SURVEY ON EXCEPTIONS IN OFFICE INFORMATION SYSTEMS

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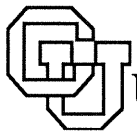

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Survey on Exceptions in Office Information Systems

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Abstract. Exceptions tend to be expensive and laborious to handle, and they have not been taken into account in information system development. These are examples of the results of a survey on exceptions in office information systems in the Finnish industry reported in this paper. A questionnaire inquiring details of the last exception detected or handled by the responder was returned from 97 organizations. The results of this survey indicate the significance of the problem under inspection and state that exception handling is one of the most critical success factors of office information systems.

Keywords: Exception, Office, Office Information System

1. INTRODUCTION

Dynamic properties, especially exceptions and interruptions belong to the basic characteristics of office information systems (OIS). Office work has been found to be full of exceptions [12]. Office work can be characterized by data-intensive activities supporting operative functions and decision making, unstructuredness, interactiveness, a multitude of exceptions and interruptions, and frequent changes [7 and 13]. A typical large office of today is a complex, highly parallel, interactive information processing system [6, 7]. All this is often found problematic in the formulation of action procedures for office workers. In the OIS, there are several reasons for exceptions, several types and levels of exceptions, and many ways to handle them and to return to normal routine. These all should be taken into account in OIS design methodologies.

In the OIS development projects the designer frequently meets with issues of identifying, characterizing and modeling exceptions, rule bases and exception handling processes. But even the fundamental concepts of the field have been missing in the scientific information systems literature. The basic concepts of this research field were profoundly discussed and defined in [15]. A normal case is a case with rules necessary for identifying as well as for handling it (see also [1, 16]). An exception is a case for the handling of which no rules exist [1]. Exception detection is an operation designing if some exception handling actions are necessary [17]. Exception handling is setting system back to a coherent state [5].

Our survey rests on certain hypotheses which arose during a case study in the Finnish Air Force Signal School (see [16]):

- exceptions are generally not taken into account in information system development (see also [1, 10, 14, 18]),
- most organizations have not developed strategies for exceptional events (see also [1, 10, 14, 18]),
- exceptions are a source of considerably high costs in automatic data processing, especially in inflexible systems, and (see also [4])
- some exceptions tend to have a positive influence (see [1, 11]).

The hypotheses presented above are suggested by other related studies as well, however, a reliable empirical proof was not able to be found.

Another hypothesis of our survey was planned to test the classification of exceptions presented in [16]. Section 2 discusses this classification in more detail.

Based on the above hypotheses, this paper answers several questions. How can typical exceptions in information systems be characterized and classified? What are the sources of the exceptions? What are their consequences? How much does their handling cost? How often do the exceptions recur? Have they some dependency on and correlation to the size of the organization?

In the next section the classification of exceptions is clarified. In Section 3 the technical details of our survey are defined. The contents of the questionnaire is explained as well with descriptions of obtained data. Section 4 makes a thorough statistical analysis over the data. Section 5 includes a discussion over the results and outlines a new type of an approach to the classification on the basis of the questionnaire results. Finally, section 6 makes a conclusion.

2. CLASSIFICATION OF EXCEPTIONS

Auramäki and Leppänen [1] have studied the characteristics of exceptionality. Saastamoinen and Savolainen [16] found their approach too narrow and gave those characteristics fuller definitions and added some new features in order to improve the characterization of exceptions.

The first characteristic of exceptionality is the severity of the exception. The more the exception hinders the work, the more severe it is. Another characteristic is the organizational influence area of the exception. The larger part of an organization the exception affects, the more profound influence it probably has. The third characteristic is the degree of difference of the exception from the corresponding normal case. The fourth characteristic is the frequency in which the exceptional case occurs. The more usual the case is, the more possible is that a rule with necessary details exists. The fifth characteristic is the source or the reason for the exception.

This classification is deepened so that each characteristic is divided into four types. The characteristics and their types are presented in Table 1. Excluding the types of difference degrees the meanings of the types of the other characteristics are quite obvious. These types of characteristics are discussed in more detail in [16]. To clarify the examples to be presented later in this paper, the definitions of the types of difference degrees are made explicit.

