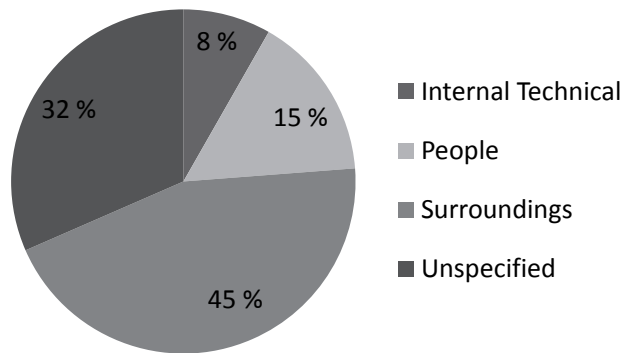
Article I examines what the essential and most visible IT-based problems in our society and infrastructure are, according to the mass media. This study gives a wide-ranging and general perspective of IT-based problems in our society from the mass media’s viewpoint. This is an important area of research due to the influence the mass media has on both citizens and society, since the attitudes of a system’s users affect system usage which, in turn, affects the image and finances of companies and ultimately the economy of a whole society.

### 3.1.2 Main results and contributions

The study presented in Article I is based on newspaper data and reveals the situation of Finnish society and its most visible IT-based problems according to the media. The study presents the proportion of different types of problems in the core infrastructure, which are divided into four classes (Fig. 1):

1. System inner technical problems
2. Problems caused by people
3. Problems in surroundings with socio-economic and technical issues
4. A class of unspecified technological problems

System inner technical problems are problems with usability and faulty software. Problems caused by people are caused either by the system user or an outsider and can be accidental or deliberate. Problems in surroundings with socio-economic and technical issues are problems that arise because of circumstances in the system's surroundings and community, such as a problem caused by another system, and problems arising from legal and sentiment issues. The fourth class of problems contains those reported in the news in general or in vague terms and without specified reasons.



**Fig. 1. Problems by class (Article I, published with permission of IEEE).**

The results presented in Article I show how the main sources of problems (45%) in a society's infrastructure are due to the systems' surroundings (Fig. 1), while system internal technical problems account for 8%; people for 15%; and unspecified problems for 32%. The newspaper survey shows that most IT failures in our society are not hostile attacks or system internal problems; rather, they are

a complicated combination of various communication problems and insufficient risk analyses.

In problems with surroundings, the most dominant reasons were system updates and new system installations. Business processes, services, and systems are increasingly interconnected and problems will thus be reflected more widely. Large nets of systems become complicated combinations of divergent systems. Global buyouts resulting in system integrations and migrations meet operational challenges, especially in cultural aspects and legal matters.

The study presented in Article I revealed that even systems in the core infrastructure are not as dependable as expected. In several situations, beginning from system planning and development, more collaboration is needed to achieve a more holistic view of systems or services and their needs. One method to address this could be by collecting and publishing incidents and best practices within a system's development. It appears that developers do not always understand the character of contemporary systems. IT systems are rarely intended to work in isolation—most often they are interconnected. When the safety and usability of focal systems in our infrastructure are improved, total cost savings will accrue.

## **3.2 Article II: “Failures and Image”**

### **3.2.1 Research motivation**

When IT systems become larger and more interconnected, failures in systems will have wider effects. This raises the question of how widely IT-based failures in organizations affect their public image and surrounding society, and how this reflects back to the organization and its system. The newspaper data contained one significant incident which generated new incidents and was reported on and followed for several months in all of the papers: a bank merger which resulted in a series of ongoing problems. As this incident provided a wealth of data on one IT failure and its effects on society, it was decided that this would be examined in more detail. In the IS field, studies of incidents are usually restricted to a certain field of research, such as information system threats (Im & Baskerville 2005), or the direct economic damage that failures cause (Zhivich & Cunningham 2009). Escalating risks are difficult to predict and traditional risk analysis methods and frameworks do not adequately cover them (Alter & Sherer 2004, Rainer *et al.*

1991). There is a lack of research in the IS domain that takes a broader view of how failure affects corporate environments, society, public image, and people.

