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UNIVERSITY of OULU

# **Users' Experiences of Changes in University Level Print Services**

University of Oulu  
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Science  
Master's Thesis  
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## Abstract

The aim of this research was to examine how the personnel of the University of Oulu experienced a change in print services. The print services managed by the university were replaced with print services provided by an external service provider. The management of the university was interested to find out how satisfied the employees were with the new services, so a master's thesis topic for studying the experiences of the personnel was announced. The service provider, Canon, was interested in the results of the research, too.

Data for the study was collected with a user satisfaction questionnaire that was sent to the personnel in February 2015. The survey consisted of open ended and closed-ended questions. The research was a qualitative case study and the emphasis was on qualitative analysis of the open ended questions. The data collected from the closed questions was analysed quantitatively.

The findings of the study revealed that the users were quite satisfied with the new print services, and that some of the new features were highly appreciated. However, a few relatively clear areas of dissatisfaction existed, too.

This research contributed to science by adding knowledge about managed print services, and on a more detailed level, about how personnel of a university experienced a change from print services managed by the university to print services provided by an outside service provider. Also, a possible positive relationship between implementing a managed print services solution and user satisfaction was found. On a practical level the findings provided helpful information for the university and the service provider for improving the new print services. Also, this study contributed to the research of information systems success, user resistance and user satisfaction in the context of managed print services.

### *Keywords*

Managed print services, user resistance, user satisfaction, IS success, case study

### *Supervisor*

Adjunct Professor, University Lecturer Raija Halonen

## Foreword

I would like to thank my supervisor Raija Halonen for her support and guidance, my opponent Tero Vartiainen for his feedback, CIO of IT Administration Kari Keinänen for his comments, Canon Oy for being a part of my thesis, and also everybody else at the University of Oulu who helped me at some point. Last but not least, I would like to express my gratitude for my family for their support and encouragement; thank you for bearing with me.

*Begin at the beginning and go on till you come to the end: then stop.*

- Lewis Carroll

Kaisu Hekkala

Oulu, May 6, 2015

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# 1. Introduction

In this chapter the following research is presented briefly. The covered topics are purpose of the study and motivation, prior research, research question and methods, and the contribution of the research. Finally, the structure of the thesis will be presented also.

## 1.1 Purpose of the study

New university level print services were implemented at the University of Oulu in 2014 replacing the old services. Therefore the IT administration of the university and the service provider were interested to find out what the users thought about the new services. Hence, the aim of this research was to examine how the users, in this case the personnel of the University of Oulu, experienced the change in the print services.

## 1.2 Motivation

The assignment and the topic of the thesis came from the university of Oulu. The implementation of new print services was a significant change and there was a need for a Master's Thesis made about the effects of the change to user satisfaction. Personal motivation arose from the will to execute a research and write a thesis about something that would truly be of benefit somehow to someone. Also, the topic was interesting due to the fact that managed print services is a current and global issue.

## 1.3 Prior research

Information systems can be used in organisations to improve performance (Joshi, 2005). Implementation of managed print services can lead to reduced costs and simplified document management processes in organisations (Handley, Schneider, Ciriza, & Earl, 2010). At the University of Oulu cost savings and increasing the performance of printing were motivating factors behind the change in the print service. However, measuring the success of new information system is important so that the value the implemented system creates can be assessed and understood (Gorla & Somers, 2014). Therefore a user satisfaction survey was conducted at the university to find out how the users of the print service experienced the new system and the change.

User satisfaction is one of the most often used measures of information systems success. If the users use the new system it can be a proof of satisfied users but it is not always so. (Bokhari, 2005.) In the case of university level print services the users have no choice but to use the system if they want to print at the premises, so use may not mean the users are satisfied. Therefore a survey was used at the University of Oulu to find out the opinions of the users. Users are often quite direct when commenting the information systems they use (Bokhari, 2005) so a questionnaire is a good means to collect data in such cases.

One of the main reasons for unsuccessful implementation of an information system is user resistance (Jiang, Muhanna, & Klein, 2000; Kim & Kankanhalli, 2009; Markus,

1983). For resistance to occur users have to perceive some kind of a threat. The perceived threat can be for example implementation of new information technology. (Lapointe & Rivard, 2005.) The implementation of the new managed print services was a potential threat for the employees of the University of Oulu so therefore also the presence of user resistance was plausible. Resistance at its worst can lead to users attacking the new system (Hirschheim & Newman, 1988) but with a suitable strategy resistance can be alleviated (Jiang et al., 2000).

## 1.4 Research question

The research question of this study was:

*How have the users experienced the change in the print services?*

The users were the employees of the University of Oulu. The print services before the change were managed by the university. After the change Managed Print Services solution by the service provider Canon was implemented. The solution included all printing related functions at the university.

## 1.5 Research methods

The empirical part of this study consisted of a user satisfaction survey that was held for the personnel of the University of Oulu in February 2015. The research was a qualitative case study but the data collected in the survey enabled also quantitative data analysis. The emphasis was, however, on the qualitative analysis of the open ended questions.

Literature review was done based on information searched from many electronic databases such as ACM Digital Library, EBSCOhost, Google scholar, IEEE Xplore Digital Library, and ScienceDirect. Keywords such as print management, printer, academic, campus, information systems success, user satisfaction, user resistance, and several kinds of combinations were used.

## 1.6 Contribution

Managed print services are a growing business around the world today (Handley et al., 2010), but scientific research of the issue so far has been scarce. This research adds knowledge about managed print services, and more specifically about how personnel of a university experienced a change from print services managed by the university to print services provided by an external service provider. The results of the study implied that there might be a positive relationship between implementing a managed print services solution and user satisfaction. On a more practical level the findings of the study provided helpful information for the university and the service provider for improving the print services. This study also contributes to the research of information systems success, user satisfaction, and user resistance.

## 1.7 Structure of the thesis

The rest of the thesis is structured as follows: first a literature review including chapters about information systems in organisations, information systems success, user satisfaction, user resistance, and print management. In chapter three the research

methods are presented. Chapter four describes the actual study and the background of it. In chapter five the findings of the study are presented. Chapter six consists of discussion and implications of the study, and chapter seven concludes the thesis.

## 2. Literature Review

In this chapter the literature related to the current study is presented. The meaning and purpose of information systems in organisations is first explained. Next, the complex phenomenon of information systems success is described, following with sub chapters consisting of user satisfaction and user resistance. Finally, the concept of print management is presented with two example cases of print service renewal projects.