As was mentioned in the introduction a normal case is a case with defined rules necessary for identifying as well as for handling it [1, 16]. An established exception is a case for which the organization has defined exception handling routines, but the rules of the organization cannot identify the right ones [16]. An otherwise exception is a case for which the organization has not defined precise exception handling routines; however, the organization has rules for handling the normal cases and can identify the case as an exceptional one [16]. A true exception is an uncommon and unanticipated case for which the organization has not created rules [15].

Characteristic	Classes
Severity	Positive
	Harmful
	Locally fatal
	Globally fatal
Organizational influence area	Employee level
	Group level
	Office level
	Organization level
Degree of difference	True exception
	Otherwise exception
	Established exception
	Normal case
Frequency	Infrequent
	Temporary
	Periodic
	Permanent
Reason	Organization born
	Market born
	Technical malfunction
	Force major

Table 1. Classification of exceptions.

There have also been some other attempts to classify exceptions. Berztiss [2] concentrates to uncertainty in data, but he also provides some concepts related to the frequency of exceptions. He states, that there are permanent and temporary exceptions. Strong and Miller [17] categorize initial reasons of exceptions into four groups. The causes were incorrect or incomplete information inputs, changes to information inputs, special process requests and imperfect computer systems. They also noted that according to their study, humans are not initial causes for exceptions.

Those classifications have had an influence to the classification presented in [16] and tested in this study. However, The classification presented in [16] is the sole classification that addresses to various dimensions of exceptionality and was thereby chosen as the key point of this survey.

3. THE SURVEY

This section includes an overview of the survey. The general information about the survey is first given. After that, the questions inquiring background information of organizations, details of the last exception encountered, and comments to statements covering exceptions, are described. These three groups of questions formed three sections of our questionnaire and are here examined one by one.

3.1. General information

The survey was based on a questionnaire sent to 347 Finnish private and public organizations, which all have well organized computerized information systems. The organizations were selected from the Annual Report published by the Finnish Association of Information Technology. All organizations that had a named person responsible on Information Resource Management were included. An equal number of questionnaires were sent both to people responsible on the systems and people using them. A small number of the questionnaires were canceled afterwards: eight of the addressees were unreachable and one questionnaire was returned empty, because the addressee was not allowed to answer to such questions.

The questionnaire was designed and tested during the spring 1993. The test of the questionnaire took place in two industrial companies, Panda Chocolate, Inc., and Valmet Paper Machinery, Inc. These companies were used because they were already involved to other studies covering information system exceptions. Final questionnaires included 13 questions and were sent on May 15th. The questionnaires were to be returned to authors before May 25th. 58 forms were returned within the given time limit. A new set of questionnaires was sent on July 2nd to those people who had not yet answered. This second posting produced 39 new answers and increased the total number of received replies to 97. However, four of the answers were not correctly filled, so the final number of useful answers was 93. That is 27.5% of the number of the questionnaires sent. From these number only 90 (26.7%) had answered fairly completely to all questions.

We have endeavored to ensure randomness in sampling. This is important when we concentrate to the second section of the questionnaire, which inquired a detailed description of an exception. We guided the responders to describe the very last exception they had faced with. We did not want them to describe the worst, most laborious or most expensive cases, but the last exception regardless of its characteristics. Thus we got a more truthful picture of the exceptions in various organizations. This kind of data can also be statistically analyzed and used to provide generalized information without strong precautions and limitations.

The classification was supposed to gather a true picture of information system exception, so it formed a basis for the questionnaire. Questions based to the dimensions of the classification were supplemented by other questions relevant to the hypotheses.

3.2. Background of the organizations

The questions 1 - 3 were set for collecting background information about the organizations formed the first section of the questionnaire. The very first question asked about the number of the employees. There were three classes from which the responders chose the appropriate one. The given classes were under 100, from 100 to 500, and more than 500 employees. This question was answered by 84 people, of which 20 reported the number of employees being less than 100. 19 of answers came from organizations with 100 - 500 employees and 45 from organizations that employed more than 500 people.