To fill this gap in the research, Article II studied and analyzed, based on newspaper data, the case of a large failed information system merger and its effects on society, the reactions among the people and companies involved, as well as the developed public image. Based on the results, the study outlines a model of IT failure effects in society from the perspective of the mass media.

### **3.2.2 Main results and contributions**

The study presented in Article II analyzes a bank merger and the subsequent IT system merger, based on a newspaper survey. The IT system merger failed and resulted in escalating and continuous problems to Finnish society. The problems, which eventually widened to other organizations and systems, included interruptions in e-banking, failures in using bank cards, as well as customer dissatisfaction in using the services. The bank also failed in crisis communication—it remained silent for the first two days, which caused anger and frustration among its customers and business partners, according to the news data. One problem led to another and this continued for months.

Problems in the news were categorized into two groups: problems with the defective system, and escalating problems with economic and social effects. The consequences, reflections, and interdependencies were examined and aggregated into one model of the effects of IT failure in society (Fig. 2). The combined influence of the problems with the defective system and the escalating problems had a continuous impact on the situation in the organization. These kinds of problems may have complex, unforeseeable connections in the surrounding society. Public discussion in the mass media shapes the public image, which affects a company's services and operations.

The media reflects the public image. Our contemporary society with its extensive mass media coverage makes the service failure situation different from that of two or three decades ago. While the incident itself may have far-reaching economic impacts, the media also has a strong economic influence by creating a certain kind of public image of the situation, system, or corporation. When the media provides a wide-ranging picture of escalating problems in the media from the point of view of a citizen, the stakeholders are able to better see the general view and impacts of their actions.

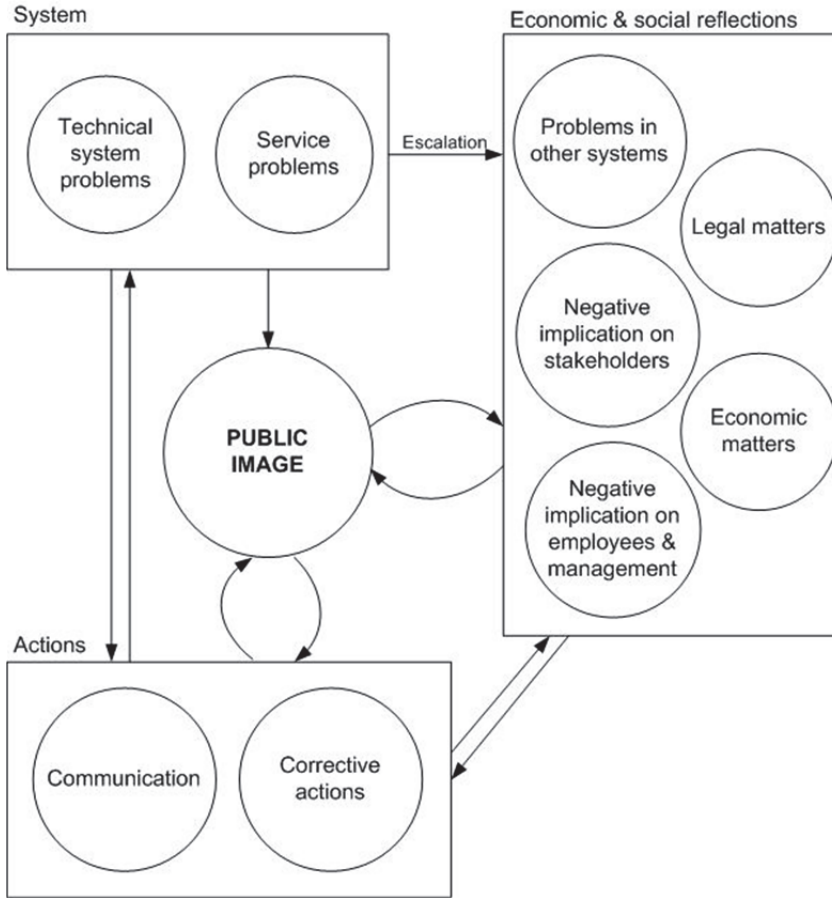


Fig. 2. Different effects of an IT failure on society (Article II, published with permission of the Association for Information Systems).

