Institutionen för datavetenskap
Department of Computer and Information Science

Final thesis

Post-Deployment Usability
Opportunities: Gaining User Insight
From UX-Related Support Cases

by

Emelie Oskarsson

LIU-IDA/LITH-EX-A–16/003–SE

March 16, 2016
Final thesis

Post-Deployment Usability Opportunities: Gaining User Insight From UX-Related Support Cases

by

Emelie Oskarsson

LIU-IDA/LITH-EX-A–16/003–SE

March 16, 2016

Supervisor: Hillevi Rystedt, IFS
Johan Åberg, Linköpings Universitet

Examiner: Aseel Berglund, Linköpings Universitet
Abstract

UX-related issues is one type of issue that customer support is facing. This thesis project investigates the possibility to look at support cases as a source of insight to how users interact with an information system application at an ERP company. It is also investigated if it is possible to use this gathered information when further developing the product. Support case data are gone through in order to map what type of problems the users are encountering and a category structure is developed based on this information. The categorization framework is evaluated by letting employees test the structure by categorizing incidents in to different categories. Further data collection are gathered by a questionnaire and follow-up interviews with the classification participants. To evaluate the value in the support case information, employees with product responsibility are also interviewed to get insight from their perspective.

The result from the evaluation of the category structure indicated that it wasn’t easy to make a categorization of incidents. The incidents were placed in different categories and in order to apply a category structure it would need further evaluation before applying in large scale.

The information in support cases are concluded to be valuable. The collection of information related to where users are encountering problem and also how many are experiencing the same issue could serve as a basis when prioritizing the product backlog. A mapping of issues could justify resources spent on usability by showing business value based on the presumed impact.
Acknowledgements

My supervisor at IFS, Hillevi Rystedt, I am so grateful for your time and dedication during my master thesis work. Your energy, positive attitude and passion for usability has really inspired me. Thank you for your support, you have been the best.

I would also like to thank every single one at IFS who has welcomed me and shown interest in my thesis work. And to all of you IFS:ers who has participated in my study with your time and experience somehow: without you there would not have been much for me to write about, so thank you.

My supervisor at LiU, Johan Åberg, thank you for helping me putting the pieces together and for pointing me in the right direction when needed. And also for answering my emails at the speed of light! Your feedback has been very valuable and I am grateful for your time and effort.

My examinor Aseel Berglund, thank you for providing feedback and support. Your comments and encouragement has been much appreciated.

My opponent Rebecca Ocklind, thank you for your feedback. You helped me improve the quality of this report (and reduce my embarrassing spelling mistakes).

A thank you also goes out to all of my friends who has been there for me. Especially Mikaela and Hanna, your friendship and good advices have helped me keep my spirit up during my whole education. Thanks a million.

Nicklas, thank you for always being my biggest support.

Emelie Oskarsson
Linköping, February 2016
# Contents

1 Introduction 1

1.1 Thesis motivation 1

1.2 Aim of study 2

1.3 Research questions 2

1.4 Delimitations 3

1.5 Disposition of the report 3

1.6 Abbreviations 4

2 Theoretical framework 5

2.1 Introduction 5

2.1.1 Usability 5

2.1.2 User experience 6

2.1.3 ERP systems 6

2.2 Usability benefits 7

2.3 Varieties of usability issues 7

2.4 Severity assessments of usability problems 10

2.4.1 Nielsen and Mack severity assessment 10

2.4.2 Severity assessment by Rubin and Chisness 11

2.4.3 Severity assessment method by Akers et al. 12

2.5 Usability and ERP systems 13

2.6 Customer support 14

2.6.1 Usability as a support issue 14

2.7 Usability in the development process 15

2.7.1 Usability inspection methods 15

2.7.1.1 Heuristic evaluation 16

2.7.1.2 Cognitive walkthrough 16

2.7.2 Usability evaluation with users 16

2.7.3 Card-sorting 17

2.7.4 Proceeding after usability evaluations 18

2.7.5 Usability as a training issue 18

3 Method Theory 20

3.1 Case study method and alternatives 20

3.1.1 Alternative approaches 21
CONTENTS

3.1.1.1 Experiment .............................................. 21
3.1.1.2 Survey .................................................. 21
3.1.1.3 Action research ....................................... 22
3.2 Research approaches ........................................ 22
3.3 Case study approaches ...................................... 22
3.4 Case study phases ........................................... 23
  3.4.1 Phase one: defining and designing ....................... 23
  3.4.2 Phase two: preparing, collecting and analyzing ........ 25
     3.4.2.1 Data collection: interviews ........................ 25
     3.4.2.2 Data collection: questionnaires .................... 26
     3.4.2.3 Data collection: documents and archival data ...... 27
  3.4.3 Phase three: analyzing and concluding .................. 27
     3.4.3.1 Analysis strategy: content analysis .............. 27
3.5 Research quality and validity ................................ 28
  3.5.1 Construct validity ...................................... 29
  3.5.2 Internal validity ....................................... 29
  3.5.3 External validity ...................................... 29
  3.5.4 Reliability ............................................. 29

4 Case study: categorization & evaluation 31
  4.1 Case study background ...................................... 32
     4.1.1 Introducing IFS ...................................... 32
     4.1.2 IFS Support .......................................... 32
  4.2 Development of category structure ......................... 33
     4.2.1 Support case data collection ........................ 33
     4.2.2 Classifications ...................................... 35
     4.2.3 Category structure ................................... 35
     4.2.4 Preparing testing of categories ...................... 36
  4.3 Phase one: plan and design ................................ 37
     4.3.1 Case study questions .................................. 37
     4.3.2 Case study activities ................................ 37
     4.3.3 Linking strategy and interpreting criteria .......... 38
  4.4 Phase two: preparing and collecting ....................... 38
     4.4.1 Data collection activities ........................... 38
     4.4.1.1 Classification study and questionnaire ............ 38
     4.4.1.2 Participants in classification exercise ........... 39
     4.4.1.3 Interviews .......................................... 40
  4.5 Phase three: Analyzing and concluding ..................... 42
     4.5.1 Classification exercise and questionnaire ............ 42
     4.5.2 Interviews ............................................ 42

5 Results ....................................................... 43
  5.1 Results from categorization exercise ...................... 43
     5.1.1 Results from grading .................................. 43
     5.1.2 Placement of incidents in categories .................. 45
     5.1.3 Indications from questionnaire feedback .............. 45

iv
## CONTENTS

5.2 Results from follow-up interviews with classification exercise participants .................................................. 47
5.3 Results from interviews with PSM:s ................................. 49

6 Discussion ................................................................. 51
6.1 Results ................................................................. 51
  6.1.1 Categorization of support incidents ................................. 51
  6.1.2 Applicability of categorization structure ......................... 53
  6.1.3 Value in support case data related to usability ................. 53
  6.1.4 The definition of usability ...................................... 55
6.2 Method ................................................................. 55
  6.2.1 Support cases as a data source ................................. 55
  6.2.2 Closed card sorting .............................................. 56
  6.2.3 Data collection .................................................. 56
6.3 Research quality assurance ........................................ 57
  6.3.1 Construct validity ................................................ 57
  6.3.2 External validity ................................................. 57
  6.3.3 Reliability ....................................................... 57
6.4 Ethical aspects ....................................................... 58

7 Conclusions ................................................................ 59
7.1 Conclusions ........................................................... 59
  7.1.1 Research question 1: classification .............................. 59
  7.1.2 Research question 2: value in information ...................... 60
  7.1.3 Improvements of categorization structure ....................... 60
7.2 Recommendations for IFS ........................................... 61
7.3 Suggestions for further research ..................................... 63

Bibliography ................................................................ 63

A Content in categorization exercise ................................... 69
  A.1 Incidents to categorize ............................................... 69
  A.2 Categories .......................................................... 70

B Introduction mail ....................................................... 71

C Classification study ..................................................... 73
  C.1 Welcome text ....................................................... 73
  C.2 Instructions ........................................................ 74
  C.3 Classification exercise ............................................. 75

D Classification questionnaire ........................................... 76
  D.1 Questions before the classification step in the questionnaire: 76
  D.2 Questions after the classification step in the questionnaire: 76

E Purpose with the categorization and related data collection .... 78
  E.1 Creating of usability categories ................................... 78
E.2 Testing of the category structure .......................... 78
E.3 Interviewing study participants ............................ 78
E.4 Interviewing employees with product responsibility ........ 79

F Interview questions 80
F.1 Follow-up interviews with classification study participants . . . 80
F.2 Interviews with employees with product responsibility ........ 82

G Basis for interviews with classification evaluators 84

H Basis for interviews with PSM:s 85

I Placement matrices 86
I.1 Classification exercise ........................................ 86
I.1.1 2nd line participants ................................. 86
I.1.2 3rd line participants ................................. 87
I.1.3 Both 2nd and 3rd line participants ................. 87
## List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Severity Rating by Nielsen and Mack (1994)</td>
<td>11</td>
</tr>
<tr>
<td>2.2</td>
<td>Severity Rating by Rubin and Chisness (2008)</td>
<td>11</td>
</tr>
<tr>
<td>2.3</td>
<td>Frequency Rating by Rubin and Chisness (2008)</td>
<td>12</td>
</tr>
<tr>
<td>2.4</td>
<td>Impact &amp; Persistence rate by Akers et al. (2009)</td>
<td>12</td>
</tr>
<tr>
<td>2.5</td>
<td>Frequency rating by Akers et al. (2009)</td>
<td>12</td>
</tr>
<tr>
<td>4.1</td>
<td>Usability issues and their connection with literature</td>
<td>35</td>
</tr>
<tr>
<td>4.2</td>
<td>Participants in classification exercise</td>
<td>40</td>
</tr>
<tr>
<td>4.3</td>
<td>Interviewees: participants in classification exercise</td>
<td>41</td>
</tr>
<tr>
<td>4.4</td>
<td>Interviewees: employees with product responsibility</td>
<td>41</td>
</tr>
</tbody>
</table>
List of Figures

3.1 Case study phases as described by Yin (2014) .................. 23
5.1 Grading of incidents ............................................. 44
5.2 Grading of familiarity ............................................. 44
5.3 Grading of categories ............................................. 44
5.4 Understanding of categories ..................................... 45
Chapter 1

Introduction

This section will present a background to the thesis followed by the aim and the research questions. The limitations for the study and the disposition of the report will afterwards be presented. The abbreviations used in this report will conclude the introduction chapter.

1.1 Thesis motivation

In today’s competitive market, customer support is an essential part related to product development. The market globalization and the high service focus makes customer support a potential competitive advantage (Negash et al., 2003). Goffin and New (2001) brings up that customer support is also a means for companies to establish reliable relationships with their customers after a purchase and it may even affect the success rate of new products.

Among all of the issues customer support faces, user experience (UX)-related problems is one of them. Both Shneiderman and Plaisant (2010) and Felstad et al. (2014) bring up that these UX-related issues are giving important and valuable information regarding how users are interacting with the system in real-life situations. This is information that possibly can be utilized when working with improvements and future extensions of the product. Felstad et al. (2014) suggest the opportunity to view UX-related support cases as a usability evaluation resource.

Even though UX-related issues may not be associated with severe failures in the system, there are still reasons to deal with these. Usability problems can be an obstacle regarding the productivity of the users which could make it difficult for them to carry out their daily tasks and keep high productivity and it can also make system acceptance an excessively difficult procedure (Topi et al., 2005). Studies (Oja and Lucas, 2014; Chien and Tsaur, 2007; Calisir and Calisir, 2004)
have shown that how the users are experiencing the usability in an information system (IS) are affecting the overall end-user satisfaction with the system.

Chilana et al. (2011) presents a study showing that the post-deployment phase of the product lifecycle doesn’t involve usability professionals to a great extent. When involved though, the interactions between usability professionals and support have been shown to provide significant value.

As technology evolves, product complexity increases and products go towards being used by a wider variety of users. Due to this, there are arguments that UX must be given appropriate attention to, in order to provide easy to use technology (Tullis and Albert, 2013). Enterprise Resource Planning (ERP) systems are one kind of IS that are known for their challenges in usability (Babaian et al., 2004; Chien and Tsaur, 2007; Singh and Wesson, 2009; Oja and Lucas, 2014). By giving usability attention in the post-deployment phase there are possible gains in terms of lowering high software maintenance costs and software support costs (Chilana et al., 2011). Usability is also a potential product quality enhancer which is important from a competitive perspective (Negash et al., 2003).

1.2 Aim of study

As stated in previous section, customer support is an important part of the product lifecycle in order to maintain customer relationships and ensure product quality. UX-related support cases could contain valuable information regarding how the users interact with the products in their daily life. There is little research related to to which extent support cases can provide usability information such as usability inspections and usability testing, as mentioned by Følstad et al. (2014). Therefore, the aim of this study is to explore how a company can utilize information contained in UX-related support issues in order to collect usability insight.

1.3 Research questions

To answer the aim of the study, the following research questions have been stated:

1. How can a company classify an incoming support case as a UX-related issue?

2. How can this kind of post-deployment usability information be utilized in future product releases?
   • Is it possible to get useful insight regarding users’ product usage in the real world by looking at UX-support case data?
1.4 Delimitations

The focus of this study is to handle information that users already have shared, the study will hence not deal with how to get the users to share UX-related information. UX testing or usability testing will not be covered within the scope of the case study, more than briefly reviewed as a usability technique in the theory section.

Regarding the terms user experience versus usability, the concepts could be a bit overlapping depending on which definitions are being studied. Usability can be defined as a part of user experience. This study and this report will have its focus on usability-related issues, assuming usability is a part of user experience. More regarding terminology definitions will be presented in the theory section.

The time frame for this thesis project is 20 weeks, which is considered to be a limiting factor to the scope.

1.5 Disposition of the report

The report is divided into seven chapters: introduction, theoretical framework, method theory, case study: categorization and evaluation, results and analysis, discussion and conclusions. The content of each chapter is briefly described below.

Chapter 1 - Introduction
The introductions presents a background to the thesis that will give a context to the thesis subject and motivate the problem. Aim of study, research questions and limitations for the study will also be presented.

Chapter 2 - Theoretical framework
The theory section presents the theoretical foundation for this thesis project. This includes an introduction to relevant concepts and a presentation of relevant research within the field.

Chapter 3 - Method theory
The method section presents relevant method theory that will be a basis for the conduction of the case study in the following chapter.

Chapter 4 - Case study: categorization and evaluation
Presentation of the conducted case study, based on the method presented in Chapter 3: method theory.

Chapter 5 - Results
The results from the case study are presented.

Chapter 6 - Discussion
This chapter presents discussion of the results and the applied method.
Evaluation of study quality will also be presented followed by ethical and societal aspects of the study.