The second question covered the lines of business of the organization. The responders were encouraged to choose from a list of 22 lines as many items as they wanted. The last choice provided a possibility to determine a line outside of the given list. The list was composed according to Business Line Classification published by the Finnish Statistical Center. 93 answered to the question with total number of 113 answers. This indicates that some of organizations were operating in various business lines. The most common line was adp-services (18%). Other usually reported lines were trade (15%), metal industry (9.8%), insurance (6.8%), public administration (6.8%), data communication (6.8%), and wood and paper industry (6.0%). 24.0% of the organizations belonged to 11 other business lines and 6.8% reported a line that was not included in the list.

The third question inquired about the annual sales of the organization in 1992. This information was given by 88 responders. The average turnover was 598 million USD. The average, however, was raised significantly by some big companies. Thus the median gives a better description from this part of the data. The median was 192 million USD while the lower quartile was 29 and the upper quartile 510 million USD.

These questions aimed to clarify if a certain size of organizations or a certain line of business correlated to a larger number or certain kinds of exceptions. However, the sample is not large enough for extremely strict conclusions in this matter.

3.3. Details of the exceptions appeared most lately

The questions 4 - 9 formed the next section of the questionnaire concentrating on the details of the latest exception appeared in the responsibility area of the responder. The questions were set in conformity with the classification of OIS exceptions developed by Saastamoinen and Savolainen [16] (see Table 1).

The first five questions of this section, i.e. questions no. 4 - 8. were based on this classification of characteristics. In the fourth questions responders were asked to describe the very latest exception they had faced in their work. They were also asked to characterize the reason of the exception. The description asked was used to put the answers to the right context. The answers were also used to determine if the reported cases really were exceptions or not. Table 2 presents the reported numbers of exceptions according to their degrees of difference. The reasons for reported exceptions are classified in Table 3.

Degree of difference	Freq.	%
Established exception	21	23.3
Otherwise exception	33	36.7
True exception	36	40.0
Total	90	100.0

Table 2. Degrees of difference.

Reason	Freq.	%
Organization born	32	36.4
Market born	3	3.4
Technical malfunction	47	53.4
Force major	6	6.8
Total	88	100.0

Table 3. Reasons for reported exceptions.

The fifth question asked how much trouble the exception had caused. The classification of the answers is presented in Table 4. An estimation of the financial costs caused by the exception were asked as well. The average costs were 3600 USD. The average, however, was raised significantly by two very expensive exceptions. Thus the median gives a better description from this part of the data. The median was 800 USD while the lower quartile was 500 and upper quartile 4000 USD.

Severity	Freq.	%
Harmful	85	94.5
Locally fatal	3	3.3
Globally fatal	2	2.2
Total	90	100.0

Table 4. Severity of reported exceptions.

The question number six asked for the frequency of the exception and the seventh question inquired about the organizational influence area of the exception. These characteristics are reported in Tables 5 and 6.

Frequency	Freq.	%
Infrequent	76	84.4
Temporary	2	2.3
Periodic	8	8.9
Permanent	4	4.4
Total	90	100.0

Table 5. Frequencies of reported exceptions.

Organizational influence area	Freq.	%
Employee level	3	3.3
Group level	49	54.4
Office level	1	1.1
Organization level	37	41.1
Total	93	100.0

Table 6. Organizational influence area.

The eighth question asked if the exception has led to any organizational development. We have classified the development activities in accordance with the way presented by Auramäki and Leppänen [1]. They distinguished the following main categories:

1) Nothing is done to the rules. The rules for the normal cases and for the possible established exceptions are maintained as such.
2) Instance updating is done. The rules on the general level remain unchanged. In other words, the handling of a certain exceptional case will continue in accordance with new rules that apply for this specific case only.

3) Type updating is done. The rules are updated according to the experiences obtained from the handling of exceptions of the type concerned. In the case of a type update changed rules govern all future cases, e.g. all incoming invoices or all orders from a certain customer.

Table 7 presents the classification of the organizational development activities raised by reported exceptions.

Development category	Freq.	%
Nothing is done to the rules	25	27.8
Instance update is done	51	56.7
Type update is done	14	15.5
Total	93	100.0

Table 7. Organizational consequences of reported exceptions.

3.4. Statements to comment

The third section included five general statements that the responders could comment. These statements formed the questions 9 - 13. The questions were answered by circling one of five alternatives indicating if the responder more or less completely or partially agreed or disagreed the statements or had no opinion about them.