### 3.3 Article III: “Information Technology Failures: What the Media Says and Managers Know”

#### 3.3.1 Research motivation

In public discussions, IT is often considered troubled and unpredictable. The mass media’s reflection of this image has influence not only on the behavior of newspaper readers, but also on system providers, users, organizations’ finances, and so forth. It is important to know whether the knowledge in organizations

contradicts information in the mass media. Public images that the mass media sustains may hurt organizations. Organizations, on the other hand, may benefit from seeing public reality from the end-users' viewpoint. After reviewing the IS literature in light of the above, we were unable to find research that compared organizations' views on IT incidents that have been reported in the mass media. Studies of IT and the impact of incidents, or reasons for incidents, are usually restricted to a certain field of research, such as the root causes of failure or risk factors in a technical system or in organization and project management (Beynon-Davies 1995), or failure recovery in a technical system (Lyu 1996), or the viewpoint of a service provider (Miller *et al.* 2000). This study attempts to fill this gap in cross-domain research.

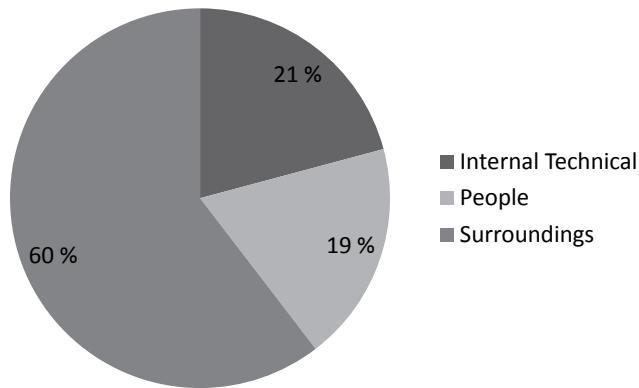
The study examines how failures presented in the mass media differ from the most common failures in organizations. Two data sets were analyzed: society's focal IT incidents from the viewpoint of the mass media, and organizations' focal IT problems from the viewpoint of managers in the organization at issue. The focus of information in newspapers, compared to knowledge in organizations, will often provide new understanding of the impact of public image, since the organization's image may be quite low. This knowledge can lead organizations to conduct comprehensive, reconstructive operations with their information systems and services.

### **3.3.2 Main results and contributions**

The two data sets, society's focal IT incidents from newspaper data and organizations' focal IT problems based on interviews of managers, were analyzed to determine their differences, similarities, and contradictions. Comparing the data from interviews and the newspaper data, the study shows that results from both data sets are similar. The respondents in interviews gave rather united opinions on problems in general, while the news data covered various individual incidents. In both data sets, the most severe source of problems was identified as issues related to system surroundings (Fig. 3).

Many of the problems and incidents that managers encounter stay within the organization and never become public, and are often different from the public incidents discussed in the media. This is not in contradiction with the study presented in Article III; the problems out of the media's sight are typically of a kind for which the organizations are well prepared. Troubles that cause harm are those that find their way into the news media. They are historically managed

poorly in organizations and they are the ones for which organizations should be better prepared.



**Fig. 3. Problems by class from interviews with managers.**

The results from this study reveal that the most noticed and problematic IT-based incidents in our society emerge from issues in the whole environment where the systems lie such as collaboration, interconnectedness, haste and the pressure of economics, a lack of thorough specification, or simply a lack of knowledge and know-how. The mass media and managers in organizations give a fairly consistent picture of the present situation with IT problems.

The study presented in Article III shows the importance of research on issues in system surroundings in IS. The complicated environment and the society where the systems exist cause more problems for system providers and users than hostile attacks and user inabilities, for example. The results in Article III may induce system providers and user organizations to confront problematic situations and to cease neglecting these issues no matter how complicated and difficult they are to confront.