### 2.1 Information systems in organisations

Information technology (IT) is widely utilised in organisations (Dewett & Jones, 2001; Doherty & King, 2001). It can be perceived as a medium for, and a product of, human action. Information technology, therefore, has a dual nature. Firstly, information technology can shape human action. For example, when information technology is implemented in an organisation, it changes the way people act either by facilitating or constraining the outcomes. Secondly, information technology is a product of human action. Because information systems (IS) are created in a systems development process, in which information technology is configured as an information system, it can be said that information systems are products of social actions. (Orlikowski & Robey, 1991.)

Defining what information system as a term means is a challenge. Many propositions have been made but no single truth has been found. (Alter, 2008.) For organisations, information is a resource for decision making and work execution, and information technology enables the execution of information processing activities in formalized processes (Orlikowski & Robey, 1991). Thus, information systems can be viewed as instruments for problem solving (Lyytinen, 1987). It can also be said that in organisations information systems are utilitarian, which means that they are created for improving the performance of individuals and therefore also organisations' performance (Petter et al., 2008).

By implementing information systems organisations can improve their position in competition and performance in many operational areas such as distribution, customer service and marketing (Joshi, 2005). Accordingly, the main idea behind an organisational information system is to improve decision making and organisational effectiveness (Raymond, 1990). When new information systems are implemented in organisations, large-scale changes are usually needed in organisational level and in the ways people work. If there are no changes made, successful operation of an information system in the particular organisational environment in which it is implemented, is not probable. (Doherty & King, 2001.)

Today, because of the rapidly changing markets, organisations are investing in information technology striving to cope with the changes (Lu & Ramamurthy, 2011). Increasing competition and economic uncertainty, however, lead to discussions of cutting expenses in organisations, and therefore also the possible profits and losses of investing in information technology are assessed more closely (Petter, DeLone, & McLean, 2008).

Nevertheless, it has been proposed that investing in information technology has a positive effect on organisations' profitability and revenue growth. More specifically,



investing in IT projects that aim for cost reduction is not as rewarding from profitability perspective as investing in IT-enabled revenue growth projects is. Thus, organisations should focus on IT projects that have revenue growth potential and pay less attention to those that prioritise cost savings. (Mithas, Tafti, Bardhan, & Goh, 2012.)

## 2.2 Information systems success

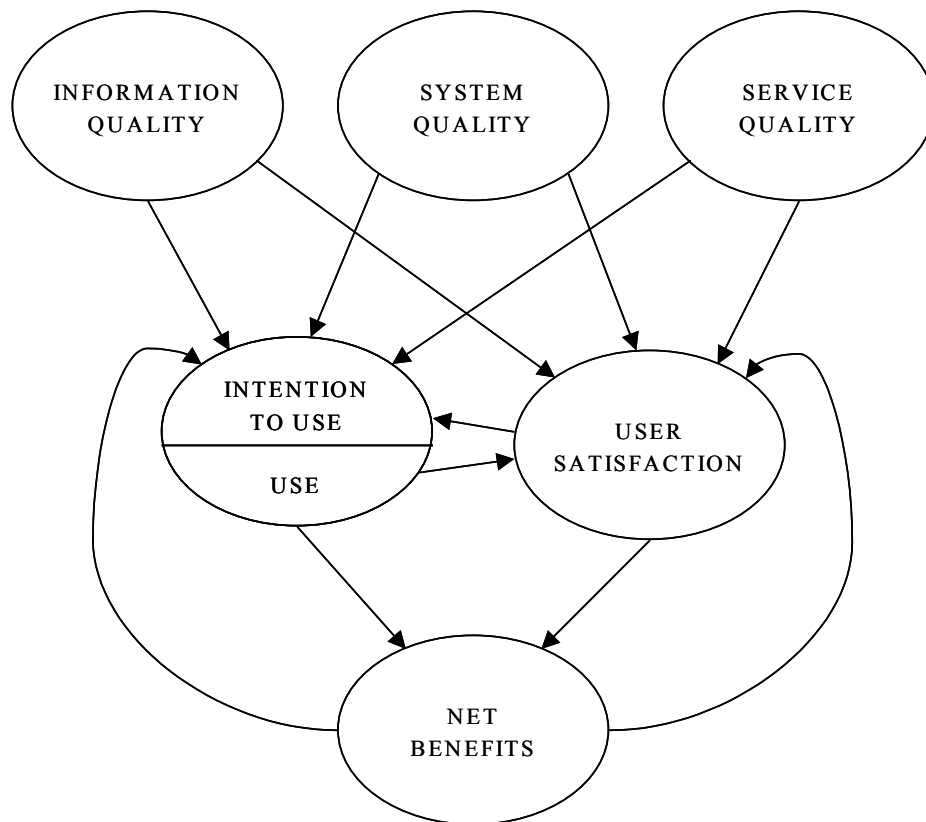
Measuring information systems success is important for organisations in order to assess and understand the value that information systems create (Gorla & Somers, 2014). The factors that contribute to information systems success are difficult to define, even though a lot of research on the matter has been done. However, success has many factors and thus it is not dependable on only one single measure. (DeLone & McLean, 1992.) The development and use of information systems is both a technical and a social process, and the problems that may arise can be social, organisational or related to the conceptual aspects of the system (Kaplan & Duchon, 1988).

A research covering over 5400 information technology projects by McKinsey and the University of Oxford found out in 2012 that “on average, large IT projects run 45 percent over budget and 7 percent over time, while delivering 56 percent less value than predicted” (para. 1). Also, 17 percent of IT projects fail so badly that the existence of the company is threatened. (Bloch, Blumberg, & Laartz, 2012.) Starting from the 1970s the failure rates of information systems have been high. This is alarming, because a lot of money and other resources are wasted on systems that do not deliver the benefits they are meant to. (Doherty, Ashurst, & Peppard, 2012.)

One reason for the high rate of information system project failures is that commonly a project is perceived successful by the project team if the system is delivered on time, on budget and to specification. Organisations, on the other hand, view a project as a success if the benefits it delivers exceed the expenses used for achieving them. (Doherty et al., 2012.) On the whole, rather simple measures are used to represent the success of information systems projects and implementations regardless the uncertainties and randomness involved in those representations (Cecez-Kecmanovic, Kautz, & Abrahall, 2014).