The statements were "More attention about exceptions should be paid in information system design", "Our organization has not enough rules and strategies for exceptional situations", "The costs of automatic data processing could be reduced if the systems would be more flexible when faced with exceptions", "I have not thought over exceptions before", and "There are also positive exceptions in our organization".

The questions 9 tested the hypothesis that exceptions are generally not taken into account in information system development while the question 10 and 12 tested the hypothesis stating that most organizations have not developed strategies for exceptional transactions. Question 11 tested if responders agreed with the hypothesis that exceptions are a source of considerably high costs in automatic data processing, especially in inflexible systems. The last question was set to investigate if the hypothesis stating for the existence of exceptions with a positive influence was relevant. The distributions corresponding to answers of questions 9 - 13 are presented in tables 8 - 12.

Opinion of responders	Freq.	%
Completely agree	56	60.2
Partially agree	30	32.3
No opinion	3	3.2
Partially disagree	4	4.3
Completely disagree	0	0.0
Total	93	100.0

Table 8. Comments to the statement "More attention about exceptions should be paid in information system design".

Opinion of responders	Freq.	%
Completely agree	8	8.6
Partially agree	50	53.8
No opinion	11	11.8
Partially disagree	21	22.6
Completely disagree	3	3.2
Total	93	100.0

Table 9. Comments to the statement "Our organization has not enough rules and strategies for exceptional situations".

Opinion of responders	Freq.	%
Completely agree	32	34.3
Partially agree	34	36.6
No opinion	12	12.9
Partially disagree	12	12.9
Completely disagree	3	3.2
Total	93	100.0

Table 10. Comments to the statement "The costs of automatic data processing could be reduced if the systems would be more flexible when faced with exceptions".

Opinion of responders	Freq.	%
Completely agree	5	5.4
Partially agree	12	12.9
No opinion	3	3.2
Partially disagree	32	34.4
Completely disagree	41	44.1
Total	93	100.0

Table 11. Comments to the statement "I have not thought over exceptions before".

4. AN ANALYSIS OF THE DATA

Straight distributions presented in Tables 1 - 7 were calculated from the obtained information. The variables were put in cross tables and the Spearman correlation coefficients between variables were examined to find dependencies between all the variables that satisfied the method. These correlation coefficients are presented in two tables. Table 13 presents Spearman correlation coefficients of the background variables, the costs and the characteristics that could be analyzed by using the method. Table 14 presents dependencies of the statements and background variables. The first row in each cell presents the validity of the correlation. The second row shows N, i.e. the size of the sample. The third row presents the correlation

coefficients. Values under 0.050 state for significant dependencies and are printed as a boldface.

Opinion of responders	Freq.	%
Completely agree	18	19.4
Partially agree	36	38.7
No opinion	22	23.7
Partially disagree	11	11.8
Completely disagree	6	6.5
Total	93	100.0

Table 12. Comments to the statement "There are also positive exceptions in our organization".

The most appropriate statistical method to analyze this kind of data would have been the Chi-square test. However, the test was not suitable, because the answers were accumulated to certain classes while others remained almost empty. Thus calculating Spearman correlation coefficients was the best method available. Nevertheless, the method requires at least orderly graduated data, and was not possible to be applied with all variables. The variables left out by the method include "frequency", "reason", and "impact to organization's rules".

	Costs	Turn over	Employees	Rule base updating	Difference degree	Severity
Turn over	.3079 47 **0.035**					
Employees	.1364 46 0.366	.6679 80 0.000				
Rule base update	.1792 49 0.218	.0529 85 0.630	.0043 82 0.970			
Difference degree	-.2167 49 0.135	-.1278 85 0.244	-.0006 82 0.996	-.1350 90 0.205		
Severity	.3359 49 **0.018**	.0371 85 0.736	.1140 82 0.308	.0674 90 0.528	-.0821 90 0.442	
Influence area	.4172 49 **0.003**	.1560 85 0.254	.0125 82 0.911	-.1070 90 0.315	-.1356 90 0.203	.1904 90 0.072

Table 13. Spearman correlation coefficients of the background variables, costs and some characteristics.