### **3.4 Article IV: “How IT-Based Service Degradation Influences the Use of Services: A Qualitative Study”**

#### **3.4.1 Research motivation**

Recovering from service degradation in an information society is a multidimensional process. As the results in previous studies show, failure

recovery includes both technical system recovery as well as many human issues in customer relationships. If users lose their trust in the system, repairing a technical problem is not enough to bring users back. In a real failure situation or service degradation—whether it is an IT-based service or not—we must take into consideration all possible attributes related to the event, such as attributes related to the failure, service, service provider’s corrective issues, users’ expectations, and users’ knowledge. In addition, we must take into consideration the dynamic situation: the values the above attributes had before the incident and how they change during and after the situation. Service providers must deal not only with users; they must also deal with society as a whole, including the mass media.

Previous research related to systems use and respective problems in the IS field can be divided into five streams of research:

1. Information systems success (*e.g.*, DeLone & McLean 1992, Petter *et al.* 2008)
2. Risks/threats and failures (*e.g.*, Im & Baskerville 2005, Smith & McKeen 2009)
3. Transaction cost perspective (*e.g.*, Coase 1960, Williamson 1981)
4. Information systems acceptance (*e.g.*, Lazarsfeld *et al.* 1944, Rogers 1962, Rogers & Shoemaker 1971)
5. Information system continuance (*e.g.*, Bhattacharjee 2001, Limayem & Cheung 2008).

While the existing research has considerably increased our understanding of IS use, we have not found any studies that have examined what kinds of failures affect the use of IT services after a failure or service degradation, and how such incidents affect the use of IT services.

This study in Article IV aims to add to the literature by examining how users react to IT-based service degradation in today’s information society, and what affects their attitudes and usage of services.

### **3.4.2 Main results and contributions**

The study presented in Article IV is based on interviews where users of services utilizing IT were asked about various IT-based service degradation scenarios. The scenarios were derived from the newspaper data presented in Article I in order to have as authentic a picture of real IT-based incidents in our society as possible.

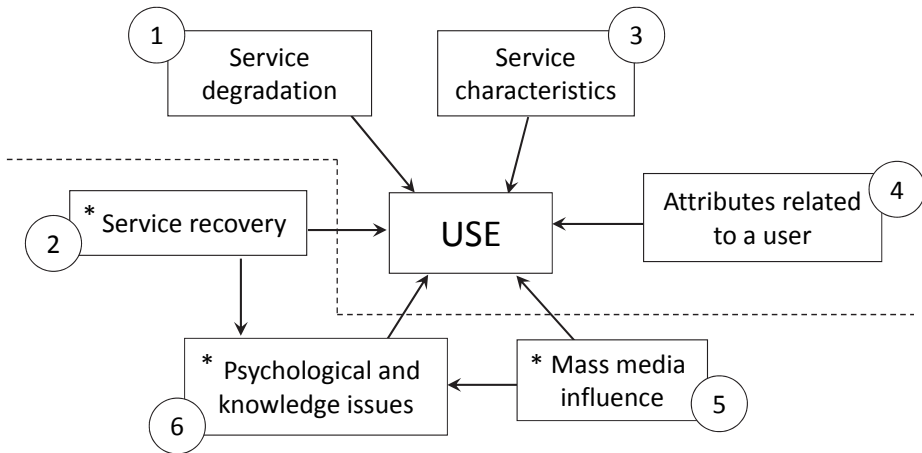
The study provides a variance model (Burton-Jones *et al.* 2004) of issues that affect users during an IT-based service degradation (Fig. 4). The variance model explains the use of service with different factors related to the user, the service, and society. The proposed model attempts to enhance previous models of service recovery to cover the whole environment that is being affected during the incident. This is because the information society has brought new challenges with its fast information exchange, for example, compared to that of the 1960s to the 1980s. User behavior before, during, and after service degradation is a complicated process, since various items affect the user and influence other items in complex ways.

There are six factors in the model that affect system use:

1. Service degradation
2. Service recovery
3. Service characteristics
4. Attributes related to the user
5. Mass media influence
6. Psychological and knowledge issues

In the model, there are some factors that can be considered as static during the incident, and some as dynamic. The incident itself (service degradation) is a static factor by nature: once the incident occurs, the attributes and characteristics of the incident are not changed. This also applies to service characteristics and attributes related to a user. These are factors that appear before the incident and are not really dynamic or interactive during the incident. On the other hand, service recovery and mass media information are dynamic and interactive during and after the incident; thus they have an opportunity to affect users and their mindset and therefore users' decisions more heavily than static factors (see also Fig. 5).