DeLone and McLean (1992) conducted a study reviewing previous research papers that tried to define the factors affecting IS success. Based on the results they created a model, the DeLone and McLean model of information systems success. It was originally published in 1992 and has been widely referenced and used in IS research. In the research they point out that there are many factors affecting IS success, but those can be categorized under six main dimension. In the model the dimension are interdependent and IS success is viewed as a process that has both causal and temporal influences. The dimensions in the model are system quality, information quality, use, user satisfaction, individual impact and organisational impact.

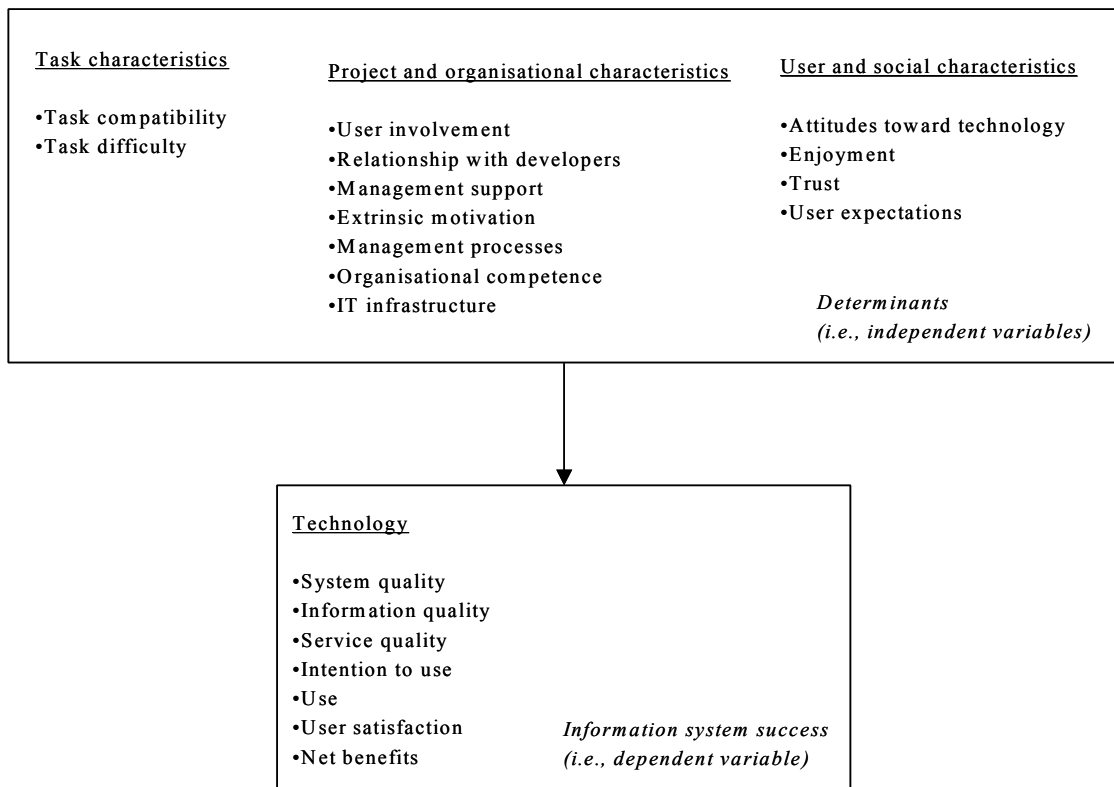
The D&M IS Success Model was updated in 2003 because IS research had progressed since the publication of it. There were many papers written that validated the original model, but also some that critiqued it. The updated model consists of six interdependent dimensions, like the earlier model, but there are some changes too. The dimensions in the updated model are information quality, system quality, service quality, intention to use/ use, user satisfaction and net benefits. (DeLone & McLean, 2003.) The updated model is presented on Figure 1.



**Figure 1.** Updated D&M IS Success Model (DeLone & McLean, 2003).

More recent study by Petter, DeLone and McLean (2008) demonstrated the applicability of the model to the utilitarian information systems. The appropriateness of the model for evaluating hedonic information systems, such as IS meant for gaming or social networking, was not discovered. It may be that some of the model's dimensions are not applicable to those systems.

While the D&M IS Success Model describes the dependent variable of information systems research, information systems success, Petter, DeLone and McLean (2013) have studied the independent variables that are positively related to information systems success, that is to say the variables that "cause" IS success (see Figure 2). In their research, based on literature review, they found 43 different variables and classified them into five different success factor categories: task characteristics, user characteristics, social characteristics, project characteristics and organisational characteristics. From the 45 variables they picked the most important ones that were in several research papers recognized influencing IS success. These success factors are enjoyment, trust, user expectations, extrinsic motivation, IT infrastructure, task compatibility, task difficulty, attitudes toward technology, organisational role, user involvement, relationship with developers, domain expert knowledge, management support, management processes and organisational competence. It can be concluded, that even if there is no single variable that can alone cause information systems success, there are many that enhance the possibility of success.



**Figure 2.** Determinants of IS Success (Petter, DeLone, & McLean, 2013).

Some of the identified variables are related to all dimensions of IS success, and others to a specific dimension. Because of this, success outcomes for an information system that is being implemented should be defined. When the success outcomes are clear, the variables influencing on them can be identified, too. Hence, trying to influence on the variables that the success is most likely dependable on may increase the chances of information systems success. (Petter et al., 2013.)

Inspired by the DeLone and McLean IS success model, Bradley, Pridmore, and Byrd (2006) state in their research that the quality of an IT plan and organisational culture have an effect on information systems success. IT plan is a plan consisting of issues such as priorities, purpose, and development strategy. The plan acts as a guide for development and purchase of information technology in an organisation, and can be viewed as a standard that helps creating coherent information systems that can connect with each other. The quality of an IT plan is an antecedent for IS success. The organisational culture, be it entrepreneurial or formal, influences IS success too, even though there are some small differences in how strong the relationship is. Creating a good quality plan for IT is hence important in general in organisations when developing and implementing effective information systems.