	Turn over	Employees	Statement No 1	Statement No 2	Statement No 3	Statement No 4
Employees	.6679 80 0.000					
Statement No 1	-.0270 88 0.802	-.1143 84 0.301				
Statement No 2	.0342 88 0.752	-.0986 84 0.372	.1067 93 0.309			
Statement No 3	.1533 88 0.154	.1361 84 0.217	.2046 93 **0.049**	.0043 93 0.967		
Statement No 4	.3011 88 **0.004**	.1775 84 0.106	.0024 93 0.982	.1569 93 0.133	.0070 93 0.947	
Statement No 5	.0223 88 0.836	-.1071 84 0.341	.0406 93 0.700	.0259 93 0.805	-.0335 93 0.750	-.0215 93 0,838

Table 14. Spearman correlation coefficients of the statements and background variables.

As mentioned above, Spearman correlation coefficients cannot be examined between all variables. However, there is no other statistical method that could be used to process that kind of divergent data. For the reason the variables are put in traditional cross tables to find out possible dependencies "frequency", "reason", and "impact to organization's rules". Some interesting dependencies could be found through this kind of analysis. Table 15 presents the matches of the frequency and severity of reported exceptions.

	Severity		
Frequency	**Harmful**	**Locally fatal**	**Globally fatal**
Infrequent	81.1%	1.1%	2.2%
Frequent	2.2%	-	-
Temporary	7.8%	1.1%	-
Permanent	3.3%	1.1%	-

Table 15. Cross table of frequency and severity.

A certain match between frequencies and rule base updating could also be detected. Table 16 presents the corresponding cross table.

Frequency	Rule base updating: No update	Instance update	Type update
Infrequent	25.6%	13.3%	45.6%
Frequent	-	-	2.2%
Temporary	1.1%	2.2%	5.6%
Permanent	1.1%	-	3.3%

Table 16. Cross table of frequency and rule base updating.

A light match between frequencies and reasons was encountered as well. Table 17 presents the cross table showing these dependencies.

Frequency	Reason: Organization	Market	Technical malfunctions	Force Major
Infrequent	27.3%	2.3%	47.7%	6.8%
Frequent	1.1%	-	1.1%	-
Temporary	5.7%	1.1%	2.3%	-
Permanent	2.3%	-	2.3%	-

Table 17. Cross table of frequency and reason.

There is a match of technical malfunctions and harmful exceptions. This is presented in Table 18.

Severity	Reason: Organization	Market	Technical malfunctions	Force Major
Harmful	35.2%	3.4%	50.0%	5.7%
Locally fatal	1.1%	-	1.1%	1.1%
Globally fatal	-	-	2.3%	-

Table 18. Cross table of severity and reason.

5. DISCUSSION

This section discusses data presented in sections 3 and 4. The discussion has four parts. Observations related to basic characteristics of exceptions are first presented. This is followed by observations related to organizational consequences, such as costs and rule updates. The third part concerns with responders comments. The last part analyzes the classification applied and its usefulness as a statistical tool.

5.1. Basic characteristics
Some of the questions addressed to the basic characteristics of exceptionality; degree of difference, reasons, severity, frequency and organizational influence area. The frequencies of exceptions within each of those dimensions are first interpreted.

Degrees of difference
There were no normal cases reported as exceptions. This suggests that our questionnaire was successful. It also suggests, that responders had completely understood the main concepts.

The large number of true exceptions (40.0%) can be explained by the difficulty to prepare offices for such cases. However, the high number of otherwise exceptions (36.7%) and relative low number of established exceptions (23.3%) are surprising. Organizations tend to concentrate in finding problematic exceptional situations or in preventing them instead of developing routines to handle them.

Reasons
There seems to be two major reasons for exceptions. As table 3 indicated, 36.4% of exceptions were organization born and 53.4% of exceptions were technical malfunctions. That stresses that the changing environment is a minor problem compared to organizations own ways to handle issues. It is plausible that organizations internal relations and rules are not as well formed than their external relations. It is of course true, that the number of internal events is greater than the number of external ones.

Although, in terms of exception handling organizations internal rules and technical solutions are more problematic than other sources. It was also found out, that there are two major reasons for technical malfunctions: hardware failures and software errors. In terms of hardware failures, network failures and disk breaks have an important role. What comes to organization born exceptions, staff carelessness is a major reason for such exceptions. However, also breaks in internal information flow as well as development activities of internal information systems caused some of the exceptions.