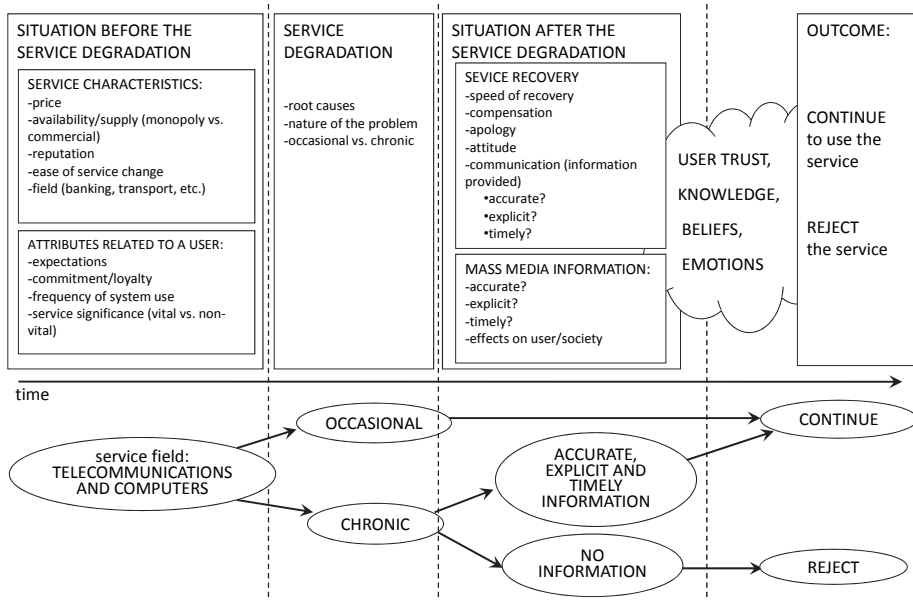
Our results suggest that, in an information society, if the owner of a failed system remains silent, the users and general public will listen to the media. Our results suggest that providing information about the situation plays an important role in creating trust, loyalty, and commitment to the customer. Characteristics of IT-based problems from a user's point of view are unpredictability and uncertainty. This is why information plays such a significant role in situations concerning IT-based incidents—information generates confidence which, in turn, creates safety and trust. This builds positive emotions, which again allow for a better tolerance of failures.



**Fig. 4. Model of issues affecting service use during and after IT-based service degradation (\* = dynamic factors during and after the incident).**

In addition to the issues found affecting service use, congruent user behavior was found in two special cases: vital services and services around telecommunications and computers. In these situations, the effect of the provided information had a significant role and the incident occurrence—occasional or continuous—was also a dominant aspect.

Our results suggest that telecommunications and computers seemed to be special cases with more user tolerance of problems in general. If the user believed that there was enough information to feel confident that the problem would be fixed and it was a “normal” IT problem, then the tolerance was much higher. In contrast, however, tolerance was low with regard to vital services. In vital services related to children, health, safety, and civil rights, for example, the failure was a trigger to change the service. However, it was seen in interviews that the effect of real time and accurate information created trust, which again increased user tolerance, often more than any other activities in failure recovery. See the example of a process model on services and user decisions in the case of telecommunications and computers in Fig 5.



**Fig. 5. A process model on probabilistic usage after service degradation in the case of telecommunications and computers according to analysis of the interviews. The factors of the variance model are transposed to the illustration showing the relationship with the decision making process, with emphasis on the dynamic factors.**



## 4 Conclusions

This dissertation studied IT-based failures in a contemporary information society from three points of view: citizens, service providers, and the mass media. In addition to the effects of system or service failure or service degradation, public image affects organizations' services and finance as well as citizens' attitudes. It is important to understand the effect of failures and service degradation on society as a whole, since a contemporary information society is based on nets of systems and services, people and organizations, as well as complex, multiple interactions. For this reason, IT-based failures may have far-reaching influence on society. However, little cross-domain research has been reported on failures and their effects in the IS field.