A different approach to IS success is presented by Cecez-Kecmanovic, Kautz and Abrahall (2014). They propose that information systems success or failure are sociomaterial accomplishments that are performed by constantly changing IS project actor-networks. The actor-networks can for example consist of managers, developers, methodologies and documents. It is within these networks where the assessment of success or failure of an information system happens, and because of changing sociomaterial practices different assessments are possible. Their view to IS success is performative instead of the dominant representational perspective. Representational perspective means in this context that the success of information systems is represented

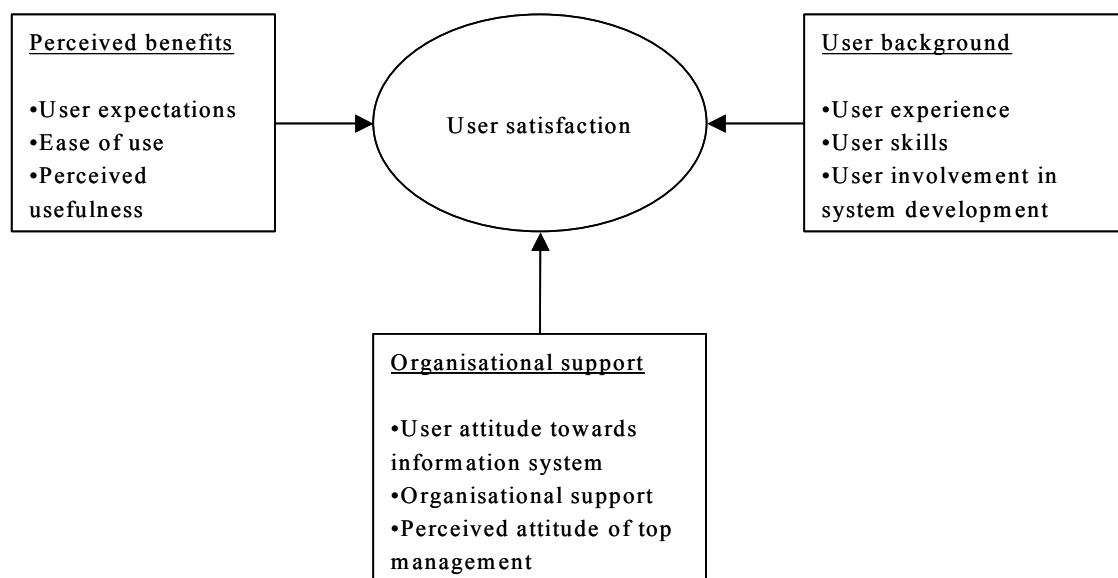
by subjective perceptions of people or by some objective measures, whereas the performative perspective focuses on the sociomaterial practices.

Information systems success can also be affected by IT outsourcing. According to Gorla and Somers (2014), service quality is an important measure of information systems success, and through it outsourcing can impact on users' attitudes and behaviours, perceived usefulness of the system, use and user satisfaction. Their research shows that service quality is positively and the extent of outsourcing is negatively related to user satisfaction. Also, outsourcing has a negative impact on perceived usefulness.

## 2.3 User satisfaction

User satisfaction is an information systems success measure that has been widely examined by researchers (Delone & McLean, 1992). In fact, the most often used measures for information systems success are user satisfaction and system usage. That is not a surprise since users are generally vociferous and direct with their comments on the information system they are using. (Bokhari, 2005.) However, user satisfaction is not always a sign of an effective information system (Melone, 1990), and information systems are created for multiple other reasons than just making users happy (Bokhari, 2005).

Mahmood, Burn, Gemoets and Jacquez (2000) have identified nine variables affecting user satisfaction, and three categories that these variables can be divided into (see Figure 3). These categories are perceived benefits and convenience, user background and involvement and organisational attitude and support. The nine variables are perceived usefulness, ease of use, user expectations, user experience, user skills, user involvement in system development, organisational support, perceived attitude of top management and user attitude toward information system.



**Figure 3.** Variables affecting user satisfaction (Mahmood et al., 2000).

Mahmood et al. (2002) conclude that user satisfaction will be higher if users are well involved in system development because user involvement leads to designing systems that are perceived more useful. If the system is perceived useful, it will also raise positive feelings and thus affect positively on user satisfaction. Also, the information

system should provide information that is relevant for the users. The system should have a positive impact on the users' job performance in order for the IS to gain acceptance of the users.

Au, Ngai and Chen (2008) have proposed that end users have different needs and therefore users' input requirements for achieving a needed result should be noticed. They point out that "end user satisfaction with an IS depends not only on the levels of different needs being fulfilled (i.e., benefits received) but also whether the effort (i.e., inputs) required to fulfil each category of those needs is worthy or not" (p. 47). This means that "user's rating of the benefits that an IS can bring depends on the amount of effort or input that is required to gain those benefits" (p. 47). So focusing only on the technological aspects of the information system and how it can benefit the users is not enough to achieve user satisfaction. Their research shows also that perceived performance of an information system seems to be the most critical factor affecting user satisfaction. In contradiction to previous studies, their research suggests that end users' expectations are not a dominating factor affecting user satisfaction. However, they do point out that expectations may be a more important factor influencing end user satisfaction when the information system is new, not when it has already been in use for some time.

Hartwick and Barki (1994) differentiate user participation and user involvement by stating that the roles of participation and involvement in IS development are different. User participation stands for the actual partaking in development, whereas user involvement refers to psychological state that can be for example a belief of the system's relevance. According to them, user participation leads to user involvement while involvement acts as a mediator between user participation and system use.

User participation in the implementation of a system has a connection to user satisfaction but the connection is not straightforward. High user participation does not necessarily lead to high user satisfaction. In fact, user satisfaction can be low even if user participation was high. (McKeen, Guimaraes, & Wetherbe, 1994.) The type of an information system to be implemented may be relevant when it comes to the strategies of promoting it, but participative approach still seems to be desirable to the users regardless of the information system type (Jiang et al., 2000).