Severity
No positive exceptions were encountered. This was regrettably due to the style of the questionnaire and the enclosed letter. While the previous versions of the questionnaire were tested, we discovered it too problematic for responders to concentrate to both positive and negative exceptions. Since both our previous empirical test and the literature suggest that most exceptions are problematic we made the questionnaire and the letter to guide the responders to concentrate upon negative exceptions.

Most of the exceptions reported were only harmful (94.5%). The very small number of locally fatal (3.3%) and globally fatal (2.2%) exceptions stresses that most of the exceptions are not very dangerous. This is, however, very natural. Fatal cases always force organizations to adapt situation instead of governing it. Harmful exceptions do not force organizations to change their goals or objectives, but just to do some extra work. This is often acceptable. It might also be the case, that trying to anticipate and govern all the minor exceptions would be more costly that just handling them case by case.

There is a match of technical malfunctions and harmful exceptions (table 18). 50.0% of exceptions are both harmful and technical malfunctions. There is probable no real dependency between these properties: they both just are features characterizing exceptionality.

Frequency
As Table 6 indicated, 84.4% of the detected exceptions were infrequent. Organizations try to keep their routines as stable as possible and employ rules and procedures which simply are

decisions made in advance in their execution [9, p. 43], This explains the small number of frequent exceptions: if the recur of some exception is known, organizations try to govern its next occurrences by established rules. Organizational reactions (reported in Table 7) very rarely, i.e. only in 27.8% of cases, leave the rules as they were before the appearance of the exceptional case. The handling of exceptions typically demands new forms of information processing and decision making. For this reason the decision makers try to handle them as quickly as possible, thus endeavoring to reduce the number of both permanent and also temporary exceptions.

The table 15 shows that there is a certain match between infrequent exceptions and harmful exceptions. This kind of a cross table, however, does not expose the direction of the dependency. It is most obvious, that harmfulness and infrequency just are properties characterizing exceptions and that there is no real dependency between the characteristics.

A light match between frequencies and reasons was encountered as well. As table 17 showed, 47.7% of the reported exceptions were both infrequent and consequences of technical malfunctions. Even the kind of cross table really does not tell the direction of the dependency, a conclusion that technical malfunctions are infrequent can probably be drawn.

Organizational influence area
Most of the exceptions (54.4%) concern work of a group of people. However, exceptions affecting whole organization tend to be quite typical as well (41.1%). It is our view that exceptions typically are situations that single employee cannot handle and that often occur in communication between organizational units. That expounds the high frequency of both group level and organization level exceptions.

The number of employee level exceptions is remarkably small. That can be the case, but the even smaller number of office level exceptions (1.1%) does not give a true picture and indicates problems related to this dimension of the classification.

The small number of employee level exceptions obviously reflects a somehow wrong attitude of responders. Our previous empirical study (see [16]) suggests that most of the exceptions belong to employee level. Even a set of examples of exceptions were attached to our questionnaires, responders might not have reported very slight exceptions, but cases that they felt were troublesome. They may have felt that minor exceptions are not in the interest of this survey and reported more harmful ones.

5.2. Organizational consequences
Exceptions always bring something with them: costs. That is why exceptions tend to change the ways organizations prepare to future events as well.

Costs
Three significant correlation coefficients can be found in Table 13. (Of course the exceptional value 0,000 showing a high dependency of Employees and Turnover is of no interest in our study.) They are all related to costs.

The higher the turnover of an organization is the more expensive the handling of an exception seems to be. There are two explanations to this observation. Companies with minor turnover cannot face with very expensive exceptions. The facilities they own are not so expensive and their typical business transactions deal with smaller amounts of money. Companies with huge turnover can face with costly exceptions and they are even able to cope with them. Another explanation is, that in larger companies have to have strict rules in order to govern and coordinate tasks carried out by various people. Thus small activities that could face with less expensive exceptions are very well controlled. However, this might not be the case with larger

or more rarely performed activities. In larger organizations it is also possible to appear more lacks in information flows and communication between different departments.