To address this gap, this doctoral thesis investigates the IT-based failure phenomenon in our society. To achieve this aim, four studies were carried out to achieve a broad view and concept of contemporary IT-based problems in an information society. The studies included a newspaper survey of society's visible IT-based incidents and two interview studies, one with service providers and another with service users.

The dissertation makes important contributions to IS research on IT-based failures. First, Articles I and III report how the most visible IT-based problems in society—those that citizens encounter in their daily life and that are reported by the mass media—are actually the same that service providers consider to be the most problematic. The majority of these problems originate from the surroundings where the systems exist, such as problems caused by another system, and legal issues between service providers. Article II provides a model of a failure's consequences on customers, service providers, stakeholders, and the society as a whole, from the viewpoint of mass media information.

Second, Article IV gives a new perspective on service degradation that is caused by IT problems, and failure recovery. Compensation alone may not satisfy users when the incident creates unpredictability and uncertainty for them. After a failure or service degradation, users are eager to use the service again provided that they get enough information on the IT-based incidents. In the present information society, real time information has become a major factor in daily life. Information and knowledge play a significant role in service degradations and failure situations—information creates confidence which, in turn, creates safety and trust. This builds positive emotions, which allow people to better tolerate

failures. If the system provider does not inform users directly after a failure, the users usually get their information from the mass media.

Third, in Article IV, congruent behavior was seen in two types of failure situations: telecommunications and personal use of computers seemed to be special cases with more tolerance of problems overall, while with vital services—those related to children, health, and safety—there is low tolerance. Nevertheless, in interviews it was also seen that in both of these types of services the effect of real time and accurate information had influence on the users, often more than any other activity during the failure recovery.

The results of this dissertation have important implications for both IS research and practice. These findings provide important contributions for IS research on IT-based problems in an information society, and enhance our understanding of the effects of and reasons for failure processes concerning the service, the service provider, and the surrounding society as a whole. The study thus provides new insights for service providers to better recover from a service failure. Service providers are able to enhance their services during a failure or service degradation if they realize the powerful effect of information on their customers. Successful and fast service recovery with real time information resulted in the user tolerating the situation best. After reinforcing customer trust by providing honest information, the providers may create even more committed customer relationships.

There are some limitations in this study, which provide views for future research. First, the data collected from mass media includes only daily newspapers. The study would be more comprehensive if data were collected from news on television, radio, and the Internet as well. However, daily newspapers in Finland are considered very reliable and provide news from our society extensively; thus selecting daily newspapers for the data source is justified. Second, all four studies concern Finnish society, and it is reasonable to question how the results will fit in other societies and cultures. This is an interesting follow-up for the research. Third, the interview sample in Article IV is rather small, even though the study was qualitative and saturation was achieved within this sample. Also, the interview sample was opportunistic, which may have influenced the results. Having a larger interview sample with random citizens would improve the work and give stronger evidence for the results. Fourth, the interviews in Article IV were based on scenarios and users' opinions and thoughts on these scenarios. It would provide an interesting improvement for the research if a new interview set was conducted with a real incident situation and users that

have faced the incident in question. Finally, the model of IT failure's effects in society from the perspective of the mass media presented in Article II is based on mass media information, hence giving a mass media point of view. It would be interesting to enhance the viewpoint and make the model more generic with data from the bank's employees as well as present and former customers.



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## Original publications

- I Tervo H & Wiander T (2010) Sweet Dreams and Rude Awakening – Critical Infrastructure’s Focal IT-Related Incidents. In Proceedings of the 43rd Hawaii International Conference on System Sciences (HICSS ’10), Koloa, Kauai, Hawaii.
- II Tervo H & Wiander T (2010) Failures and Image. In Proceedings of the 18th European Conference on Information Systems (ECIS 2010), Pretoria, South Africa.
- III Tervo H & Wiander T (2011) Information Technology Failures: What the Media Says and Managers Know. In Proceedings of the 44th Hawaii International Conference on System Sciences (HICSS ’11), Koloa, Kauai, Hawaii.
- IV Tervo H & Siponen M (2011) How IT-Based Service Degradation Influences the Use of Services: A Qualitative Study. Manuscript.

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