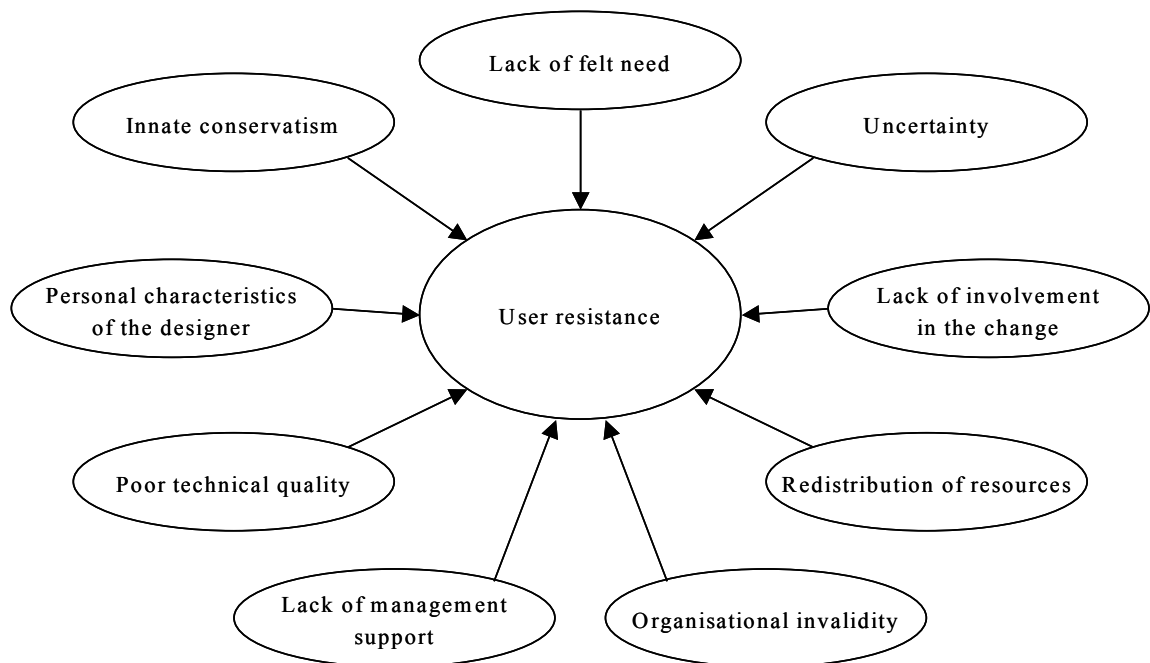
The relationship between user satisfaction and system use, that was proposed in DeLone and McLean's IS success model but not validated empirically, is positive even though it is not necessarily a very strong one. It is possible that system usage leads to user satisfaction, and user satisfaction can invite users to use the system more, but the connection is not untroubled. Sometimes the use of a system may be a proof of satisfaction towards the system. (Bokhari, 2005.)

## 2.4 User resistance

User resistance is one of the fundamental reasons for unsuccessful implementation of information systems (Jiang et al., 2000; Kim & Kankanhalli, 2009; Markus, 1983). Resistance is not something that can be unambiguously explained and it can show up in different forms (Hirschheim & Newman, 1988). Kim and Kankanhalli (2009) define user resistance as "opposition of a user to change associated with a new IS implementation" (p. 568). Hirschheim and Newman's (1988) definition of resistance is "an adverse reaction to a proposed change which may manifest itself in a visible, overt fashion (such as through sabotage or direct opposition) or may be less obvious and covert (such as relying on inertia to stall and ultimately kill a project" (p. 398).

In general, for resistance to occur there has to be some threats perceived by the users. In turn, the perceived threats result from interaction between an object and initial conditions. The object refers to an object of resistance, which can be for example users' resistance towards implementation of information technology. Initial conditions refer to existing conditions or routines that may influence on how threatening users perceive the object to be. (Lapointe & Rivard, 2005.)

The reasons of user resistance are many (Hirschheim & Newman, 1988), and responding to it inadequately can cause increase in resistance (Lapointe & Rivard, 2005). It is important to explain and recognize how resistance takes place because the descriptions of it have an influence on how information systems are implemented (Markus, 1983). Hirschheim and Newman's (1988) research summarizes causes for resistance proposed in the literature. They present nine different causes (see Figure 4), but mention that there are other possible causes as well. The nine reasons, innate conservatism, lack of felt need, uncertainty, lack of involvement in the change, redistribution of resources, organisational invalidity, lack of management support, poor technical quality and personal characteristics of the designer, are briefly explained next.



**Figure 4.** Reasons for user resistance (Hirschheim & Newman, 1988).

Innate conservatism, a reluctance to change the status quo, is one of the main reasons for resistance. People do not like changes in general, and prefer to continue doing the same work they are familiar with. Lack of felt need occurs if the change is not perceived by the users as positive or they are content with the current situation. Uncertainties cause fear in people and a change can be viewed as a threat. People can be for example afraid of losing their jobs or not being skilled enough to deal with the new system. Users may resist change because they feel they have been left out of the process of the change. Feeling lack of involvement in the change can originate from not being involved in making the decision to change or not participating in the development of the new system. Redistribution of resources, such as staff, equipment, budgets and power, disrupts the status quo and threatens people and their interests. The interests of different stakeholders should be therefore defended or improved but it can be challenging. (Hirschheim & Newman, 1988.)

Organisational invalidity means that some features of the new system do not fit together with the organisation's structure or users' ways of working. Lack of management support can cause user resistance if the management does not show leadership and embrace the implementation. The users are not likely to support the change if the management does not do so either. If the implemented information system has poor technical quality, it is more likely to face resistance than a system with high quality. Personal characteristics of the designer may effect on user resistance. Developers and users may have troubles understanding each other, because the developers tend to emphasize the technical side of information systems. Users are more likely to be interested only in how the system will affect their work. Finally, lack of training and education can cause user resistance as well. (Hirschheim & Newman, 1988.)

According to Jiang, Muhanna and Klein (2000), the reasons for user resistance can vary depending on the system type. In their research they found out that users had different reasons for resistance when the system implemented was a transaction processing system or a decision support system. In spite of differences, they noticed also that change in job content and uncertainty were plausible reasons for user resistance in both cases.

Resistance can awaken different behaviours in users (Hirschheim & Newman, 1988; Lapointe & Rivard, 2005), and can occur at any point of information systems' development. Resistance behaviour can be categorized in different ways but they are all quite alike. One proposed categorization for resistance behaviour is aggression, projection and avoidance. Aggression behaviour is described as an attack towards the object causing the problem with an intent to harm or injury it. Projection behaviour appears when users blame the system as the cause of the problems. Avoidance happens when users avoid using the system and thus defend themselves. (Hirschheim & Newman, 1988.)