Chapter 7 - Conclusions
The final chapter contains conclusions related to the aim and the defined research questions as well as recommendations for IFS and some concluding comments regarding further work within the field.

1.6 Abbreviations

The following abbreviations are used in this report:

AC Application Consultant
BSA Business Systems Analyst
ERP Enterprise Resource Planning
IFS Industrial and Financial Systems
IS Information System
ISO International Organization for Standardization
IT Information Technology
LCS Life Cycle Support
PSM Product Solution Manager
R&D Research and Development
UI User Interface
UX User Experience
Chapter 2

Theoretical framework

The theory chapter will present the theoretical foundation which will include an introduction to relevant terms and concepts and previous research within the field.

2.1 Introduction

Some necessary concepts will be covered in order to present a foundation for the sequent theoretical framework.

2.1.1 Usability

The ISO 9241-11 definition for usability, as cited in Bevan (2009), is:

*The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.*

Nielsen (1993, 2012) presents five quality components when defining usability as a quality attribute:

- **Learnability** - the system should be easy to learn
- **Efficiency** - the system should be efficient to use
- **Memorability** - the system should be easy to remember
- **Errors** - the system should have a low error rate
- **Satisfaction** - the system should be pleasant to use

Shneiderman and Plaisant (2010) include five factors when describing usability:
• **Speed of performance** - the time it takes to perform a task
• **Time to learn** - the time it takes to learn how to perform a task
• **Retention over time** - how well knowledge about usage is remembered after not using the system for a while
• **Rate of error by users** - how many errors occur and how often? How severe are they?
• **Subjective satisfaction** - the satisfaction with the system after performing a certain task

These factors are very similar to the quality attributes introduced by Nielsen (1993). Rubin and Chisness (2008) define usability as:

... when a user can do what he or she wants to do the way he or she expects to be able to do it, without hindrance, hesitation, or questions.

Mayhew (1999) states usability as a measurement of a product user interface. There are plenty of different ways to describe usability, but what the definitions by Nielsen (2012), Shneiderman and Plaisant (2010), Rubin and Chisness (2008) and Mayhew (1999) have in common is that they are all related to a quality measurement of the users’ experiences of a system.

### 2.1.2 User experience

ISO 9241-210, as cited in Bevan (2009), defines UX as:

A person’s perceptions and responses that result from the use or anticipated use of a product, system or service.

Regarding the terms usability and UX, Tullis and Albert (2013) describes UX as a broader term than usability and also that UX involves the users’ interactions from a wider perspective. UX includes the feelings and thoughts that the users perceives during the interaction and does not only focus on whether the intended task could be performed or not. Wilson (2010) describes UX as a successor to usability with more dimensions and Hassenzahl and Tractinsky (2006) explain it as a perspective which extends beyond the functional characteristics.

### 2.1.3 ERP systems

Enterprise Systems were the outcome of the 1990s innovations in IT regarding integrations of the flow of information throughout a company (Yusuf et al., 2004). One of these systems was called Enterprise Resource Planning (ERP) systems. The market competition added pressure on the companies regarding cost reductions, shorten lead times, high return on investments and also the
need to be responsive to demands from the customers (Wei et al., 2003). The purpose with an ERP system is to integrate business processes and the use of ERP systems can make the company obtain competitive advantages, according to Yusuf et al. (2004). Yusuf et al. (2004) further present three major benefits that ERP systems offers companies:

- Automation of business processes
- Access to management information
- Improvement in the supply-chain

It is not enough to compete with just price and quality today, there is a demand for companies to be flexible and responsive as well as meeting the market requirements (Yusuf et al., 2004). ERP systems can be seen as a means to support organizational strategies and meet the business goals (Yusuf et al., 2004) and most of the fortune 500 companies had some kind of ERP system implemented in year 2000 (Scott and Wagner, 2003).

### 2.2 Usability benefits

Joint to definitions and explanations of usability is that they (Bevan, 2009; Nielsen, 1993; Shneiderman and Plaisant, 2010; Rubin and Chisness, 2008; Mayhew, 1999) describe how well an end-user can achieve their goal with a system interaction and there is also a quality aspect taken into account in the definitions.

Bias and Mayhew (2005) and Mayhew (1999) give numerous of examples regarding how user interface (UI) design and usability can be cost-justified in order to motivate time and money being spent on usability. They emphasize that usability engineering and the improvement of usability can reduce development costs and time, reduce maintenance and redesign costs, increase sales revenues, attract more customers and also increase market shares. Decreased support costs is also brought up as a possible benefit.

From the users’ point if view, Bias and Mayhew (2005) give examples of possible benefits such as: improvement of user effectiveness, efficiency and productivity, increased user satisfaction, ease of use and ease of learning.

### 2.3 Varieties of usability issues

Rubin and Chisness (2008) argue that it is not possible to measure how usable a product is, the only thing that is measurable is how unusable it is. Rubin and Chisness (2008) further explain that this can be done by identifying areas where there are issues, problematic domains. Nielsen and Mack (1994) analyzed
data of usability problems and identified 249 types of usability issues. These were compiled into a list containing ten usability heuristics, which are known usability principles within the field:

1. **Visibility of system status** - the system status should give the user information regarding what is going on.

2. **Match between system and the real world** - the system should "speak the users' language", by using familiar terminology.

3. **User control and freedom** - users should have control of the system by having a possibility to redo and undo steps.

4. **Consistency and standards** - the use of words should be consistent regarding what they mean and should also follow conventions.

5. **Error prevention** - the system should be designed so that errors are hard to do.

6. **Recognition rather than recall** - the system should be designed so that it is easy to understand how tasks should be done, there should be no need to remember how to do it each time.

7. **Flexibility and efficiency of use** - the design should support a flexible use of the system, frequent actions should be easy to perform.

8. **Aesthetic and minimalistic design** - only relevant and needed information should be displayed for the user.

9. **Help users recognize, diagnose, and recover from errors** - the system should show error codes that are understandable for the user which gives a clear indication of the problem and how it can be solved.

10. **Help and documentation** - suitable help and documentation should be provided for the user.

To point out or justify usability issues, these heuristics can be used both during the design phase and also during the evaluation process. Nielsen’s heuristics are claimed to be one of the most common used heuristics within usability (Sauro, 2011; Usability.gov, 2015b). Shneiderman and Plaisant (2010) confirm that the book by Nielsen (1993) are one of the most influential within the subject of usability engineering. There are other guidelines within usability and user interface design, by Weinschenk and Barker (2000) and Shneiderman and Plaisant (2010) for example.

Weinschenk and Barker (2000) as cited in Sauro (2011) have designed cognitive engineering principles, partially based on the heuristics by Nielsen and Mack (1994). These are:

1. **User Control** - allowance from the interface that the user perceives that they are in control.
2. **Human Limitations** - the user interface will not overload the user regarding the users’ cognitive, visual, auditory, tactile or motor limits.

3. **Modal Integrity** - the interface will fit individual tasks in whatever approach is being used from the user; auditory, visual or kinesthetic.

4. **Accommodation** - the interface will fit the way each user group works and thinks.

5. **Linguistic Clarity** - the interface will communicate effectively.

6. **Aesthetic Integrity** - the interface will have an attractive design.

7. **Simplicity** - the interface will present content simply.

8. **Predictability** - the interface will behave so that the users can predict what happens next.

9. **Interpretation** - the interface will make reasonable guesses what users’ next steps are.

10. **Accuracy** - the interface will be free from errors.

11. **Technical Clarity** - the interface will have highest possible fidelity.

12. **Flexibility** - the interface will allow the users to adjust the design to their needs.

13. **Fulfillment** - the interface will provide a satisfying user experience.

14. **Cultural Propriety** - the interface will match the users social customs and expectations.

15. **Suitable Tempo** - the interface will operate at a tempo which is suitable for the user.

16. **Consistency** - the interface will be consistent.

17. **User Support** - the interface will provide assistance if needed or requested by the user.

18. **Precision** - the interface will allow the users to perform a task exactly.

19. **Forgiveness** - the interface will make actions by the users recoverable.

20. **Responsiveness** - the interface will inform users about results of their actions and also about the status of the interface.

Shneiderman and Plaisant (2010) present their eight golden rules of interface design, which they specify are principles that need to be interpreted in their context:

1. **Strive for consistency** - consistency regarding terminology should be consistent.
2. **Cater to universal usability** - the interface design should be made for the common user, there should be a trade off between design for the novice user and the expert user.

3. **Offer informative feedback** - the interface should provide suitable feedback of the users' interactions.

4. **Design dialogs to yield closure** - the user should be able to follow the sequences of actions when performing a task.

5. **Prevent errors** - errors should be prevented as far as possible, numbers shall not be possible to enter into a box that requires characters.

6. **Permit easy reversal of errors** - the users’ actions should be reversible in order to encourage exploration of the system but also to relieve anxiety for the users.

7. **Support internal locus of control** - the system should provide support so that the users feel that they are in control of the system.

8. **Reduce short-term memory load** - the user system should not oblige the user to keep information in the memory, instead it should provide the user with necessary information when performing tasks.

The heuristics and guidelines by Nielsen and Mack (1994), Weinschenk and Barker (2000) (as cited in Sauro (2011)) and Shneiderman and Plaisant (2010) are giving rules of thumb regarding which aspects to take into consideration in order to achieve high usability. The guidelines can also be used to point out areas with usability flaws when identifying usability issues.

### 2.4 Severity assessments of usability problems

After usability problems have been detected by evaluation, there is a need to prioritize them in order to decide which ones to fix. Usability improvements are not always straightforward forward, Brooks (1994) explains that it might not be economically justifiable to deal with all discovered usability evaluation problems. Brooks (1994) suggests that resources should be spent on activities which will generate high value for the users. Severity assessment might serve as a basis or guideline for problem prioritization (Nielsen and Mack, 1994; Hertzum, 2006). Shortcomings in the assessment will have consequences in the problem prioritization, it is therefore important to perform this properly in order to make the right priorities.

#### 2.4.1 Nielsen and Mack severity assessment

Nielsen and Mack (1994) present three factors that combined can determine the severity of a usability problem:
CHAPTER 2. THEORETICAL FRAMEWORK

- **Impact** - how much trouble the users experience in the context of how easy/difficult it will be to overcome

- **Persistence** - how many times the users will experience the problem, is the problem possible to overcome or will it disturb the user again and again?

- **Frequency** - how often the problem occurs

Nielsen and Mack (1994) present a scale for rating usability problems:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>I don’t agree that this is a usability problem at all.</td>
</tr>
<tr>
<td>1</td>
<td>Cosmetic problem only</td>
</tr>
<tr>
<td></td>
<td>- need not to be fixed unless extra time is available on project.</td>
</tr>
<tr>
<td>2</td>
<td>Minor usability problem</td>
</tr>
<tr>
<td></td>
<td>- fixing this should be given a low priority.</td>
</tr>
<tr>
<td>3</td>
<td>Major usability problem</td>
</tr>
<tr>
<td></td>
<td>- important to fix, so should be given high priority.</td>
</tr>
<tr>
<td>4</td>
<td>Usability catastrophe</td>
</tr>
<tr>
<td></td>
<td>- imperative to fix before product can be released.</td>
</tr>
</tbody>
</table>

Table 2.1: Severity Rating by Nielsen and Mack (1994)

### 2.4.2 Severity assessment by Rubin and Chisness

Rubin and Chisness (2008) bring up criticality as a factor that can serve as a basis for severity ranking. Criticality can be described as a combination of the problem severity and the probability for it to occur (Rubin and Chisness, 2008). Rubin and Chisness (2008) further present a severity ranking and a frequency ranking:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Irritant</td>
</tr>
<tr>
<td></td>
<td>- no problem, satisfies the benchmark</td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>- minor hindrance, possible issue but will probably not hinder the user</td>
</tr>
<tr>
<td>3</td>
<td>Severe</td>
</tr>
<tr>
<td></td>
<td>- serious problem, may hinder the user</td>
</tr>
<tr>
<td>4</td>
<td>Unusable</td>
</tr>
<tr>
<td></td>
<td>- task failure, prevents this user on going further</td>
</tr>
</tbody>
</table>

Table 2.2: Severity Rating by Rubin and Chisness (2008)

The frequency is calculated by looking at the estimated amount of affected users in combination with the estimated probability that a user will experience
problem (Rubin and Chisness, 2008). If 30% of the users will experience problems 50% of the time the product is used, than the frequency of occurrence is $0.5 \times 0.3 = 0.15 = 15\%$.

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Frequency of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Will occur $\leq 10%$ of the time the product is used</td>
</tr>
<tr>
<td>2</td>
<td>Will occur 11-51% of the time</td>
</tr>
<tr>
<td>3</td>
<td>Will occur 51-89% of the time</td>
</tr>
<tr>
<td>4</td>
<td>Will occur $\geq 90%$ of the time</td>
</tr>
</tbody>
</table>

Table 2.3: Frequency Rating by Rubin and Chisness (2008)

### 2.4.3 Severity assessment method by Akers et al.

The severity scale by Akers et al. (2009) is presented below:

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Problem impact &amp; persistence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minor annoyance, easily learned or worked around</td>
</tr>
<tr>
<td>2</td>
<td>Bigger problem (at least 3 minutes time lost), but still easily learned or worked around</td>
</tr>
<tr>
<td>3</td>
<td>Minor annoyance, but will happen repeatedly</td>
</tr>
<tr>
<td>4</td>
<td>Bigger problem (at least 3 minutes lost) and will happen repeatedly</td>
</tr>
<tr>
<td>5</td>
<td>Showstopper, can’t move forward without outside help; data loss; wrong result not noticed</td>
</tr>
</tbody>
</table>

Table 2.4: Impact & Persistence rate by Akers et al. (2009)

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Frequency of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Problem will be extremely rare (less than 1/100)</td>
</tr>
<tr>
<td>2</td>
<td>Some will encounter (at least 1/100, less than 1/3)</td>
</tr>
<tr>
<td>3</td>
<td>Many will encounter (at least 1/3, less than 2/3)</td>
</tr>
<tr>
<td>4</td>
<td>Most will encounter (at least 2/3, less than 100%)</td>
</tr>
<tr>
<td>5</td>
<td>Everyone will encounter (e.g., startup problem)</td>
</tr>
</tbody>
</table>

Table 2.5: Frequency rating by Akers et al. (2009)

To calculate the final severity rating, Akers et al. (2009) summarize the frequency rate and the impact and persistence rate and afterwards subtracts 1 in order to get the final severity level in a scale from 1 to 9. Severity level 1-2 are considered mild, level 3-4 are considered medium and level 5-9 are considered as high severity (Akers et al., 2009).
CHAPTER 2. THEORETICAL FRAMEWORK

2.5 Usability and ERP systems

A contributing factor to IS success is user satisfaction, according to Calisir and Calisir (2004) who base this statement on previous research within the field. Calisir and Calisir (2004) further states that the usability of the system and the experienced ease of use contributes to the overall end-user satisfaction of the system. Topi et al. (2005) bring up the fact that a system with usability flaws can make it hard for the user to achieve their goals in a desirable manner.