A significant dependency (0.018) can be found between the severity of an exception and the costs caused by the exception. The interpretation of the correlation is very clear and obvious: the more severe an exception is the more its handling will cost.

A third significant correlation (0.003) was found between the organizational influence area of an exception and the costs caused by it was found. Our quite obvious interpretation is that the more people are involved by an exception the more expensive its handling is going to be.

Rule base updates
Table 7 presented the classification of the organizational development activities raised by reported exceptions. The results show that the organizations react to most of the exceptions by updating the rules. In 56.7% of the cases an instance update was done and a type update took a place in 15.5% of the cases. This reaction makes next similar cases normal because then the organizations have rules for processing them. In fact this result is nearly unbelievable because 84.4% of the cases were infrequent. One could think that rather soon all the possible exceptions become quite rare as the result of the updating actions.

Exceptions causing type updates tend to be infrequent. As it can be counted from table 16, that was true with 80.4% of cases caused a type update. That is quite a natural reaction, since if the recur of such cases cannot be anticipated, it is not worth of the efforts to build rules for the handling of single instances. It is much more cost efficient to form rules that can be applied with all kinds of cases.

5.3. Statements
Comments to the statement "More attention about exceptions should be paid in information system design" manifest a lack in information system design process (Table 8). Models and design methodologies for Office Information Systems development must take into account the importance of flexibility and proper exception handling. This is what the present methods and methodologies fail to do [1]. According to Auramäki and Leppänen there exist many models which do not consider exceptions at all. Some models take a very technical view and are more interested in technical implementation of exception handling mechanisms than the nature of exceptions.

Not all special cases can be anticipated at the time when IS programs are written [3]. That is supported by the comments to the statement "Our organization has not enough rules and strategies for exceptional situations". According to Galbraith [8, p.14] the ability of an organization to successfully coordinate its activities depends on the combination of the frequency of exceptions and the capacity of the organization's hierarchy to handle them. As task uncertainty increases, the number of exceptions increases until the hierarchy is overloaded. However, if there would be accurate procedures for handling exceptional cases, the cases would not be called exceptions any more. Thus the answers in Table 9 address the difficulty to anticipate all possible situations.

Borgida [3] states that one of the distinguishing characteristics of intelligent human behavior in the natural world is flexibility, the ability to deal with unusual, atypical, or unexpected occurrences. He also utters that practically all the current commercially developed software is extremely rigid and intolerant of deviations from the norm set out by their designer. This leads to situations where events out of designers' concepts have to be handled individually. These unique processes typically cause extra costs. This is suggested by the comments to the statement "The costs of automatic data processing could be reduced if the systems would be more flexible when faced with exceptions" (see Table 10).

Comments to the statement "I have not thought over exceptions before" (Table 11) are in contradiction with answers in statement claiming the nonexistence of organizational exception handling strategies (Table 10). However, this can be exploited through the nature of exceptions. As the exceptions reported in questions of section two imply, the exceptions are typically not very dramatic or very expensive. They are more likely smaller troubles for a single person to face with. Thus individuals have probably been forced to think about the problem phenomenon, but that has not necessarily led to any discussion or design activity carried out by larger organizational units.

Auramäki and Leppänen [1] maintain that exceptions have not just negative implications, and they form an essential part of the social behavior of people in an office (see Table 12). Exceptions are something which has to be managed through collaboration. Jones [11] believes that the success of an OIS implementation really depends more on the organizational culture and the IS infrastructure than on the specific form and functions of the OIS. The collaboration used to handle exception develops the aspects Jones mentions. Thus despite of the negative nature of the exceptions their handling may raise many positive ideas and thus make the general nature of some exceptions positive. Comments to the statement "There are also positive exceptions in our organization" support this view.

Table 14 presents two interesting dependencies related to the statements. The higher the annual sales of an organization are the more the responders disagree with the statement "I have not thought over exceptions before". This makes us to assume, that exceptions are a significant problem especially in large organizations. The smaller an organization is, the less problems exceptions cause.

Another significant dependency indicates that the more the responders agree with the statement "More attention about exceptions should be paid in information system design" the more they agree also with the statement "The costs of automatic data processing could be reduced if the systems would be more flexible when faced with exceptions". This guides to a conclusion, that the lack of identifying exceptions during the information systems design process leads to increased costs while the system is used.