Workaround activities are behaviours that can result from positive and negative resistance (Ferneley & Sobreperéz, 2006). More precisely, workarounds are "informal temporary practices for handling exceptions to normal workflow" (Kobayashi, Fussell, Xiao, & Seagull, 2005, p.1561). Workaround activities can be divided into three categories that are hindrance workarounds, harmless workarounds and essential workarounds. If users regard the use of an implemented system as too difficult, time consuming or troublesome, hindrance workarounds occur. Harmless workarounds occur when the users use the system differently than it was meant to be used, while still not defacing the workflows or data. Essential workarounds are behaviours perceived by the users critical or crucial regardless that they differ from prescribed processes. (Ferneley & Sobreperéz, 2006.)

Different strategies to alleviate resistance have been proposed by researchers but mainly they can be divided in two groups: participative and directive strategies. Participative strategies are for example training and establishing support services. Examples of directive strategies are top management support and financial incentives. (Jiang et al., 2000.)

In the literature, some practical means have been proposed that can be used to reduce user resistance, too. A user's perceived value of a new system can be improved by enhancing one's colleagues' opinions towards the system. Management can try to enhance colleagues' opinions by publicising the importance of the new system, and by trying to assure opinion leaders in the organisation about it first. Training should not be forgotten either because it enhances users' confidence and skills. The perceived value of change can be increased by explaining to the users the advantages the new system possibly creates. Users should also have time to learn to use the new system, and there

should be guidance available for them. In addition, top management should be committed to the change, too. (Kim & Kankanhalli, 2009.) Finally, management should keep in mind that the users do not resist new technology per se, they are more likely to feel afraid because of the changes it might cause in their work (Marakas & Hornik, 1996).

Nevertheless, user resistance is a complicated phenomenon that can not be explained in a few words (Hirschheim & Newman, 1988). Resistance is usually considered negative (Lapointe & Rivard, 2005), but it should not only be viewed as problem. It can be helpful in finding out what went wrong with the implementation of a new system, and resistance can thus be used to improve the situation with the new system. (Markus, 1983.) Resistance can also urge thinking over whether a change should be implemented, and it can even prevent making some unwanted changes (Hirschheim & Newman, 1988).

## 2.5 Print management

Total cost of printing in organisations can be difficult to control even though it might be relatively easy to count singular expenditures such as hardware and ink. With print management solutions organisations can manage, report, and monitor their printing costs and usage. Particularly in large companies printing is an important issue to be considered and managed. (Kalochristianakis, Grammatikakis, Saldaris, Demesoukas, & Tzanodaskalakis, 2013).

Managed print services (MPS) are a global and growing business. MPS offer for example inks, toners, repairs for printers and multifunction devices, and customer service. The reasons behind implementing managed print services are to reduce costs and simplify document management processes. In addition, when printer support is outsourced to the managed print service, the service level of IT departments may improve due to freed resources. (Handley et al., 2010.)

Free printing for users is one problem that causes excessive printing and therefore also extra waste. When a print management system is taken into use the printing resources are not free anymore for the users and they tend to start rationalizing their printing behaviour. The users start to develop greener printing habits such as selecting duplex printing. Therefore by monitoring printers and photocopy machines the amount of waste and costs can be lowered and more environmental friendly printing habits fostered. (Kalochristianakis et al., 2013.)

In fact, environmentally sustainable information technology, or green IT, is a current issue these days (Bose & Luo, 2011; Joumaa & Kadry, 2012; Murugesan, 2008; Watson, Boudreau, & Chen, 2010). Green IT stands for the use of information technology resources cost-effectively and energy-efficiently (Bose & Luo, 2011), and it concerns the design, manufacturing, use, and disposal of servers, computers, and printers among other things (Murugesan, 2008). There are many reasons why organisations pursue greener IT, such as reducing power consumption, lowering environmental impact, and space savings. (Bose & Luo, 2011.) Whether organisations are trying to improve productivity or profitability, or reduce costs, at the same time they could also pay some attention to sustainability issues (Watson et al., 2010).

Organisations can reduce the environmental impact of their information systems by behavioral and technological changes. For instance, with printer consolidation it is possible to increase energy and material efficiency, and by developing a printer policy



for reducing the amount of printed material and desktop printers, people's behavior can be influenced. (Bose & Luo, 2011.)

In 2010 a print management system was implemented in the library of Raritan Valley Community College. Two main reasons for the implementation were high and rising costs of supplying paper and toner, and the amount of waste caused by unnecessary printing. Prior to the print management system was taken into use the users did not have to release their printing jobs before the actual printing begun, but after the implementation the users were required to login to a designated release station where the printing jobs could be released. Users were after the implementation also able to cancel unnecessary printing jobs from the release stations, even though the system was set out to cancel unreleased printing jobs automatically after 30 minutes. A limit of 50 pages for a print job was also set in order to prevent accidentally printing long documents and deterring users from using the printers as copying machines, in other words printing many copies of one document. (Dempsey & Palilonis, 2012.)

One potential problem with the releasing of printing jobs was that the peak times of printer usage might cause congestion at the printers when users release several print jobs at once. On the other hand it was considered more likely that users would not forget to collect their prints when they are consciously releasing their printing jobs. (Dempsey & Palilonis, 2012.)

When the implementation was done there was some confusion among the users. They were for example wondering why their printing jobs did not come out even though instructions were available for them near the release stations and printers. The users questioned about the reasons for the implementation, and cutting down the amount of wasted paper was perceived as a sensible explanation by them. (Dempsey & Palilonis, 2012.)

With the implementation the amount of printed pages was reduced with 32 percent between Fall 2009 and Fall 2011. Also, it was noticed that the lifespan of toner cartridges increased. It was assumed that the need to separately release the printing jobs would make users go printing elsewhere but that did not happen. The users accepted the procedure and understood the motivation behind the change. (Dempsey & Palilonis, 2012.)

In an academic setting a print service renewal was conducted at the University of Texas at San Antonio. The project focused on student printing, and the aim was to ease the releasing of printing jobs, lower the cost of printing, involve as many colleges as possible to maximize efficiency, remove maintenance tasks from the colleges, and to have a central point of contact for issues related to the printing of the students. (Williams & Koch, 2012.)

Before the students had to use specified computers in three different locations at the university to print. After the implementation the students were able to send print jobs to a universal print queue from computers in the campus as well as from their laptops via wireless connection. They were also able to send print jobs from home. The implementation of multifunction printing devices made it possible to release print jobs without using specified release stations because they enabled the release of the printing jobs with a card swipe or using a touch screen. The renewal also made it possible to monitor printing devices with a monitoring system. (Williams & Koch, 2012.)