Topi et al. (2005) have performed research regarding common usability problems related to ERP-systems and they identified six categories of issues:

- Identification of and access to the correct functionality
- Transaction execution support
- System output limitations
- Support in error situations
- Terminology problems
- Overall system complexity

The identified issues further affected the users in consequences related to learning time of the system and the amount of errors that occurred due to lack of understanding (Topi et al., 2005).

Oja and Lucas (2014) have identified and listed ERP usability issues, categorized by the severity of the issue:

- **Most severe usability problems**
  1. Difficulty in finding the next step to perform
  2. Lack of clarity in feedback and information from the system
- **Medium severity usability**
  3. Unclear regarding data entry rules
  4. Difficulty to distinguish the current location in the system and understanding what is possible at this stage
  5. Inconsistency within transactions
  6. Unclear design, placement and purpose of buttons
- **Mild severity usability problem**
  7. Difficulty regarding the understanding of how a function works
  8. Difficulties regarding changing of settings
These problems were found by observing users while they were using an ERP-system and also by having the users report their experienced problems (Topi et al., 2005). The severity categorization were based on the severity assessment method presented by Akers et al. (2009).

Oja and Lucas (2014) also discuss short- and long term actions based on the knowledge regarding which usability issues that are common. Improvements related to how users interact with the system can be done right away by appropriate training. In a long-term perspective the findings regarding common usability issues can be used in further development of the ERP products in order to develop more intuitive and user-friendly products.

2.6 Customer support

Most end-users will at some point need assistance to achieve maximum value from their purchase (Goffin and New, 2001). In today’s competitive market, customer support is an essential part related to product development. The market globalization and the high service focus make customer support a potential competitive advantage (Negash et al., 2003). Goffin and New (2001) claim that increasing challenges regarding product differentiation will make customer support a means to gain customers and could hence be a potential competitive advantage.

Customer support is also a means for companies to establish reliable relationships with the customers after a purchase and it may even affect the success rate of new products (Goffin and New, 2001).

2.6.1 Usability as a support issue

Shneiderman and Plaisant (2010) and Følstad et al. (2014) argue that UX-related issues are giving important and valuable information regarding how users are interacting with the system in real-life situations. This is information that possibly can be utilized when working with improvements and future extensions of the products. A study by Kuijk et al. (2007) showed that product developers had a wish to receive more information about product usage after sales in order to get insight in real-life usage. According to a study by Chilana et al. (2011) regarding post-deployment usability, approximately 70% of the usability or UX professionals claimed that they started to work with a new release of the product or another product immediately after a release has been done. Another finding was that 23% of the UX or usability respondents never interacted with support personnel during post-deployment and only 30% claimed they have interactions "once in a while" (Chilana et al., 2011). This lack of interaction between usability practitioners and support personnel in combination with the absence of usability practitioners'
involvement in post-deployment development could result in lost opportunities regarding insight in users’ post-deployment interactions.

Følstad et al. (2014) suggest the opportunity to view UX-related support cases as a usability evaluation resource. Følstad et al. (2014) further emphasize that there is a lack of research related to customer support feedback as an evaluation resource. Research tend to focus on usability testing and usability inspections when dealing with usability evaluations (Følstad et al., 2014).

2.7 Usability in the development process

Holzinger (2005) brings up five usability characteristics that should be a part of every software project: learnability, efficiency, memorability, low error rate and satisfaction. These are identical to the five quality components Nielsen and Mack (1994) present when defining usability. Methods for achieving usability in products’ user interface are provided by usability engineering activities during the product development. These activities include (Mayhew, 1999):

- Usability requirements analysis
- Usability goal setting based on the usability requirements analysis
- Supporting activities to reach the goals (design)
- Usability evaluations (testing)

Mayhew (1999) emphasizes that user requirements and user interface design should be driving in the development process. This is motivated by the fact that the user interface is the product, from the users’ perspective.

When performing usability evaluations with the goal to improve usability in a product, there is need to consider the interaction with the rest of the development activities as well. Wixon (2003) argues that this is a requirement in order for the usability improvements to be practically doable. This also needs to be reconsidered when choosing usability evaluation method. Four types of usability evaluation methods will be presented below.

2.7.1 Usability inspection methods

Common to usability inspection methods is that they don’t involve users directly, instead they are addressing usability issues by using practitioners. UI specialists are looking for problematic areas which they experience can cause usability problems. Nielsen and Mack (1994) explains the goal for usability inspection methods as to find usability problems in an interface and use these findings to evaluate and improve the usability. Jeffries et al. (1991) also highlight the fact that UI specialist might not be part of the development team and hence might not be aware of technical or functional limitations.
2.7.1.1 Heuristic evaluation

The goal of heuristic evaluation is described by Nielsen (1992) as finding usability issues in an existing interface design. This is done by letting a couple of evaluators individually analyze the design and then compare the findings with usability heuristics (as presented in section 2.3). Jeffries et al. (1991) present a study where four user interface evaluating techniques (heuristic evaluation, cognitive walkthrough, software guidelines and usability testing) were compared. Heuristic evaluations’ advantages were found to be the large amount of identified problems (were many of them were considered as serious) and the low cost. Jeffries et al. (1991) mentions the need of UI expertise for the evaluation performance as a disadvantage with the method. Nielsen (1992) also concludes that people with usability expertise performed better at evaluating compared to those who didn’t have the same background.

2.7.1.2 Cognitive walkthrough

The main focus for cognitive walkthrough is evaluation of the ease of learning (Nielsen and Mack, 1994). This is evaluated by exploring how users accomplish predetermined tasks and provide the evaluators with detailed information regarding the users’ interactions with the system. The evaluators take on roles as users. Nielsen and Mack (1994) bring up the narrow focus as a disadvantage of the method and Jeffries et al. (1991) also point out shortcomings in detecting general and reoccurring problems. Cognitive walkthrough can be used by software engineers and does not particularly need UI specialists involved, which Jeffries et al. (1991) point out as one of the advantages with this evaluation method.

2.7.2 Usability evaluation with users

It is recommended that an inspection evaluation method is combined with evaluation methods involving actual users (Nielsen and Mack, 1994). According to Nielsen (2012), user testing is the most basic and useful method in order to study usability. To do so, there is a need to involve representative users and let them perform tasks in the system with a goal to evaluate the design by observing them while interacting. When involving real users, they can for example test a system or a prototype with directions from the evaluator (Goodwin, 2009). Real users can provide the evaluators with a perspective different from practitioners that are taking the role as users. Real users interact frequently with the system on a regular basis and Preece et al. (2007) claim that involving real users is the best way to ensure that the users’ goals are taken into account and get properly addressed. Oja and Lucas (2014) also emphasize the benefits with having users evaluate the system and report
the problem as it happen, compared to having interviews or surveys afterwards.

Usability.gov (2015c) presents five benefits with usability testing:
1. Possibility to investigate whether the users are able to complete given tasks
2. Examine how long it takes for the users to complete given tasks
3. Evaluate the users’ satisfaction of the product or system
4. Identify what changes are required to improve the user experience
5. Examine whether the system performance meet the usability objectives

According to a study by Jeffries et al. (1991) usability testing often identifies serious and reoccurring problems but since it requires both users and UI expertise, it is also associated with high costs.

2.7.3 Card-sorting

Tullis and Albert (2013) present card-sorting which is a technique used for designing and organizing content in a system. There are two kinds of card-sorting (Tullis and Albert, 2013):
1. **Open card sort** - the users get cards to sort, which are sorted in their own defined categories.
2. **Closed card sort** - the users get cards to sort and are also given categories to sort them into (compared to open card sort where the users get to define own categories).

The goal with the card sorting is to investigate where the information is logical to find according to the user (Tullis and Albert, 2013). The aim is to utilize this information when designing and structuring content in an information system or website. The open card sort is more commonly used according to Tullis and Albert (2013). Closed card sort can be used when the evaluator already have an idea regarding the categorizing and want to see how the users match it. This can be an idea if there is a wish to evaluate a category structure in order to judge its applicability. Between 10 and 20 users are a good number of users to test on, these numbers are results of a card-sorting study performed by Tullis and Wood (2004) as cited in Tullis and Albert (2013). The aim of their study was to investigate how many users are suitable in order to get reliable results.

Usability.gov (2015a) discusses different techniques when performing card sorting. Card sorting can be done remotely and there are several available software services that provide support for this. Usability.gov (2015a) brings up the analyzing support the services provide as an advantage. A disadvantage that is brought up, is that you don’t get any information regarding how the
2.7.4 Proceeding after usability evaluations

Nielsen (2012) argues that there are significant improvements to gain when usability is taken into account in the development process of software and products. Both Van Welie et al. (1999) and Wixon (2003) emphasize the importance to not just find the usability issues but also to look in to the reasons why they exist. After detecting possible usability issues, Van Welie et al. (1999) suggest looking into what needs to be changed and also how when proceeding with the usability evaluation results. Brooks (1994) argues that there are other parts of the product than the interface that need to be addressed before establishing usability fixes. There can be functional limitations or monetary matters which need to be considered and also the question whether the suggested change is bringing any value (Brooks, 1994).

There are arguments to take usability into account early on in the development process. This is brought up as a value proposition by Mayhew (1999) with the motivation that changes are more expensive the later in the development process they are managed. The number of possible alternatives regarding the design of a UI are also decreasing the longer the project proceeds.

2.7.5 Usability as a training issue

Ross (2010) argues that one common excuse for not having a focus towards usability is that training eliminates the need for usability. The explanation that complex applications take time to learn and that it is possible to show people how to use the system in order for them to overcome and solve the issue are described as common by Ross (2010). Ross (2010) further lines up arguments emphasizing why usability is not just a training issue:

- Fixing usability problems will reduce the need for training. Training will most likely be needed when dealing with complex systems, but if the system is usable the training can be easier and quicker.
- Training doesn’t solve inefficiencies in use. Even if a user knows how to overcome an issue, the workaround can make it complicated for the user to perform his or her tasks.
- Training doesn’t improve user satisfaction. Solving a usability issue with training can oblige the user to do unnecessary steps that can cause frustration and irritation.
- Training isn’t cheap. The trainers must be educated in how to perform the training, and from the users’ or customers’ perspective training takes
It's difficult to change the behavior of people who have learned to cope with inefficiencies. The users have been used to do workarounds for a long time and they might not want to change how they are used to manage the system. This can cause resistance when later upgrading the system to a new release.

Ross (2010) also states that training can never be a substitution for designing a usable application. Initial training can not be avoided when dealing with complex systems, but it is possible to limit the amount of additional training by having a stronger usability focus.
Chapter 3

Method Theory

In this chapter, relevant method theory will be presented. Background and motivation for the chosen method will also be provided as well as a short section related to possible alternative methods.

The method that has been used in this thesis project is an exploratory single case study with a positivist approach. Data for the study has been collected through interviews and questionnaires. Chapter 4 will later present the conduction of the case study.

3.1 Case study method and alternatives

Runeson and Höst (2008) summarize previous definitions of case studies where one of them is:

\[ \ldots \text{case study is an empirical method aimed at investigating contemporary phenomena in their context.} \]

According to Yin (2014), the suitability to use a case study approach as a research method could depend on the defined research questions:

The more your questions seek to explain some present circumstance (e.g, “how” or “why” some social phenomena works), the more that case study research will be relevant.

Runeson and Höst (2008) claim that a case study approach is well suitable when doing software engineering research and presents three reasons motivating this:

1. The study objects are developing software rather than using software systems.
2. The study objects are project oriented rather than line or function oriented.

3. The studied objects are often highly educated and are performing advanced engineering work rather than routine work.

Følstad et al. (2014) mention that research related to support cases as a source of usability insight is a rather unexplored area in existing theory. According to Eisenhardt (1989), a case study is a suitable method when dealing with new research areas. Rowley (2002) brings up that case study research is useful when dealing with an exploratory stage of a project.

Runeson and Höst (2008) present critique towards case study as a research methodology. There are opinions that case studies are giving less value than other methodologies, that they have a lack of generalizability and also that case studies are being biased by researchers (Runeson and Höst, 2008). How to ensure high quality research when performing case study research will be further presented in chapter 3, section 3.2; research quality.

3.1.1 Alternative approaches

There are alternative methods that could have been chosen in order to conduct this thesis work. Some opportunities will be presented here to give an insight into other possible approaches. Runeson and Höst (2008) bring up three methods that are closely related to case studies.

3.1.1.1 Experiment

The term "experiment" is often used synonymously with empirical study according to Sjoberg et al. (2005). Sjoberg et al. (2005) hence prefer to use "controlled experiments" when naming the method. Controlled experiments are described by Sjoberg et al. (2005) to be a classical method when doing research with a purpose to identify cause-effect relationships. Sjoberg et al. (2005) further define controlled experiments to be a randomized experiment where individuals or teams follow through with one or several software engineering tasks with a purpose to analyze the outcome. Runeson and Höst (2008) emphasize that case study research provides a deeper understanding of the studied phenomena compared to controlled experiments. Rowley (2002) also confirms that case studies might lead to insights that are not possible to reach with other methods.

3.1.1.2 Survey

A survey is a "collection of standardized information from a specific population, or some sample from one, but not necessarily by means of a questionnaire or
"interview" according to Robson (2002) as cited in Runeson and Höst (2008). According to Goodwin (2009), surveys are beneficial to identify relationships but does not provide support when it comes to explaining those relationships. Surveys are the most common method regarding collection of quantitative data (Goodwin, 2009).

3.1.1.3 Action research

Action research has its focus on changing some aspect or process while case study is a more observational methodology (Runeson and Höst, 2008). Runeson and Höst (2008) explain that action research and case studies are similar methods, but action research might be more suitable when dealing with a change process of any kind.

3.2 Research approaches

Which research approach that is suitable depends on the aim of the research study, what it seeks to answer (Runeson and Höst, 2008). Runeson and Höst (2008) bring up four different types of research approaches:

- **Exploratory** - aims to find out what is happening by seeking new insights in order to create ideas and hypotheses for further research.
- **Descriptive** - is portraying a phenomena or a situation.
- **Explanatory** - aims to explain a situation or a problem by identifying causal relationships.
- **Improving** - aims to improve an aspect of a phenomena.