5.4. About the classification as a statistical tool

The classification presented in Table 1 [16] was much more complete than the one presented earlier by Auramäki and Leppänen [1]. In general, this study indicated the usefulness and the full coverage of that classification. Especially its ability in separating exceptional cases was quite satisfactory. Nevertheless, this classification also had several deficiencies that were detected in our empirical tests. Most problems appeared in our tests derived their origins from deficiencies in the definitions of the classes. The main problems are here summarized in the following:

Single classifications were based on multiple criteria. This was true with the classifications of severity and frequency. For example, both an influence of an exception to the point of time in which the case can be handled and an amount of extra work caused by an exception were used as the criteria to classify severity.

Definitions of some classes were so ambiguous that it was difficult to determine an appropriate class to certain exceptions. This was the case with the classes of organizational influence. In our empirical studies we found it very difficult to determine whether a case was a group level or an office level exception. There were also typically major difficulties in deciding the decent class of severity. Especially the decision between the classes of harmful and locally fatal was problematic.

The definitions of some classes conflicted with the definitions of the concepts of an exception and a variation. We now understand that if a certain kind of cases is permanently handled in a predefined way there is not much exceptional in this handling. However, the previous classification according to the frequency of exceptions had classes of permanent exceptions and temporary exceptions. In both cases some kind of rules for guiding the handling may exist.

Empirical studies revealed that some classes tend to remain empty or nearly empty while some other classes become crowded. The questionnaire asked for a description of the last exception met by the receiver. In 93 questionnaire answers there was only one office level exception and no positive exceptions. However, 85 of the exceptions were harmful and 76 were infrequent.

We faced major difficulties while interpreting the responses related to organizational influence area of exceptions. It was often clearly stated that a handling of a case required cooperation with coworkers. However, with many cases the answer claimed that a larger portion of an organization was involved by an exception, but it was totally impossible to determine whether a case concerned only a single office or numerous organizational units.

In terms of practical difficulties also dimensions "degree of difference" and "frequency" were problematic. Even the degrees of differences were difficult to determine, we believe that there is nothing wrong with this classification; it just is not so easy to make these classification decisions. This, however, is not the case with frequencies. The definitions of the classes are partly irrelevant and too fuzzy to guide the classification process successfully.

6. CONCLUSIONS

This study revealed an enhanced picture of reality in the occurrence and the nature of exceptional cases in Office Information Systems today. Also the reactions of the decision makers were studied. The results of this paper indicated clearly the importance of the exception handling research. Our conclusion is that exceptions should better be taken into account already in the development of Office Information Systems.

Exceptions are true exceptions, i.e. they cannot be anticipated in advance and they have to be handled instance by instance. Some of them have a corresponding normal case, but the handling methods for the exceptions themselves have to be found out individually. Anticipation to exceptions is difficult, because they tend to recur infrequently. However, when an exception is handled organizations tend to update their rules in order to anticipate further recurs.

Most exceptions are technical malfunctions, i.e. they are caused even by broken or violated computer hardware or by faulty operating software. In spite of the fact, carelessness of employees is an important reason as such and can often be found from the background of technical malfunctions as well. Fortunately exceptions are more likely only harmful than fatal, however, they still typically concern a work of a group or an even larger organizational unit than a work of an individual. Furthermore, handling of exceptions also cost several thousands of dollars in average.

The responses stress that exceptions are a problem that is recognized in organizations. However, most responders strongly agree that more attention about exceptions should be paid in information system design. Most of them also state that their organization has not enough rules and strategies for exceptional situations. It was also found out from the responds that the costs of automatic data processing could be reduced if the systems would be more flexible when faced with exceptions.

It is our honest opinion, that exceptions are a permanent part of office work and that all exceptions cannot be anticipated. In spite of the fact, many of them could be avoided by more flexible and better secured systems. It just seems to us that current work flow based design

methodologies are unable to capture all the activities and events the offices face with. Applying the kinds of methodologies leads to mismatch between the events systems can handle and the events that really occur. Moving towards goal based and more open design methods could provide at least a partial solution to this severe problem.

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