The project at the University of Texas was a success. The students were satisfied, cost savings were achieved, and the access to printing for the students was improved.

Possible future improvement plans included for example integrating printing from mobile devices. (Williams & Koch, 2012.)

### 3. Research Method

In this section the research methods of the study will be presented. The research is a case study, but both qualitative and quantitative data analysis methods are used. Hence, first the characteristics of qualitative and quantitative research are presented, and then case study research method and survey as a data collection method are described.

#### 3.1 Qualitative and quantitative research

The research of information systems and information technology has a relatively short history. It emerged in the 1960's but has since grown considerably. In the beginning the research focused on technical aspects from where it evolved to include the management of information systems in the 1980's. In the 1990's the focus was on the relationship between information systems and organisations as a whole, and today the research of information systems includes issues ranging from communication between people and organisations to the Internet and electronic commerce. Nowadays universities around the world teach information systems for students, and there are many valued journals, associations, and conferences in the field. (Myers & Avison, 2002.)

In the study of information systems many research methods and approaches are used due to the extensive scope of the field. Quantitative and qualitative research are both accepted in top journals provided the quality of the research is high enough. (Myers & Avison, 2002.)

One generally used way to categorize research methods is to divide them into qualitative and quantitative methods (Myers & Avison, 2002). However, for a long time, the differences between qualitative and quantitative research have been under debate, and many kinds of ways to describe the differences have been presented. Still, in practice it is difficult to separate qualitative and quantitative research from each other, and instead of seeing them as competing approaches, they should be considered as complementary approaches to research. For example, a vast quantitative survey can be conducted first in order to find out how to form meaningful groups for qualitative interviews. (Hirsjärvi, Remes & Sajavaara, 2009.)

Qualitative research methods stem from the social sciences, and they were developed in order to enable the study of social and cultural phenomena (Myers & Avison, 2002). They aim to describe real life and to reveal unexpected matters. Testing hypotheses or theories is not important; qualitative research rather focuses on examining the data from different aspects and in detail. (Hirsjärvi et al., 2009.) Also, data gathered in qualitative research can be used to pose and resolve questions (Kaplan & Duchon, 1988). Sometimes it is thought that qualitative research is about getting close to the people that are being studied, but that is not always the case. However, data collection methods that enable people to reveal their point of view are preferred. (Hirsjärvi et al., 2009.) Qualitative research methods are for example case study research, action research and ethnography (Myers & Avison, 2002).

Quantitative research methods originate from the natural sciences where they were created to study natural phenomena. Examples of quantitative research methods are laboratory experiments, survey methods as well as numerical and formal methods.

(Myers & Avison, 2002.) In quantitative research the laws of cause and effect are emphasized, and reality is perceived constructing of facts that can be objectively proven. (Hirsjärvi et al., 2009)

All research, including qualitative and quantitative research, is based on philosophical perspectives. The underlying philosophical epistemology can be positivist, interpretive or critical. These assumptions can sometimes be hidden, and thus it is important to be familiar with them. Even though a research can be positivist, critical or interpretive, the research method selected is not dependent on the researcher's underlying philosophical assumptions. Hence, for example, a case study can represent any of the perspectives. (Myers & Avison, 2002.) All three philosophies can be used in the study of information systems and each of them can provide valuable information. Still, researchers should be aware of the effects of the chosen philosophical perspective in order to avoid biased perceptions. (Orlikowski & Baroudi, 1991.)

Like there are more than one philosophical perspective to research there are also many research methods. Research methods are strategies for inquiry that involve the philosophical assumptions, research design and data collection. In other words, research methods influence the way data is collected, the practices of the research, the skills needed, and the assumptions related to it. (Myers & Avison, 2002.)

Qualitative and quantitative methods can be integrated in a same research (Bryman, 2006; Gable, 1994; Kaplan & Duchon, 1988; Venkatesh, Brown, & Bala, 2013) and it is reasonably common (Bryman, 2006). Because information technologies are changing and advancing quickly today, information systems researchers face situations where previous findings and theories can not explain the emerging phenomena. In these kinds of situations mixed methods can offer new insights and strategies to study them. (Venkatesh et al., 2013.)

Combining both research methods can be done at different phases of the research, for example in data collection or analysis, or when developing the research question. However, multi-strategy research is not always simple to conduct and researchers should be careful when employing this approach. For instance, when qualitative and quantitative methods are combined, data redundancy is possible. (Bryman, 2006.)

In the literature terms multimethod and mixed methods are used about using multiple methods in research but there is a difference between them. Mixed methods research is about employing multiple methods or both qualitative and quantitative approaches in one research. Quantitative and qualitative methods are used concurrently or sequentially. In multimethod research multiple research methods can be used and both qualitative and quantitative approaches employed. The approach can be limited to either one of them also. Thus, mixed method researches are multimethod researches, but all multimethod researches are not mixed method researches. (Venkatesh et al., 2013.)

It should be noticed that using mixed methods is not an absolute value or always desirable, and therefore whether to use it or not should be evaluated based on the research question, purpose and context. Mixed methods research is an additional research approach that can be used along with qualitative and quantitative approaches, and it has its limitations. Data collection, validation and analysing in mixed methods research, for instance, requires more time than in single method research. (Venkatesh et al., 2013.) Still, combining multiple methods can be valuable (Kaplan & Duchon, 1988; Venkatesh et al., 2013). It enables data triangulation and can provide new insights as well as new ways to analyse data (Kaplan & Duchon, 1988). As Kaplan and Duchon (1988, p. 583) profess, "*No one method can provide the richness that information systems, as a discipline, needs for further advance*".

### 3.2 Case study overview and survey as data collection method

Usually the target of a case study is to describe a phenomenon (Hirsjärvi et al., 2009.) or to understand the problem being studied (Gable, 1994). According to Hirsjärvi, Remes and Sajavaara (2009), a case study is “detailed, intensive information about one single case or a small set of cases that are related to each other” (p.134). In other words, the unit of analysis in a case study can be an individual, a group or a community, and the selected case is examined in contact with its natural settings (Hirsjärvi et al., 2009). The unit of analysis can also be an event or a phenomenon (Darke, Shanks, & Broadbent, 1998).