3.3 Case study approaches

Runeson and Höst (2008) further bring up three kinds of case study approaches to use when conducting case study research:

- **Positivist case study** - searches evidence by looking at measurable variables, testing hypothesis and by using other empirical proof in order to make explanations.
- **Critical case study** - aims at looking into social, cultural and political domination that might be hindering human ability.
- **Interpretive case study** - aims to gain understanding of a phenomena by learning how participants of the study interpret their context.
3.4 Case study phases

Runeson and Höst (2008) divided the components of the case study process method into five steps:

1. Designing and planning of the study
2. Data collection preparation
3. Collection of data
4. Analysis of the collected data
5. Reporting of results

These steps are in line with the case study description of Yin (2014) regarding the structure of a case study. Yin (2014) further divides these five steps into three phases in the case study lifecycle: phase 1: define and design, phase 2: prepare, collect and analyze and phase 3: analyze and conclude. These three phases are illustrated in figure 3.1 and further described below. Creating of a case study design is a way to plan how to get from research questions to conclusions (Rowley, 2002).

![Figure 3.1: Case study phases as described by Yin (2014)](image)

3.4.1 Phase one: defining and designing

The first steps when planning a case study are stating research questions and developing a case study design (Yin, 2014). In order to build theories out of case study research, it is important to state well defined case study research questions (Eisenhardt, 1989). Eisenhardt (1989) explains that a clear research focus is necessary in order to create a reasonable and manageable scope for the study. Yin (2014) also agrees with this and further explains that a lack of clear study questions might result in a study area that is too big to handle within the
scope of the study. The purpose with the study questions is to identify which information that needs to be collected during the data collection activities (Yin, 2014). Baxter and Jack (2008) argue that having too broad research questions or too many objectives in the scope of the study is one common pitfall when performing case study research. Eisenhardt (1989) emphasizes the importance to allow the research questions to evolve if needed since the research questions might need to change as the case study proceeds.

Case study design is a process containing five components: case study questions, propositions, units of analysis, linking strategy for linking data to propositions and interpreting criteria when interpreting the findings (Yin, 2014). Propositions are decomposed study questions that have a narrower scope, with a purpose to more precise point to what is to be studied (Yin, 2014). When doing an exploratory case study, it might not be necessary to state propositions, instead Yin (2014) suggests stating the exploration purpose. Units of analysis means defining the case to be studied (Yin, 2014). Linking strategy includes analytical methods for the analyzing work later in the case study process, with a purpose to prepare for this later work (Yin, 2014). General strategies suggested for the analytical work with the case study data are (Yin, 2014):

- Relying on theoretical propositions - Using theory to analyze the case by drawing conclusions from looking at existing theories.
- Working the data from the ground up - Looking for patterns by sorting and categorizing the data into different categories.
- Developing a case description - If the research questions are unclear this can be a good idea; to create an idea of how the case situation are by analyzing the collected case data.
- Examining possible rival explanations - This method can be used together with the previous and the purpose is to test rival explanations. This require that the researcher has planned to looked at possible rival explanations before collecting the data.

Interpreting criteria include methods to justify and explain results and findings in the case study research, this is important to achieve a high quality study (Yin, 2014). When doing case study research, the addressing of rival explanations strengthens the findings if the explanations can be turned down. Yin (2014) further describes five analytic techniques: pattern matching, explanation building, time-series analysis, logic models and cross-case synthesis.

Yin (2014) suggests having a general idea regarding how to handle the collected data before continuing with the data collection.

The benefits of planning the analyzing and interpreting methods in advance (before the data is collected), is to make sure that the collected data is analyzable (Yin, 2014). The advantages of planning the report in advance is having a plan
for how collected data is going to be presented and also to prepare the data collection process (Yin, 2014).

3.4.2 Phase two: preparing, collecting and analyzing

Case study research can be done by including both qualitative and quantitative methods, often two or more data sources are used to base the research on (Rowley, 2002). It is important to include more than one source of information when drawing conclusions, according to Runeson and Höst (2008). Drawing conclusions from several sources strengthens the credibility and consistency of the study. In order to deal with the case study data collection material, Yin (2014) recommends taking field notes while collecting the material and store them in an organized way so that they can be used later in the analyzing process. Yin (2014) further recommends storing any other case study documents in an organized way to facilitate the use of them in the analyzing phase.

Interviews, questionnaires and documents as data collection sources are reviewed in following sections.

3.4.2.1 Data collection: interviews

Interviews are an important data collection source in case study research (Runeson and Höst, 2008). Yin (2014) brings up the degree of insight and the focus it provides as two strengths with interviews. When preparing interview questions, these can be defined by breaking down the case study research questions down to (Runeson and Höst, 2008). Interviews can be unstructured, semi-structured or fully structured (Runeson and Höst, 2008). The differences between these interview approaches are how specific the questions and interview plan are. In a fully structured interview the interview questions are asked exactly as planned in the interview protocol while the structure is considered to be more free in a semi-structured interview that lets the interview take direction as it progresses (Runeson and Höst, 2008). Brinkmann and Kvale (2011) present three key questions to reflect on when planning an interview:

- **why** - stating the purpose of the study
- **what** - gaining knowledge within the field
- **how** - getting familiar with interviewing and analyzing techniques to apply

Regarding the questions asked in an interview, these need to be well formulated in order to avoid any biases as a result of poorly designed questions (Yin, 2014). Yin (2014) describes two tasks that the interviewer needs to accomplish: follow the research plan and ask the questions in an unbiased way. Robson (2002) brings up some questions to avoid in order to perform a good interview:
• **Long questions** - these can be hard for the interviewee to recall and hence there is a risk that they only answers to part of the question.

• **Double-barrelled questions** - it is better to break these kind of questions down so that they get simpler to understand and answer.

• **Questions with jargon** - words that might not be familiar to the audience should be avoided, it is better to keep it simple.

• **Leading questions** - it is not wished that the interviewee gets pointed in a certain direction.

• **Biased questions** - writing unbiased questions are a first step to avoid being biased. There is also a need to be aware of possible biases during the interview, trying to be natural in the dialogue is important in order to maintain an unbiased approach.

Runeson and Höst (2008) suggest that the interviews are recorded since note-taking cannot get all the details and to counteract poor recall, which according to Yin (2014) is a risk with interviews. It might also not be clear what is considered important information during the interview and then it is useful for the interviewer to go back and listen to the recording (Runeson and Höst, 2008). Before proceeding with the data analysis, Runeson and Höst (2008) suggests transcribing the interview in order to facilitate the synthesizing process. In order to do this, recording is needed.

Regarding face-to-face interviews versus interviews over telephone, Robson (2002) brings up potential advantages and disadvantages. Telephone interviews are cheaper and quicker to perform but they lack visual attributes that can be seen as a help for the interviewer when interpreting the interviewees responses (Robson, 2002).

### 3.4.2.2 Data collection: questionnaires

Questionnaires are seen as a quantitative data collection method. When deciding what to ask in a questionnaire, it is important to have a clear mindset regarding what data to collect and to present the questions properly. Kelley et al. (2003) suggest that the questions should be numbered and grouped by subject. Regarding the questions asked in a questionnaire, the same advices applies as for interview-questions. Kelley et al. (2003) argue that closed questions are easy to administrate and easily analyzed compared to open questions which demand more from both researcher and participants. If using a tool to collect the data, Kelley et al. (2003) suggest piloting the questionnaire before sending it out in order to test if the instructions are clear and the questions are understandable.

Kelley et al. (2003) further describe that information regarding how the participants were chosen and contacted, the response rate and how the survey
was administrated should be presented by the researcher.

3.4.2.3 Data collection: documents and archival data

Yin (2014) describes documentation and archival data as other possible sources of evidence in case study research. Documentation can include different types of documents; personal documents (e-mails and calendars), administrative documents (reports and internal records) or formal studies or evaluations related to the case (Yin, 2014). What is needed to be considered when using documents or archival data as case study evidence is that they are not written with the purpose to be used in the case study (Yin, 2014). Yin (2014) suggests that having a focus on the archival data objectives can help interpreting the correct meaning of the observed content.

3.4.3 Phase three: analyzing and concluding

After data has been collected and compiled, the analyzing of the material takes place. In order to draw any conclusions from the findings, Yin (2014) recommends using several sources of evidence, triangulation. When triangulating data, this shows that case study findings are supported by more than one source and hence strengthens the construct validity of the case study. In order to increase the reliability of the study, Yin (2014) explains that it is important to describe the evidence in the report all the way from data to conclusions to create an understanding. The goal is to make the reader understand the basis for the drawn conclusions. According to Yin (2014), this will increase the quality of the study, if done properly.

3.4.3.1 Analysis strategy: content analysis

Yin (2014) suggests looking for patterns in collected data by sorting and categorizing the data. Content analysis is a method used for interpreting data and (Hsieh and Shannon, 2005) describe that the method sometimes is mentioned as "a quantitative analysis of qualitative data". Elo and Kyngäs (2008) describe content analysis as "a method that can be used with either qualitative or quantitative data and in an inductive or deductive way". Both the inductive and deductive way have three main phases (Elo and Kyngäs, 2008): preparation phase, analyzing phase and reporting phase. In the first phase, the units of analysis are decided. What is the material to be analyzed? Next thing to do is to get familiar with the material by going through the data several times. Elo and Kyngäs (2008) describe the inductive and deductive approaches:

- **Inductive way** - is recommended where there is little previous research within the field. The inductive content analysis has three steps: open
coding of the material, creating of categories based on the coding and at last an abstraction phase. Open coding is the process of making notes and headings while going through the data. The categories are developed based on the content. The categories are later also grouped in order to gather similar categories with each other. The abstraction includes the developing descriptions of the groups. The categories are described and could have subcategories if needed.

- **Deductive way** - is recommended if the aim of the study is to test an existing theory in a new context. The first step here includes the creating of categories to code the data into. The difference from the inductive approach is that the categories are decided before the data is coded, the data is coded with an aim to fit in to the created categories instead of developing the categories based on the coding. This could be useful when the aim is to test a hypothesis.

The data to interpret can come from a variety of sources: surveys, interviews, observations, documents, articles or books as a couple of examples (Hsieh and Shannon, 2005; Elo and Kyngäs, 2008). The overall purpose with content analysis is to classify the material into categories with a goal to draw conclusions related to the meanings in these categories (Hsieh and Shannon, 2005). When sentences and words are classified into the same groups, they are assumed to have related meanings (Elo and Kyngäs, 2008).

One crucial factor regarding the reliability of the findings is how well the identified categories covers the data (Elo and Kyngäs, 2008). Elo and Kyngäs (2008) also point out the importance of being clear when describing the conduction of the whole process, so that it is possible to understand the reasoning behind the results. Citations from the data that represents findings are brought up as one approach to justify conclusions (Elo and Kyngäs, 2008). One important thing to keep in mind is to never use quotes in a way that the informant could be identified (Elo and Kyngäs, 2008).

### 3.5 Research quality and validity

To address the critique towards case study research; lack of provided value, lack of generalizability and bias, proper practises can be used (Runeson and Höst, 2008). The validity of a performed study is an important aspect to address in an early phase of the case study process according to Runeson and Höst (2008). If validity is addressed to late, enough actions might not have been taken during the case study to ensure high quality of the study (Runeson and Höst, 2008). There are four generally used tests to perform to ensure a high quality study (Runeson and Höst, 2008; Yin, 2014). These are construct validity, internal validity, external validity and reliability. These tests are ensuring the case study trustworthiness, credibility, confirmability and data dependability and are used
during different stages of the case study (Yin, 2014). Generalization is also an important aspect related to research quality according to Rowley (2002).

3.5.1 Construct validity

Construct validity is a test to identify that the case study has correct measures in order to measure what it intends to be measuring (Yin, 2014). In order to achieve construct validity, Yin (2014) suggests the use of multiple sources of evidences, establishing of an evidence chain and having key informants reviewing a draft of the case study report. Runeson and Höst (2008) suggest having the interview transcripts reviewed by the interviewees. The first two strategies to ensure construct validity is appropriate to use during the data collection process and the reviewing is performed during the reporting of the compilation of the study (Yin, 2014).

3.5.2 Internal validity

Internal validity is relevant in explanatory studies and not in descriptive and exploratory studies (Yin, 2014). The purpose with internal validation is to ensure that correct conclusions are drawn during the study in order to explain a phenomena (Yin, 2014). In order to establish internal validity, Yin (2014) suggests pattern matching, explanation building, addressing of rivaling explanations and the use of logic models in the analysis.

3.5.3 External validity

External validity is a test to make sure the study results and findings are generalizable and possible for others to apply (Yin, 2014). Yin (2014) suggests to use theory as a means to establish external validity and also by making sure that the research questions are stated in terms of "how" and "why" in the case study design stage. Generalization can be achieved by comparing the research results with existing theories within the field (Rowley, 2002). Generalization is necessary in a study in order for it to contribute to existing theory (Rowley, 2002).

3.5.4 Reliability

Reliability testing is making sure that if the same study was performed again by another researcher, the same result and findings will be the outcome (Yin, 2014). Yin (2014) advises to use a case study protocol and to develop a case study database in order to minimize errors in the study and thereby establish
reliability. Yin (2014) brings up accuracy and precision during the case study process as the key to achieve reliability.
Chapter 4

Case study: categorization & evaluation

The case study chapter presents the performing of the case study, from the preparation phase to conduction. The case study chapter begins with an introduction of Industrial and Financial Systems (IFS) and continues with a presentation of the categorization structure. After this, the three case study phases are gone through. A coarse case study plan is:

Phase one: defining and designing
- Making a detailed case study plan
- Stating research questions and define scope of the study
- Interpreting criteria for findings
- Preparing for the analyzing and reporting phase

Phase two: preparing, collecting and analyzing
- Planning data collection
- Performing data collection

Phase three: analyzing and concluding
- Analyzing of material
- Drawing conclusions
- Present the findings
4.1 Case study background

The case study background will give a presentation of IFS and further introduce the case environment and scope.

4.1.1 Introducing IFS

IFS is an IT company that sells and implements their own developed component based enterprise resource planning (ERP) system, IFS Applications. IFS has about 2700 employees worldwide where about 200 of them are situated at the IFS head quarter office in Linköping. This thesis work is conducted at the product group Projects at IFS R&D department in Linköping.

IFS Applications has over 1,000,000 users (IFS, 2015a). Except functionality regarding ERP, the IFS Applications also includes solutions for enterprise project management (EPM), enterprise asset management (EAM) and service management, among others (IFS, 2015b). IFS Applications has functionality to handle four core processes: Service & Asset Management, Manufacturing, Projects and Supply Chain Management, and two support processes: Human Resources and Finance (IFS, 2015a). In addition to their products, IFS also offers consulting services.

4.1.2 IFS Support

IFS has a global support organization that works with correction of errors and to a limited extent also further development of their products. One of the purposes with IFS support is to ensure that the customers experience of the product quality is the best possible. IFS has a Global Support Organization (GSO), which is a global network of support centers and support teams which also includes IFS R&D.

1st line support does not perform corrections in the software. If a correction is required, they are responsible to make sure that necessary information is available for 2nd line. If needed, 2nd line can send a request for a bug correction to 3rd line of support (which is the R&D department). Approximately half of the reported cases get rejected as bugs. They are instead explained by:

- The issue is a duplicate of an already known problem
- The problem can’t be recreated
- The user hasn’t understood the functionality correctly (and need instructions/training)
- Design issues, i.e technical or functional limitations
A time after a new release of the application, adding of new functionality will be stopped and only modifications of the application connected to bug corrections will be accepted in support. Support cases related to bugs in the system will hence be taken care of and a correction will be done. Support cases related to issues concerning new functionality (i.e. not bugs or errors in the system) are not possible to take care of in the support department at this stage. This is due to the process, which does not allow new functionality in the application after release.

When a support case is closed, it is given a closing category in order to categorize and save the cause of the case.

IFS has a community where IFS employees can suggest and submit ideas regarding IFS Applications, IFS Idea Wall. It is possible to create own ideas, vote on existing ideas and make comments on ideas in the Idea Wall community. The submitted ideas on the Idea Wall are monitored by IFS R&D Product Management Team and they will consider ideas that have gotten positive attention in the community for further development of the product. The selection for implementation is based on the following factors:

- Interest from the community regarding the idea (votes and comments)
- Interest from outside the community
- Whether the idea is in line with future direction of the product
- Feasibility of an implementation regarding effort needed and technical risks

### 4.2 Development of category structure

In order to utilize information from usability related support issues, it is desirable to first identify them. Therefore a framework for classification of usability issues has been developed. The purpose with the categorization framework is to identify and map what sorts of usability issues that are occurring. It is also investigated how the issues can be categorized according to usability categorizations in theory. The procedure of creating the framework will be presented in the sections below.

#### 4.2.1 Support case data collection

Support cases that are resolved by training and explained with the clarification that "the user hasn’t understand the functionality correctly and needs training" might contain information related to usability areas. The closing category "Product Support -Training" is hence interesting to look into. Data was collected from the IFS support case system from 2nd line of support.
A search in the support case database was made in order to find relevant cases. The search criteria were:

- The case state is "Closed"
- The closing category is "Product support - Training"
- The case register date is during 2015

The search criteria resulted in 700 support cases\(^1\). In order to make an appropriate selection of relevant cases to base the framework on, a subset of the support cases were gone through. If the support case were related to one or more of the following criteria, they were removed from the selection and not considered relevant for the framework:

- The support case issues are not related to IFS Application. An example of this could be an issue which is related to a 3rd party product.
- The support case is bug-connected. A bug connected case means that IFS Support has assessed that a correction is needed in order to overcome the issue. If any usability issues are bug-connected, they are considered as errors.
- The support case issue was not possible for the customer or IFS Support to recreate. The issue appeared for the customer but couldn’t be recreated after the reporting of the issue.
- The support case is not usability-related, or there is too little information in the support case to determine whether it is a usability issue or not. Non-usability related issues could be problems with installation files, database crashes or software compatibility issues.

To collect enough cases to form a categorization framework, the cases were gone through one by one in the order they appeared in the search result. Approximately 170 support cases were gone through and 30 support cases related to usability were considered as a sufficient amount of cases to base the categorization of. The selected support cases were collected in a table to keep track of them. Each case were given a number, starting with 1 and increasing in the order they were selected. Case references were also noticed in order to be able to go back to the case in the database easily. The support case issue was also summarized as well as possible usability-areas that they were related to. The table also contained reporting date, case severity\(^2\), case importance\(^3\) and product area\(^4\). The purpose of collecting this information was to keep the cases trackable and to get an overview of the information in them.

---

\(^1\)The search was performed 2015.10.11, and the list of resulting cases is continuously growing as more cases get closed under the training-category  
\(^2\)Case severity is set by IFS Support on a scale from 1 (system down) to 4 (minor)  
\(^3\)Case importance are set by the case reporter on a scale from 1 (very high) to 4 (minor)  
\(^4\)Product area refers to IFS Application product area
4.2.2 Classifications

When identifying relevant cases and structuring the information in the support case table, possible usability concerns were listed. When all necessary cases were documented in the table, these were gone through once again in order to map them to a usability area. These were afterwards connected to heuristics and principles by Nielsen and Mack (1994), Rubin and Chisness (2008) and Weinschenk and Barker (2000) as cited in Sauro (2011). The usability issues which Oja and Lucas (2014) identified when analyzing ERP systems were also compared with the issues that were identified in the cases. The result is presented in table 4.1. The abbreviations in the rightmost column are references to the following usability principles from literature:

- **N&M** Nielsen and Mack ten heuristics (1994)
- **W&B** Weinschenk and Berker cognitive engineering principles (2000)
- **S&P** Schneiderman and Plaisant eight golden rules (2010)
- **O&L** Usability issues found in an ERP system by Oja and Lucas (2014)

<table>
<thead>
<tr>
<th>No.</th>
<th>Usability Issue</th>
<th>Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Difficulty understanding how a function works</td>
<td>N&amp;M(6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O&amp;L(7)</td>
</tr>
<tr>
<td>2</td>
<td>Hard to understand system limitations</td>
<td>O&amp;L(4)</td>
</tr>
<tr>
<td>3</td>
<td>Difficulties finding settings in the system</td>
<td>O&amp;L(8)</td>
</tr>
<tr>
<td>4</td>
<td>Error messages in the system are not providing enough information</td>
<td>N&amp;M(2,9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W&amp;B(4)</td>
</tr>
<tr>
<td>5</td>
<td>Lack of information in documentation</td>
<td>N&amp;M(10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W&amp;B(17)</td>
</tr>
<tr>
<td>6</td>
<td>Lack of feedback from system</td>
<td>N&amp;M(1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S&amp;P(3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W&amp;B(8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O&amp;L(2)</td>
</tr>
</tbody>
</table>

Table 4.1: Usability issues and their connection with literature

4.2.3 Category structure

The following category structure was suggested after going through and analyzing the support case data:

- *Difficulties understanding how a function works*

5this category were later removed, see section 4.2.4 for more information
Example: when users are having trouble performing a task due to difficulties in realizing how to perform it.

- **Hard to understand system limitations**
  Example: when a user wants to perform a task but are not sure whether the task is supported or even possible to do in the system.

- **Difficulties finding settings in the system**
  Example: when users want to modify settings but can’t figure out how to manage it.

- **Error messages in the system are not providing enough information**
  Example: when users get error messages that don’t give them information regarding how they can overcome a problem or contains a language that is not familiar for the user.

- **Lack of information in documentation**
  Example: when users seek for information in documentation but can’t find information related to what he/she expects to find.

- **Lack of feedback from system**
  Example: when users can’t complete a task but doesn’t get any information from the system why this is not possible. Another example is users that might not realize where they are in a process of performing a task.

### 4.2.4 Preparing testing of categories

The category structure will be evaluated in order to examine how IFS employees are experiencing the logic and intuitiveness in the category structure. Another purpose is to control whether the incidents in the items to categorize feel familiar from the IFS employee perspective. To test the category structure, the testers gets 15 items consisting of incidents that are based on information from closed support cases. The incidents are presented in appendix A. A web based tool, OptimalSort\(^6\) provided by Optimal Workshop\(^7\) was used to conduct the test. The tool provides drag and drop functionality letting the testers easily categorize items by dragging them to different categories. There is also a possibility to include a questionnaire after the categorization has been done in order to ask follow-up questions directly after the categorization has been made. Information and instructions from the classification exercise are presented in appendix C followed by the questions that were included in the classification questionnaire in appendix D. The work with the questionnaires will be further described in section 4.4.

As part of the preparation of the testing, a trial run was performed on an IFS employee in order to detect any issues with the provided instructions or with

---

\(^6\)https://www.optimalworkshop.com/optimalsort
\(^7\)https://www.optimalworkshop.com
the test itself. After the trial run, one category of usability issues, Difficulty understanding how a function works, was removed. The feedback from the trial was that this category was possible to include all of the other categories. To avoid any ambiguity regarding the categories, this category was hence removed as a result from the feedback.

### 4.3 Phase one: plan and design

The background of this case study, a definition of the case is provided in section 4.1 and can be seen as the stated units of analysis. This section will describe the conduction of the first phase in the case study: the planning and design phase.

#### 4.3.1 Case study questions

In order to address the research questions stated in chapter 1, the following case study questions have been developed to serve as a basis for the case study planning and performing:

1. Can IFS Support employees relate to the incidents and categories in the study?
   - Are the categories relevant? Why/why not?
   - Are the incidents relatable? Why/why not?
2. What value does the information from support case data brings, from a product perspective?
   - Could it be useful information for R&D when further developing IFS Application? Why/why not?
   - What would be needed in order for the information to be useful?

#### 4.3.2 Case study activities

The planned data collection activities in the case study are:

1. Testing of the category structure (distributed to 20 persons)
2. Questionnaire in connection to the testing (distributed to 20 persons)
3. Follow-up interviews with a subset of the testers (five persons)
4. Interviews with IFS employees with product responsibilities (two persons)
5. Analyzing the outcome and present the result.
In order to have a clear goal with the categorization exercise and the data collection activities, the data collection purposes have been stated in appendix E. The aim with stating clear purposes was to use this as a foundation when designing questionnaire questions and planning the interviews. As an alternative to stating propositions (as described by Yin (2014)), the exploration purpose is supported by the information in this document.

4.3.3 Linking strategy and interpreting criteria

The collected data are planned to be tackled from the "ground up" as suggested by Yin (2014). Content analysis is used as a strategy in order to analyze the data. The data shall be connected to the research questions together with possible conclusions with the aim to investigate different possible concepts. In order to interpret the case study findings, the plan is to have a discussion regarding the outcome of the results in order to address possible rival explanations.

4.4 Phase two: preparing and collecting

The phase two section, the preparing and collecting phase will present the preparations of the data collection (gathered through the classification exercise, a questionnaire and interviews) and the data collection conduction.

4.4.1 Data collection activities

The data collecting activities are:

- Classification exercise and a follow-up questionnaire in connection with the exercise (distributed to 20 persons)
- Follow-up interviews with a subset of the testers (five persons)
- Interviews with IFS employees with product responsibilities (two persons)

4.4.1.1 Classification study and questionnaire

The classification exercise and the questionnaire were sent out to 20 IFS employees: 10 persons with experience from working in 2nd line of support and 10 people with experience from working in 3rd line of support. These persons are a mix of people from different product groups and also from different offices, including offices in Sweden, Denmark and Sri Lanka. Names of available people with support experience were provided for this thesis project by Support Managers at different locations in the organization.
To introduce the study and its purpose, an introduction mail was sent out to all invited participants. The introduction mail is presented in appendix B. To participants with Swedish as native language, a Swedish version of the introduction mail was sent out. There have also been small modifications in the introduction mail depending on how much the person knew about the thesis work from previous contact, but the same information has been communicated to all of the participants.

4.4.1.2 Participants in classification exercise

From 2nd line, there were seven respondents and from 3rd line there were eight respondents. Information regarding the respondents are listed in table 4.2: Participants in classification study. They are listed with information regarding title, years of working within IFS and also which line of support they have experience from. The different roles are:

- **Application Consultant (AC)** - The application consultants are experts in their field and are assisting the IFS Applications’ customers with consulting when the need for this arises.

- **Business Systems Analyst (BSA)** - Among the responsibilities included in the role of the BSA, some of them are: formulating requirements into application solutions, writing functional specifications, performing application testing, performing bug verification as well as writing training material and documentation.

Regarding the number of people to include in a card sorting study, between 10 and 20 users are recommended numbers of users to test on according to Tullis and Albert (2013).

The purpose of the category evaluation and the questionnaire is:

- To test the logic in the structure
- To test the realistic nature of the structure

This information is also presented in appendix E. This has served as a basis when creating the exercise and the questions in the follow-up questionnaire. In appendix D, the classification questionnaire is presented. The logic is tested by looking at the outcome of the classifications and how the testers experience the exercise. The realistic nature of the structure is evaluated by questions in the questionnaire. There are questions related to if the testers feel that the items in the study are familiar compared to issues they have faced when working with support. Qualitative input related to these areas are gathered by interviews with a subset of the classification testers.
CHAPTER 4. CASE STUDY: CATEGORIZATION & EVALUATION

<table>
<thead>
<tr>
<th>Role at IFS</th>
<th>Time at IFS (years)</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AC</td>
<td>&gt;1</td>
</tr>
<tr>
<td>2</td>
<td>AC</td>
<td>5-10</td>
</tr>
<tr>
<td>3</td>
<td>BSA</td>
<td>10+</td>
</tr>
<tr>
<td>4</td>
<td>BSA</td>
<td>1-3</td>
</tr>
<tr>
<td>5</td>
<td>AC</td>
<td>5-10</td>
</tr>
<tr>
<td>6</td>
<td>BSA</td>
<td>1-3</td>
</tr>
<tr>
<td>7</td>
<td>BSA</td>
<td>5-10</td>
</tr>
<tr>
<td>8</td>
<td>BSA</td>
<td>10+</td>
</tr>
<tr>
<td>9</td>
<td>BSA</td>
<td>10+</td>
</tr>
<tr>
<td>10</td>
<td>BSA</td>
<td>5-10</td>
</tr>
<tr>
<td>11</td>
<td>BSA</td>
<td>5-10</td>
</tr>
<tr>
<td>12</td>
<td>BSA</td>
<td>10+</td>
</tr>
<tr>
<td>13</td>
<td>BSA</td>
<td>3-5</td>
</tr>
<tr>
<td>14</td>
<td>BSA</td>
<td>10+</td>
</tr>
<tr>
<td>15</td>
<td>BSA</td>
<td>10+</td>
</tr>
</tbody>
</table>

Table 4.2: Participants in classification exercise

4.4.1.3 Interviews

To get qualitative input related to the classification exercise and the questionnaire, interviews are used to gather information. Interviews are also held with IFS employees with product responsibility, in order to look in to other aspects related to case study question two (stated in section 4.3.1).

As with questionnaires, the purpose with the interviews are defined (as described in appendix E):

- To get qualitative input on the results from the categorization study
- To investigate the realistic nature of the categories and incidents deeper
- To discuss the outcome of the categorization study

The first participants completing the classification exercise and the questionnaire were contacted by e-mail and were asked if they could consider participating in a follow-up interview. The reason why the first ones were the ones contacted was because of the time frame for this thesis project. Further information regarding the interviews are summarized below:

- Six people participated in a follow-up interview, these are listed in table 4.3.
- The mean time of the interviews were 34 minutes.
- One interview were conducted face-to-face and four were conducted over Skype, due to geographic differences.
Table 4.3: Interviewees: participants in classification exercise

- All of the interviews were recorded and transcribed.
- Each interview was summarized in a bulleted list with key points from the discussion and e-mailed to the interviewee in order for she/he to review the information.

Interviews were also conducted with employees with product responsibility:
- **Product Solution Manager (PSM)** - Among the responsibilities included in the role of a PSM, they are contributing to the product backlog with long-and short term improvements. They are also working closely with the projects performing development and support in the components of the Product area, supporting them with guidance regarding quality assurance, functional coherence, maintainability and design.

Table 4.4: Interviewees: employees with product responsibility

- Two PSM:s were interviewed.
- The mean time for the interviews were 54 minutes.
- Both interviews were conducted face-to-face.
- Both of the interviews were recorded and transcribed.
- Both interviews were summarized in a bulleted list with key points from the discussion and e-mailed to the interviewee in order for him/her to review the information.

The designs of the interviews are presented in appendix G: Basis for interviews with classification evaluators and appendix H: Basis for interviews with PSM:s. The interview questions are presented in appendix F.
4.5 Phase three: Analyzing and concluding

This section will describe how the *analyzing and concluding phase* has been structured.

4.5.1 Classification exercise and questionnaire

The outcome classification of the classification exercise, both the categorization itself and the follow-up questionnaire, were reviewed in order to draw conclusions from the material. All answers were compiled and printed in order to analyze the material according to the method content analysis (as described in section 3.2.3.1).

4.5.2 Interviews

All interviews were transcribed and printed on paper. Each interview were also summarized in a list and e-mailed out to the interviewee for a review. If a small correction of the interpretations was needed, these were noted on the printed copy of the interview in order to consider this in the analysis. Each interview was gone through in order to identify key findings in the content. Content analysis in an inductive way was used as a method in order to analyze the material. Key points were highlighted and notes were taken on the printed copies of the interviews in order to make a structure out of the content. The notes were later categorized in to themes in order to draw any conclusions from the gathered material.
Chapter 5

Results

In the results chapter, the results from the data collection and case study will be presented.

5.1 Results from categorization exercise

The results from the categorization exercise consisting of the classification of incidents into categories and the questionnaire are presented below.

5.1.1 Results from grading

The results from the questions included grading are presented in figure 5.1-5.4 on the following pages. Note that the y-axis differs from the tables and that the percentage of the bars are visualized inside each bar.

To summarize the results, the outcome was:

- Regarding the categorization of incidents, most of the participants experienced the exercise as quite easy. 80\% of the participants graded the categorization as a 3 or a 4 regarding how easy or hard they experienced the classification of incidents into pre-determined categories.

- Regarding how familiar the incidents felt, some of the participants didn’t feel that they were familiar compared to issues they have encountered in IFS Support.

- Most of the participants thought the categories were easy to understand.

- There were some of the categories that the participants experienced as a bit hard to understand, but all of the participants graded the categories
as a 3 or higher regarding how easy they experienced that they were to understand.

Figure 5.1: Grading of incidents

Figure 5.2: Grading of familiarity

Figure 5.3: Grading of categories
CHAPTER 5. RESULTS

5.1.2 Placement of incidents in categories

A placement matrix of the results are presented in appendix I. There are three matrices, one for the participants with experience from 2nd line of support, one for the participants from 3rd line support and one with all participants in the same matrix. Looking at the matrices, there is a similar pattern in both 2nd line of support-participants and 3rd line of support-participants. Among both 2nd line and 3rd line participants, 13 of the 15 incidents were placed in three or more different categories (including the options "None of the categories" and "I don’t know"). Among 2nd line support participants six of the incidents were placed in four or more categories and among 3rd line participants nine of the incidents were placed in four or more categories (including the options "None of the categories" and "I don’t know").

5.1.3 Indications from questionnaire feedback

Indications from the feedback in the follow-up questionnaire are presented below followed by the indication sources in form of quotations from the questionnaire.

Overlapping of categories

There were mainly two of the categories that the participants found hard to understand or differentiate from each other: category 3 (Error messages in the system are not providing enough information) and category 5 (Lack of feedback from system) according to comments from the participants.

"Some are easy, some others are kind of in a grey area and could arguably be classified as multiple categories"

"It was easy to find a suitable category. There were some items which I felt could be included in two categories, but the best possible category was chosen."
"The feedback from the system is usually an error message so I didn’t really see the difference between category 3 and 5”

"What is the difference between Lack of feedback and Error messages in the system are not providing enough information?"

"Only category 5 seems a bit confusing, other categories were easy to understand."

"Lack of feedback from system could be covering the error messages as well. Maybe we should be clear enough to distinguish the difference.”

"I don’t understand the difference of Lack of feedback from the system compared to Error messages in the system are not providing enough information.”

All incidents did not feel familiar for everyone
After grading how familiar the incidents felt compared to issues the participants have met when working in support, there were comments revealing that not all incidents felt too familiar from the participants’ perspective, even though there were participants that felt they were familiar.

"Some are familiar... others not.”

"Only a few items were familiar for me... too many were too technical.”

"Some of them did I recognize since the time when I worked in support.”

"Several of the issues were not familiar compared to issues I have met in Support cases.”

"I recognize many of the errors from working in support”

"I’m still quite new on the job, some of them I have encountered and some of them I have not.”

"Most are similar compared to issues I have met in support.”

More categories are applicable
There were two participants expressing that there could be more categories added to list.

"This is in my opinion not an exhaustive list of categories. I’d say more are applicable.”

"Another category could perhaps include tasks taking long time for the user.”
"I think we would need a category to catch errors like “this task takes unnecessary long time to do in the system”. I’m not mainly thinking of performance on database queries, but rather that you maybe need to go through unnecessary many number of clicks and/or many forms/steps to perform an action."

5.2 Results from follow-up interviews with classification exercise participants

Findings from the follow-up interviews performed with six of the classification evaluators are presented in below sections.

Guidelines regarding how to meet usability issues could be lacking

Regarding how IFS employees meet usability related support-cases and working with usability in general, there are indications that usability guidelines or directives cold be lacking.

"We don’t have any specific guidelines regarding how to meet usability issues in cases, compared to other issues."

"In our development methodology, our usability goals are communicated. There are also communicated in our role descriptions, if I look at my role description, there is information that I should think of the user experience when designing."

"I experience that usability-issues in support sometimes aren’t addressed properly. The customer gets a reply where we explain the intended functionality, how it is supposed to work, but it doesn’t happen anything afterwards. /.../ The customer gets an answer “it works like this”, but that is all."

A category structure is applicable

Several of the interviewees could see the benefits of using a category structure for usability issues.

"In our day to day work, a category structure could be possible to use. We already have categorization of support cases, this could be one of them when it comes to usability issues. I think this information later can be used when we plan for next strategy or next process changes or any kind of changes in the system."

"I think that a categorization structure could be a good subcategorization structure, that could be useful both in support and also for R&D I can imagine. /.../ Changes are hard to implement in larger organization though, so I believe that part could be a bit hard... but I think it could be useful."
"Since we are already following kind of a structure, I think this one could be used. I think it could be a good approach and that it is a good idea to proceed with this. /.../ We could identify problematic things or areas with a categorization, and we can use this to base our decisions on when taking decisions about modifications or new development for next releases. In order to identify what type of problems we have."

**A category structure could be hard to implement**

Some of the the interviewees thought that a category structure could be difficult to apply.

"I am thinking about who it is that should do this categorization? Is it something that the one who register the case should do...? Since many of the issues doesn’t get escalated to R&D, there would be a need to register it early I think. But who should do it? /../ Adding more work for someone is never popular, unless there is a clear purpose with it. /.../ If there is a clear purpose and explanation why it needs to be done, I think it is possible to get understanding for the categorization work."

"I think the current system works good from my point of view [the current classifications], but your system [the suggested categories] provides more information. I do think that your classifications could have a possible impact, if we were about to go through the issues later to see what the common errors are... But I do not see anything wrong with the current system. /.../ A new system would need so much change. /.../ The new classification system would add value for R&D... but not for the support centre, the current classifications are more suitable."

5.3 Results from interviews with PSM:s

Findings from the follow-up interviews performed with the two Product Solution Managers are presented in below sections.

**Information from categorized incidents could be valuable**

According to the interviewees, they indicated that information in the form of categorized incidents could be valuable information.

"All information that you can draw good conclusions from could be useful."

"To look at each issue individually would take a lot of resources, but if there was a way of grouping the issues in areas somehow..."

"I think it [user-feedback] would be good because we don't get enough of it today... enough feedback regarding how our users actually uses the system."

"It [the information] could be useful... but it is generally quite hard to get priority when it comes to this. /.../ It is often not just a local fix when it comes to an issue, it has to be fixed on several places in the application and it would often cost to much and give too little business value back. It is possible though that support cases could give us an indication. I would really liked to see that, if it could give us an indication, a measure of how many are experiencing the same issues... then I would have something supporting that it gives business value back."

"/.../ ...just to get the facts, that we actually have “1000 cases” where users found the error messages difficult to understand for example, that would raise an awareness. If we could get it in black and white, that “this is what gets reported from the customers”, then we could use this information when building our backlog."

**A categorization structure could be hard to apply**

A category structure could be difficult to perform according to one of the PSM:s.

"I think it [the categories] could be a good thing, but it might not be that easy to apply... /.../ It can be hard to differentiate when the usability is bad and when the user hasn't understood the functionality properly."

**Usability could be a fuzzy concept**

Usability could be a concept which could include many different things and the concept can be perceived as indistinct and unclear.

"We don’t have any strategic goals related to usability... /.../ I guess it could be hard if you want something quantifiable."
"We have had something about usability on the roadmap\textsuperscript{1} before... but it can be a rather fuzzy concept. /.../ If we have goals they must be specific.”

Possible consequences when not fixing usability related issues
One of the PSM:s expressed that one risk with giving feedback to 2nd line of support is that they might not lift the same issue again, since they know that R&D will not do anything about it.

“One thing... is that 2nd line (of support) might once have got an answer from R&D that “we’re not going to fix that, it is not a bug.” and after hearing this they won’t lift more of the same issue and we don’t get information if more are experiencing the issue...”

\textsuperscript{1}A roadmap is a presentation of business goals over time
Chapter 6

Discussion

The results and method will be discussed below and connected with theories from literature and the section will also include interpretations of the findings and an evaluation of the research quality assurance. A discussion of ethical aspects related to the thesis project concludes the discussion chapter.

6.1 Results

The results will be discussed and analyzed in below sections, starting with the outcome from the categorization exercise.

6.1.1 Categorization of support incidents

Many of the participants in the classification exercise didn’t feel that the incidents felt familiar compared to issues they have encountered from working in IFS Support. The experience in terms of time working in support could be one possible explanation of this, even though that is not the only explanation. There were participants with many years of experience which didn’t experience that they could relate to all of the incidents. One participant that didn’t feel that the incidents felt familiar expressed that many of the incident felt too technical. This indicates that the background of the participants in terms of educational background and experience with the concept usability might affect how they experience the categorization. The participants which had knowledge from usability from their education experienced that the categorization felt easier compared to those who hadn’t encountered the concept before working at IFS.
About half of the participants (53.4%) experienced the categorization as easy to perform by grading the experience as a 4 or 5 in the questionnaire when asked to make a grading how they experienced it. The placement of the incidents in categories were however spread. As stated in the result section, 13 of the 15 incidents were placed in three or more different categories by the participants. The overlapping of categories could be one explanation or that the categories need a more detailed explanation. The ones performing the categorizing might also need more instructions or training before conducting the categorization. Regardless of what caused the spread of placement among the incidents, it is clear that the categorization was not intuitive and the output in terms of where to categorize the incidents differed depending on who made the categorization.

Many of the participants expressed that category 3 (Error messages in the system are not providing enough information) and category 5 (Lack of feedback from system) were hard to understand. According to comments from the participants, they didn’t understand what "Lack of information from system" included and expressed that the feedback the system is providing is error messages. As described in table 4.1, "Lack of feedback from system" were derived from heuristic 1 from Nielsen and Mack (1994):

- **Visibility of system status** - the system status should give the user information regarding what's going on.

and principle 3 from Shneiderman and Plaisant (2010):

- **Offer informative feedback** - the interface should provide suitable feedback of the users' interactions.

and principle 8 from Weinschenk and Barker as cited in Sauro (2011):

- **Predictability** - the interface will inform users about results of their actions and also about the status of the interface.

and ERP usability issue 2 as described by Topi et al. (2005):

- **Lack of clarity in feedback and information from system**

Since an error message can be seen as information or feedback from the system as well, there might be an idea to merge these two categories into one category instead. The feedback from the participants in the exercise indicates that it can be a good idea to improve the categorizations in order to avoid ambiguity.

There are also indications that more categories are applicable according to comments from participants. One suggested category is "A task is taking unnecessary long time to do in the system". This new category could be connected to heuristic 7 by Nielsen and Mack (1994):

- **Flexibility and efficiency of use** - the design should support a flexible use of the system, frequent actions should be easy to perform.

Since the categories are based on findings from support case data, the categories reflects their content. Going through a larger amount of support case data would
likely result in a wider amount of different issues. Regarding the addition of
more categories, there are both possible positive and possible negative outcomes
related to this. The more categories added, the more time and effort will it be
required from the one performing the categorization. However it is not desirable
to have too few categories either, there can’t be too much variety in the issues
in a certain category since this will make it hard to use the collected data and
draw any reasonable conclusions from them. If each category includes too big
variety of problems, there can be difficulties deciding what to prioritize when
making usability improvements for future releases.

6.1.2 Applicability of categorization structure

An introduction of a category structure of support case data related to usability
means that someone has to make the categorization in order to be able to utilize
the information. Since IFS already have a categorization structure, it could be
possible to add a subcategory when it comes to usability related issues. This will
add usability categorization responsibility for the employees working in support,
if they are the ones to perform the categorization. Since the result from the
placement of incidents in the categorization exercise were spread, there is a risk
that the outcome of the classification of usability issues would be inconsistent
regarding what category of usability issue the support case is related to.

Who is it that should be responsible for making this categorization is a
question that was raised from several of the interviewees. In order to get
understanding why the extra work needs to be done, one interviewee suggested
that that the purpose of the extra work should be clearly communicated as
well as the benefits it might bring. It is IFS R&D which decides what
enhancements to be implemented in future releases, but IFS Support also has
possible positive impacts as a result from the categorization. If IFS R&D take
actions to make usability improvements, an outcome from this might be less
incoming support cases related to usability. Decreased support costs (as a
result of fewer support cases coming in) is brought up by Mayhew (1999) as a
benefit that can be achieved when improving usability.

The interviewees could see the benefits from adding a category structure if using
the data to make future enhancements in IFS Applications, if it is used to map
common issues experienced by the users.

6.1.3 Value in support case data related to usability

As it is today when 2nd support line escalates a usability issue to 3rd line
and gets the answer “this is not a bug, it is a future enhancement”, a possible
consequence is that 2nd line of support won’t raise the same or similar issue to
3rd line again since they know that 3rd line won’t fix the issue. As a result of
this, it can be difficult for 3rd line to determine the frequency of an issue. When
it comes to severity assessment of usability issues, methods by Nielsen and Mack (1994); Rubin and Chisness (2008) and Akers et al. (2009) suggest determining the severity by looking at the impact in combination with the frequency of occurrence. In order to determine whether an issue is severe or not, looking at the frequency of occurrence is an important factor.

The PSM:s expressed that information related to how the users of IFS Applications uses the system in real life is information they don’t get enough of today.

One of the PSM:s also expresses that usability enhancements could have a hard time getting priority when deciding what to be implemented in future releases when set against other areas of improvement. The business value that a usability fix gives back could be hard to measure, but if they could have the facts in actual numbers, how many that actually are affected by an issue, they could justify a usability fix by showing numbers on how many would benefit from the improvement. In order to do so, they would need facts and figures telling the frequency of an issue. The severity assessment methods by Akers et al. (2009) and Rubin and Chisness (2008) suggests having the frequency of occurrence as a factor when performing severity rankings of issues. The occurrence could be based on statistics from collecting information in support cases.

When comparing the outcome from going through support cases with the five benefits from usability testing as brought up in theory section 2.7.2, the conclusions are:

1. **Possibility to investigate whether the users are able to complete given tasks** - When performing usability tests, the participants are often given a task to perform. When dealing with the support cases, the reported issues are issues that the user has met when performing actual task. If the user encounters difficulties or inefficiencies with their day to day tasks, this is something that could give valuable information when deciding which improvements to be done for upcoming releases.

2. **Examine how long it takes for the users to complete given task** - since the users are not observed when performing their tasks, this suggested benefit could be hard to get from analyzing support case data. Though, it is possible to get information related to inefficiencies, since one issue that employees with experience from support expressed were common among the users are that users find their tasks taking unnecessarily long time to perform in the system.

3. **Evaluate the users’ satisfaction of the product or system** - analyzing support cases in retrospect is a one way communication channel. Marking incoming support cases related to usability as "usability-related" is making it possible to measure if the amount of usability related support cases are increasing or decreasing. A decreasing amount of usability related support issues could be an indicator that the user satisfaction with the product are increasing.
4. Identify which changes are required to improve the user experience - When collecting, categorizing and analyzing the incoming support cases, it is possible to identify the areas where most users are experiencing usability-related issues.

5. Examine whether the system performance meet the usability objectives - Comparing the retrieved data with the usability goals and objectives, it is possible to investigate whether these are met or not, given that the goals are measurable. A suggested goal could be that "The company should deal with X% of the incoming usability-related support cases", for example.

With the above points as motive, there are reason to consider the output from analyzing usability related support case data as comparable to the outputs and benefits from performing usability tests.

6.1.4 The definition of usability

Looking at the definitions of usability in literature by Nielsen and Mack (1994), Weinschenk and Barker (2000) (as cited in Sauro (2011) and Shneiderman and Plaisant (2010), they differ. From the results from the interviews with the PSM:s, there are indications that usability is a concept which can be hard to quantify and set measurable goals related to.

6.2 Method

The method and approach for the study will be discussed and analysed in below sections.

6.2.1 Support cases as a data source

The categories were based on data collected from closed support cases. The support cases were not written with the intention to be used in the purpose for this master thesis, which can be seen as a limiting factor. There were no possibility to investigate each closed support case further in order to gain more information than the information provided in each case. The analyzed support cases included issues from all product groups at IFS, it is possible that there could have been another outcome if looking specifically at support cases for one product group. The reason for analyzing cases from all product groups was to get a generalizable answer to the first research question with an aim to achieve a result applicable for other companies. The risk of looking at just one of the IFS product groups were considered to be the risk of not achieving a generalizable result.
There is a possibility that usability related issues can "hide" within other cases than those closed under the closing category "training", but within this scope only the training category has been explored due to the time limitation.

Going through the support case data, it is also a possibility that usability issues have been overlooked or that the support case have been misunderstood due to the limited experiences of IFS Application. The purpose of going through the support case data were to gain understanding in what the users perceives as problematic and this were considered possible to do without having expertise in the system. However, there is a risk of misunderstandings or misinterpretations which should not be denied.

6.2.2 Closed card sorting

Card sorting were used in this study in order to evaluate the category structure. Card sorting is not intended to be used in the purpose as in this thesis project. Since the goal with card sorting is to investigate where information is logically to be found according to a person (Tullis and Albert, 2013), it was considered to be applicable and suitable for testing the category structure as well.

Closed card sorting (with pre-determined categories) was chosen instead of open card sorting (where the participant get to create own categories and place the incidents in) because the open card sorting requires a lot of time, effort and usability-knowledge from the participants. Another reason is that there are well-known established usability categories, heuristics and principles which are derived from large amounts of data. For example, the heuristics by Nielsen and Mack (1994), the principles by Rubin and Chisness (2008), the principles by Weinschenk and Barker (2000) as cited in Sauro (2011) and the golden rules by Shneiderman and Plaisant (2010).

6.2.3 Data collection

The interviews were semi-structured, and the basis for the interviews are presented in appendix G and H. The interview questions presented in appendix F were used as starting points for the interviews. 4 (out of 8) interviews were performed in English which is not the native language for the interviewee nor the interviewer. Most of the support cases are also written in English by non-native English speakers. Quotes from the interviews in Swedish have been translated to English in order to present them in the thesis report. The language barrier can be seen as a factor that potentially has affected the interpretation of information.

The number of participants in the classification exercise and the questionnaire were 15 IFS employees of which six were interviewed afterwards. Two PSM:s were also interviewed in addition to this. This were considered to be a reasonable
amount related to the size and the time limit for this thesis project, even though
more participants would have given a bigger amount of data to draw conclusions
from. The transcription of the interviews were time consuming but considered
important in order to be able to perform content analysis of the material. The
content analysis made it possible to group findings from the questionnaires and
the interviews to use as a basis for the drawn conclusions.

Regarding the selection of participants in the data collection activities, the
participants were recommended to contact by their managers based on which
were available according to their current workload.

6.3 Research quality assurance

In order to ensure a high quality study, construct validity, external validity
and reliability are evaluated. Internal validity is not addressed since this is not
necessary in explorative studies, as brought up in the method theory chapter.

6.3.1 Construct validity

Multiple sources of evidence has been used in order to achieve construct validity.
To prepare the participants they got an introduction mail where the purpose of
the study were presented as well as information about the different parts of the
questionnaire. A similar letter were sent out before the PSM interviews.

Data has been collected from several employees in different forms (questionnaire
and interviews). Within a week after the conduction of an interview, each
interviewee got e-mailed a list with key points from the conversation in order
to minimize the risk for misinterpretations and errors. Six out of the nine
interviewees responded to the e-mail, where two had small correction regarding
the interpretations of the information in the interviews.

6.3.2 External validity

In order for the case study results and findings to be possible for others to apply,
the case study questions (as stated in section 4.3.1) are stated with a purpose
to answer questions in terms of "why". The case study question were seeking
to explore if the classification structure were relevant and intuitive, and what it
would need to become applicable in the organization.

6.3.3 Reliability

The case study plan as stated in the beginning of the chapter helped keeping a
structured plan during the process. Another researcher could follow the steps
described in the case study chapter and follow in the procedures in order to perform the study again. The exact same result cannot be guaranteed since the findings have been interpreted by one researcher and that have likely influenced the outcome.

6.4 Ethical aspects

With respect to ethical aspects when presenting collected data, age span has been set to not single out participants in the study. The quotes that are presented in this report are also not possible to trace back to the informant.

The interviews were audio recorded with permission from the interviewee before starting the interview and the participants were also informed about the careful handling of the collected data. Each participant also received an e-mail with a bulleted list after the interview with key findings from the conversation, with a possibility to review and correct any misinterpretations from the interviewer. None of the collected data has been accessed by any one else other than the thesis study performer.
Chapter 7

Conclusions

The two initial research questions will be connected with the results in this section in order to conclude the result and address the purpose of this thesis project. The conclusions related to improvements of the categorization structure are also presented afterwards in this section followed by recommendations for IFS. Suggestions for further work will conclude this chapter.

7.1 Conclusions

The thesis research questions stated in section 1.3 are addressed below.

7.1.1 Research question 1: classification

How can a company classify an incoming support case as a UX-related issue?

By having usability related issues in support cases categorized, there is a way to collect the issues under categories. The category structure used in the classification exercise in this thesis study needs improvements in order to be applicable, to avoid overlapping categories and ambiguity in the structure. The suggested improvements are presented in section 7.1.3 below. There might also be a need of training of the employees that will perform the category structure since the employees could be having different knowledge about usability as a concept. The employees in this study which had less knowledge from university studies about usability, experienced the categorization harder to perform compared to those with previous experience about usability. The spread of the placement of incidents in the categories needs to be reduced in order for the categorization framework to be effective. There is also a need to
give clear examples related to the categories and to explain the categories clearly.

7.1.2 Research question 2: value in information

How can this kind of post-deployment usability information be utilized in future product releases? Is it possible to get useful insight regarding users’ product usage in the real world by looking at UX-support case data?

Since support cases related to usability issues are containing information about how the users are interacting with the system, a conclusion is that support case data could be seen as a source of usability feedback. The information from usability-related support case data is compared with benefits from usability testing in section 6.1.3 justifying this. In order to determine whether a problem is common among the users, there is a need to get the frequency of an issue in facts and figures. Collecting information from support case data related to what kind of issue is occurring and how often it occurs could provide a company with valuable information when creating and prioritizing a product backlog. If having the affected users in numbers, this is a way to motivate a fix by showing estimated business value (in terms of number of users it will affect) contra the cost for the fix. It is possible to get useful insight from the information in support case data but there might also be obstacles regarding the implementation of a classification structure as a means to retrieve the information, due to the change process needed.

7.1.3 Improvements of categorization structure

As a result from the case study, category 3 (Error messages in the system are not providing enough information) and category 5 (Lack of feedback from the system) are merged into one category called “Lack of feedback from system”. This is to avoid ambiguity in the categories. There were also comments from the classification participants that feedback from the system most often are an error message, this is also justifying the merging of the categories.

Category 4, “Lack of information in documentation”, has been renamed to “Lack of information or inadequate information in manuals or documentations” to further explain what is intended.

An additional category is added: “A task takes unnecessary long time to perform in the system”.

The modified categories in its entirety are presented below:
1. **Hard to understand system limitations**
   - when a user wants to perform a task but are not sure whether the task is supported or even possible to do in the system due to technical or functional limitations.

2. **Difficulties finding settings in the system**
   - when users want to modify settings but can’t figure out how to manage it.

3. **Lack of information or inadequate information in manuals or documentation**
   - when users seeks for information i documentation but can’t find information related to what he/she expects to find.

4. **Lack of feedback from system**
   - error messages in the system are not providing enough information for the user. The error messages that don’t give them information regarding how they can overcome a problem or contains a language that is not familiar for the user.
   - a user can’t complete a task but doesn’t get any information from the system why this is not possible or if a user does not realize where they are in a process of performing a task (due to lack of information).

5. **A task takes unnecessary long time to perform in the system**
   - when a user must go through many steps in order to complete a task, which is time consuming.

### 7.2 Recommendations for IFS

The PSM:s expressed that usability as a concept could be a bit unclear, and therefore hard to work towards strategic goals related to usability. Looking at the definitions in theory of usability, the definitions varies depending on which definition that is studied. As concluded in the theory section, usability are related to a quality measure of how a user experience an interface or a system. In order to make usability more feasible it might be an idea for a company wanting to have a usability focus to define what usability mean to them in their own measures. Before introducing a category structure as a means to collect usability improvements, IFS is hence suggested to define usability goals in order to give incentives to the employees to do the needed extra work related to the data collection.

Improvement of the category structure has been made, however it might need another round of testing in order to further improve it. In order for it to be
applicable and useful, the support employees which will be using the categorization framework might also need training related to the concept of usability, and the goal with the framework also needs to be communicated in order to gain understanding among the employees.

Having too many categories could be time consuming for the employees performing the categorization but if needed, it is suggested that more categories are added as more cases are gone through. If a usability issue doesn't fit in to the categorization, it could be placed in a category called "Other usability-issues" in order to collect them and from that collection add appropriate categories to the category structure when needed.

Marking support cases related to usability with the information "this is a usability-related issue" could make it possible for IFS to get statistics regarding how many usability related support cases are being reported. In order to later evaluate how many of these are being corrected or taken care of, a marking will make it possible to see how many percent of the usability cases are being handled. This suggestions is also applicable for other companies as well, to get the facts in numbers and figures in order to gain understanding related to how many incoming support issues that actually are usability related.

In summary, the suggestions for IFS are:

- Define what usability means for them in order to get a shared picture of what usability actually is and implies.
- State measurable goals related to usability. Goals are needed to give incentives related to having a usability-focus. When the goals are measurable, they are also feasible.
- Clarify the link between usability and business value in order to justify resources being spent on usability. The business value of usability improvements needs to be established.
- Introduce the classification framework in support together with instructions how and why it is used. It is important that the goal with the extra work are communicated thoroughly.
- Go through the categorized material and evaluate the information it provides.

The categorization framework is suggested to be applied in one of the product groups to start with in order to develop and evaluate the method further before applying in a larger extent at IFS. It can also be sufficient to start the process by looking at one of the support lines as well (for example 3rd line support), before including all lines of support. Looking at a long term perspective, it is desirable and necessary to include all lines of support in order to get a proper insight in the users interactions with IFS Applications. If not including all lines of support, there is a risk of information going missing along the way.
It is concluded that IFS Support will receive valuable information regarding how the end-users are interacting with IFS Application, and that this information could be used to justify and motivate the business value in usability fixes since the support case data will give information about how frequent a certain problem is occurring and the amount of affected users.

When prioritizing what to spend resources on, a mapping of usability issues and their frequency can serve as a basis when estimating business value and the actual return the investment will bring.

7.3 Suggestions for further research

Since the area of gaining user insight from support cases is rather unexplored from a research perspective, it would be interesting to see a similar study performed. Both to explore the generalizability of this thesis study and also to compare the outcome and results. Another interesting angle could be the introduction of a classification framework in a current process in order to test it and evaluate it in a real-life situation.
Bibliography


Appendix A

Content in categorization exercise

A.1 Incidents to categorize

1. A user wants to complete a project, but gets an error message when trying to do so. The user doesn’t know how to continue in order to resolve the issue.

2. A user is trying to perform a task and is having trouble to realize if the system supports the task or if it’s not possible to perform the task in the system.

3. A user wants to modify layout settings in a report but the system doesn’t behave as expected. The user cannot understand if she is doing something wrong or why the layout modifications doesn’t apply to the report.

4. A user wants to generate a file in offline-mode. The file doesn’t appear properly in the preview and the user doesn’t understand why.

5. A user changes a field manually and gets unexpected consequences in other areas as a result from this.

6. A user want to change settings related to an event action but can’t figure out how to make this happen.

7. A user gets an error message when trying to complete an installation, saying that the installation couldn’t be completed. The user isn’t sure what to do to resolve the issue and complete the installation.

8. A user is experiencing problems when making changes in a text. The user suspects that there might be a limitation of characters in the text field.
but is not sure.

9. A user cannot see jpg-images when previewing a report and can not understand why this is not possible.

10. A user wants to modify the layout in a report, but the modifications are not appearing in the preview and the user doesn’t understand why this is now showing.

11. A user wants to change settings by checking a checkbox but are not sure whether the checking implies a global or local change of the settings.

12. A user is unable to upload a voucher to the system but can’t figure out what the problem is according to the error message that is provided.

13. A user logs on to the system and the view has been changed. The user tries to find where the layout view can be changed to normal but can’t find this.

14. A user wants to complete a task involving the creation of an invoice. The user cannot complete the task and doesn’t understand why this can’t be done.

15. A user cannot open a link to a website and suspects that this is caused by the fact that the web browser of choice is not supported. The user can’t find any information regarding this.

Note: "A user" refers to a user of IFS Application.

A.2 Categories

1. Hard to understand system limitations
2. Difficulties finding settings in the system
3. Error messages are not providing enough information
4. Lack of information in documentation
5. Lack of feedback from system
Appendix B

Introduction mail

Hi,

My name is Emelie Oskarsson, I am doing my master thesis project right now in collaboration with IFS Projects R&D in Linköping. I am a 5th year student at the Master of Science in Engineering program within Information Technology at Linköping University. My master thesis subject is related to how IFS R&D can utilize information from support cases in order to use this when further developing and improving IFS Application.

As a part of my thesis project I have created a category structure regarding issues found in support cases. I need IFS employees to try this category structure in order to evaluate and improve it. To do this, I have used a web based service to visualize a category exercise with some following questions afterwards. The study is divided into three parts:

1. Two short background questions
2. An exercise where you get to categorize 15 items into different groups
3. A questionnaire where you get to answer eight questions related to the categorization

These three steps are estimated to take maximum 30 minutes of your time and any information you share will be treated anonymously in my master thesis report.

If you have any questions before you begin with the study or if any questions arises during it, please feel free to contact me at emelie.oskarsson@ifsworld.com or send me a message at Lync.

The study is available here: <link>

A comment regarding the study: do not press the return button in the browser after completing a step. If you do, unfortunately you need to redo that step.
Thank you for your participation!

Best regards, Emelie
Appendix C

Classification study

C.1 Welcome text

Welcome

Welcome to this study which is a part of my master thesis work, and thank you for agreeing to participate!

• This activity shouldn’t take longer than 30 minutes for you to complete.
• You will start by answering two questions related to your background as an employee at IFS. After this you will get to the categorization, where you are asked to categorize 15 items into six categories. After the categorization is done, you will get to answer some questions related to the categorization.
• If you are experiencing any trouble with this web service or have any questions regarding anything related to this study, please feel free to contact me at any time at emelie.oskarsson@ifsworld.com.
• NOTE: after proceeding to the next steps in this exercise, do not press the return button in the browser. If you do, unfortunately you need to redo that step.

Regards, Emelie Oskarsson
C.2 Instructions

Instructions for exercise

- To the left you have a list of 15 items. These are descriptions of support case incidents.
- I’d like you to sort these items into the categories provided on the right. You can put several items into each category.
- If you think that an item fits into several categories, just put it in one of them that you find suitable.
- If you need a further description of a category, just hold the mouse cursor over it and it will appear.
- There is no right or wrong answer, just do what comes naturally.
- NOTE: after proceeding to the next step, do not press the return button in the browser. If you do, unfortunately you need to redo that step.

If you are experiencing any trouble with this web service or have any questions regarding anything related to this study, please feel free to contact me at any time at emelie.oskarsson@ifsworld.com.
C.3 Classification exercise
Appendix D

Classification questionnaire

D.1 Questions before the classification step in the questionnaire:

1. What is your job title?
2. How long have you been working at IFS?

D.2 Questions after the classification step in the questionnaire:

1. How did you experience this categorisation?
   • 5 (easy to perform)
   • 4
   • 3
   • 2
   • 1 (hard to perform)

2. If you want to make a comment regarding your response above, please do it here:

3. Did the items to the left feel familiar compared to issues that you have met in IFS Support cases?
   • 5 (very familiar)
   • 4
• 3
• 2
• 1 (not familiar at all)

4. Can you please motivate your answer shortly?

5. How did you experience the categories to the right?
   • 5 (easy to understand)
   • 4
   • 3
   • 2
   • 1 (hard to understand)

6. If you thought any of the categories were hard to understand, please mark the category/categories below:
   • Category 1: Hard to understand system limitations
   • Category 2: Difficulties finding settings in the system
   • Category 3: Error messages in the system are not providing enough information
   • Category 4: Lack of information in documentation
   • Category 5: Lack of feedback from system

7. If you want to comment the categories, please to it here:

8. If you have any additional comments, please leave them here:
Appendix E

Purpose with the categorization and related data collection

E.1 Creating of usability categories

• To show that there exist usability-related issues in support cases
• To show which types of usability-related issues that exists.

E.2 Testing of the category structure

• To test and evaluate the logic in the structure
• To test and evaluate the relevance in the categories
• To test and evaluate the realistic nature of the incidents, if they are possible to relate to

E.3 Interviewing study participants

• To get qualitative input on the results from the categorization study
• To investigate the realistic nature of the categories and incidents deeper
• To discuss the outcome of the categorization study
APPENDIX E. PURPOSE WITH THE CATEGORIZATION AND RELATED DATA COLLECTION

- To discuss the applicability of a category structure

E.4 Interviewing employees with product responsibility

- Investigate the value of the information from a product perspective
- Get insight in their way of working with requirements
- To discuss the applicability of a category structure
Appendix F

Interview questions

F.1 Follow-up interviews with classification study participants

Background questions of the interviewee
1. How long have you been working at IFS?
2. How long have you been working at your current position?
3. Can you explain what your role involves?
   (a) What are your daily tasks, responsibilities and main objectives?
4. Are you familiar with the term “usability”?
   (a) Can you tell me more about this?
   (b) Where have you met it? In which context?

Questions related to the interviewees experience from working in support
1. Can you remember if you have gotten any training or education from IFS that addressed usability?
   (a) For example, how to address usability related issues?
   (b) Can you tell me more about this?
2. How do you experience that usability issues are handled in support today?
   (a) What is the normal procedure?
(b) Do you have any guidelines regarding how to meet or handle usability related issues in support?

3. If you encounter a problem that could be usability related, for example some of the incidents that I had in the classification exercise, how would you handle them?
   (a) For example if a user can’t find settings in the application, the user can’t complete a project or doesn’t understand an error message?

4. In your experience, do you often give training related to usability issues with customers?
   (a) In order for them to learn/understand application functionality?

5. From your experience, what are common usability issues that you meet?

Questions related to the classification exercise

1. Questions related to the interviewees’ responds in the questionnaire, for example:
   (a) You expressed in the questionnaire that you felt that the incidents were familiar from your work in support, can you tell me more about this?
   (b) You expressed in the questionnaire that you felt that some of the categories were a bit overlapping, can you tell me more about this?

2. Let’s say that a classification structure similar to the one that were presented in the classification exercise should be used in IFS Support, what do you think would happen?
   (a) Why do you think this would happen?
   (b) What would this mean for the IFS employees working in Support?

3. Do you think it would be useful/give value for IFS?
   (a) Why/why not?
   (b) What do you think would be needed for it to be applicable?

4. Do you have any other ideas or thoughts related to usability issues that we haven’t discussed or any other comments?
F.2 Interviews with employees with product responsibility

Background questions
1. You work as a Product Solution Manager, for how long have you had that role?
2. How long have you been working at IFS?
3. Can you explain for me what your role as a Product Solution Manager involves?
   (a) What are your daily tasks, responsibilities and main objectives?

Requirement management for future releases
1. How do you gather requirements for future releases of IFS Applications?
2. How are the prioritization of requirements done?
3. How do you use (if you use) the IFS Idea Wall?
4. Do you work towards/collaborate with support in the requirement gathering?
   (a) Why not?/Can you tell me more about this?

Usability-related requirements
1. Are you familiar with the term usability?
   (a) Where have you met it?
   (b) In which context outside IFS?
   (c) In which context at IFS?
2. Does usability has earmarked budget in projects?
3. Regarding the product, where does your usability insight come from?
   (a) Why do you use these sources?
4. Do you know if IFS has strategic goals related to usability?
5. How does usability-related requirements get prioritized?
   (a) How do you choose what should be done in the next release?
   (b) How do you determine if an issue is a common/spread problem?
   (c) How do you keep track of common issues?
Usability categorization structure

Before asking questions, the category structure were presented for the interviewee.

1. If you would get information like this, what would it mean for you?
2. Could this information be valuable/usable for you?
   (a) Why?
   (b) Why not? What would be needed in order for it to be usable for you?
3. How would you proceed with this information?
Appendix G

Basis for interviews with classification evaluators

1. Present the purpose with the interview
2. Present the content of the interview
   (a) Background questions of the interviewee
   (b) Questions related to the interviewee’s experience from working in IFS support
   (c) Questions related to the classification exercise
3. Ask for permission to record the interview and inform about how the material will be used, handled and presented
4. Answer any questions that the interviewee might have
5. Begin and perform interview
6. Finish the interview and inform that a summary of key points from the interview will be e-mailed out for the interviewee to review
Appendix H

Basis for interviews with PSM:s

1. Present the purpose with the interview
2. Present the content of the interview
   (a) Background questions of the interviewee
   (b) Questions related to requirements management for future releases
   (c) Questions related to usability-related requirements
   (d) Questions related to a usability categorization structure
3. Ask for permission to record the interview and inform about how the material will be used, handled and presented
4. Answer any questions that the interviewee might have
5. Begin and perform interview
6. Finish the interview and Inform that a summary of key points from the interview will be e-mailed out for the interviewee to review.
Appendix I

Placement matrices

I.1 Classification exercise

The tables below visualizes the results of the placement of incidents into categories. The 15 incidents are presented in the left column and the categories in the first row. The options "None of the categories" and "I don’t know" are also included.

I.1.1 2nd line participants

<table>
<thead>
<tr>
<th>Incidents (below)</th>
<th>Category 1</th>
<th>Category 2</th>
<th>Category 3</th>
<th>Category 4</th>
<th>Category 5</th>
<th>None</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From 2nd line, there were 7 participants.
I.1.2 3rd line participants

<table>
<thead>
<tr>
<th>Incidents (below)</th>
<th>Category 1</th>
<th>Category 2</th>
<th>Category 3</th>
<th>Category 4</th>
<th>Category 5</th>
<th>None</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
<td>1</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>3</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>1</td>
<td>4</td>
<td>2</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>1</td>
<td>6</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>2</td>
<td>1</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

From 3rd line, there were 8 participants.

I.1.3 Both 2nd and 3rd line participants

<table>
<thead>
<tr>
<th>Incidents (below)</th>
<th>Category 1</th>
<th>Category 2</th>
<th>Category 3</th>
<th>Category 4</th>
<th>Category 5</th>
<th>None</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td>12</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td></td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
<td></td>
<td>2</td>
<td>5</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>9</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>7</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>6</td>
<td></td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>2</td>
<td></td>
<td>11</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

The total amount of participants from 2nd and 3rd line of support were 15.
Upphovsrätt

Detta dokument hålls tillgängligt på Internet – eller dess framtida ersättare – under en längre tid från publiceringsdatum under förutsättning att inga extra-ordinära omständigheter uppstår.

Tillgång till dokumentet innebär tillstånd för var och en att läsa, ladda ner, skriva ut enstaka kopior för enskilt bruk och att använda det oförändrat för ickekommersiell forskning och för undervisning. Överföring av upphovsrätten vid en senare tidpunkt kan inte upphäva detta tillstånd. All annan användning av dokumentet kräver upphovsmannens medgivande. För att garantera äktheten, säkerheten och tillgängligheten finns det lösningar av teknisk och administrativ art.

Upphovsmannens ideella rätt innefattar rätt att bli nämnd som upphovsman i den omfattning som god sed kräver vid användning av dokumentet på ovan beskrivna sätt samt skydd mot att dokumentet ändras eller presenteras i sådan form eller i sådant sammanhang som är kränkande för upphovsmannens litterära eller konstnärliga anserande eller egenart.

För ytterligare information om Linköping University Electronic Press se förlagets hemsida http://www.ep.liu.se/

Copyright

The publishers will keep this document online on the Internet – or its possible replacement – for a considerable time from the date of publication barring exceptional circumstances.

The online availability of the document implies a permanent permission for anyone to read, to download, to print out single copies for your own use and to use it unchanged for any non-commercial research and educational purpose. Subsequent transfers of copyright cannot revoke this permission. All other uses of the document are conditional on the consent of the copyright owner. The publisher has taken technical and administrative measures to assure authenticity, security and accessibility.

According to intellectual property law the author has the right to be mentioned when his/her work is accessed as described above and to be protected against infringement.

For additional information about the Linköping University Electronic Press and its procedures for publication and for assurance of document integrity, please refer to its WWW home page: http://www.ep.liu.se/

©Emelie Oskarsson