Case studies can be used for several purposes such as description, theory building, exploration and prescription (Gable, 1994), and several methods, for example interviews and observations, can be used to collect data for the study (Hirsjärvi et al., 2009). Because case studies are not bound to specific data collection methods or type of evidence, they can be qualitative or quantitative (Yin, 1981). Also, the philosophical assumptions of the researcher can have an effect on the research, so therefore a case study research can be critical, interpretive or positivist (Myers & Avison, 2002). In case studies within information systems research positivism is the most common philosophical perspective (Dubé & Paré, 2003).

There are eleven characteristics that have been stated to define case studies. This list of characteristics has been presented by Benbasat, Goldstein and Mead (1987, p. 371):

1. Phenomenon is examined in a natural setting.
2. Data are collected by multiple means.
3. One or few entities (person, group, or organisation) are examined.
4. The complexity of the unit is studied intensively.
5. Case studies are more suitable for the exploration, classification and hypothesis development stages of the knowledge building process; the investigator should have a receptive attitude towards exploration.
6. No experimental controls or manipulation are involved.
7. The investigator may not specify the set of independent and dependent variables in advance.
8. The results derived depend heavily on the integrative powers of the investigator.
9. Changes in site selection and data collection methods could take place as the investigator develops new hypotheses.
10. Case research is useful in the study of “why” and “how” questions because these deal with operational links to be traced over time rather than with frequency or incidence.
11. The focus is on contemporary events.

According to Lyytinen (1987), case study is the best method to collect rich data on IS problems and the systems in which they occur, and it is a frequently used research method in information systems (Gable, 1994; Darke et al., 1998; Dubé & Paré, 2003; Myers & Avison, 2002). Benbasat et al. (1987) propose that there are three reasons for case study being a potential method used in information systems research. First, because information systems can be studied in their natural settings in case study, the researcher can generate theories from practice and based on the most recent developments in IS field. Second, case study makes it possible for the researcher to answer questions like “why” and “how”. These kind of questions help to understand the complexity and nature of the processes. “How” question truly are frequently used as research questions in IS case studies (Dubé & Paré, 2003). Third, if there is not much research done in the area being studied, case study is a suitable method to employ. Especially in the field of

information systems, which is developing rapidly and new topics turn out often, case study is an appropriate method to be used. Also, when organisational issues, rather than technical issues, are in the focus of the research, case study is a viable method. (Benbasat et al. 1987.) As an example, Benbasat et al. (1987) state that with the help of case studies it has been possible to point out variables influencing on information systems success or failure.

Some weaknesses of case studies have been identified, too. Problems can arise in making controlled observations and deductions, and also with replicability and generalizability (Lee, 1989). Also, how the data collected in a research is analysed depends on the researcher's interpretation. However, having a research partner may help getting a more abundant picture of the case data and also to improve the correctness of the analysis. (Benbasat et al. 1987.)

Practical issues may have an effect on how a case study research is conducted. For example, the purpose of the research, the availability of resources and the required deliverables may be affected. In a masters or a doctoral student project, for instance, resources are limited and a predefined deliverable, such as dissertation, is required. (Darke et al., 1998.)

There are several phases to go through when conducting a case study. Case study research starts with assessing the suitability of the method to the research at hand. After that, the unit of analysis is determined. Also, the researcher should define whether the research is a single-case or a multiple-case research. Next, site selection is carried out. The site of the study should be selected carefully based on the characteristics of it. After an appropriate site is selected, data collection methods should be determined and the data collection itself planned carefully. Finally, the data collected are analysed and presented. (Benbasat et al. 1987.)

Whether the researcher should adopt a single-case or multiple-case design depends on the research question. Single cases can be used when deep insight and rich descriptions are wanted. Multiple-case research enables cross-case comparison and theoretical or literal replication. (Darke et al., 1998.)

It is common to use multiple methods to collect data in case studies. The use of several methods enhances the possibility of gaining rich data about the case. (Benbasat et al. 1987.) Also, triangulation is possible due to more than one data collection method, and thus it is possible to gain more support for the results of the research (Benbasat et al. 1987; Gable, 1994). The data collection methods employed in case studies are usually qualitative, but quantitative methods, such as questionnaires, are used, too (Dubé & Paré, 2003).

Using a survey as data collection method has some advantages. A survey can reach many people and it is possible to ask several questions in the same questionnaire. Thus surveys save the researcher's time and are a good way to collect a vast pool of research data. Also, defining expenses and timetable can be done reasonably well. (Hirsjärvi et al., 2009.)

There are some weaknesses related to surveys, too (Hirsjärvi et al., 2009). For the data collection in a survey to be successful, it is important to ask the right questions and in the right way. When, for example, a questionnaire is sent for respondents and they misunderstand some questions in it, it is too late to change anything in the questionnaire anymore. Hence, survey research methods are quite inflexible in the sense of making discoveries when data collection is under way. (Gable, 1994.) It is also not possible to know whether the respondents have been honest with their answers or not, nor is it

possible to know how familiar they are with the subject of the survey. Hence, often the data collected in a survey is considered superficial. Sometimes, also, response rate can be low. (Hirsjärvi et al., 2009.)

### 3.3 Qualitative content analysis

Content analysis is a basic analysis method used in qualitative research. The aim of the analysis is to create meaningful and coherent information from fragmented textual material. By clarifying the material it is possible to use it in making reliable deductions of the studied phenomenon. The material can be for example books, interviews, discussions or any material that is documented in literary form. (Tuomi & Sarajärvi, 2002.)

The material can be analyzed inductively or deductively. This categorization is based on the logic of deduction. Inductive analysis stems from the material, and previous theories or perceptions should have no effect on the analysis or the outcomes, whereas deductive analysis is based on some already known theory or model, and the phenomenon that is being studied is defined in accordance with it. (Tuomi & Sarajärvi, 2002.) Inductive and deductive data analysis processes both have three phases (Elo, Kääriäinen, Kanste, Pölkki, Utriainen, & Kyngäs, 2014). In inductive analysis the phases are reduction, clustering, and abstraction. In reduction phase irrelevant information for the current research is reduced from the material and essential expressions are raised. In practice, reduction can be for example underlining essential expressions from the material. (Tuomi & Sarajärvi, 2002.) Before starting the analysis the unit of analysis has to be defined (Elo et al. 2014; Tuomi & Sarajärvi, 2002). The unit of analysis can be a single word or even a sentence, but it should be decided based on the object of the research and the material (Tuomi & Sarajärvi, 2002).

During clustering the expressions picked from the material are reviewed and constructs that represent similarities and/or differences are searched. Similar constructs are combined in a class and named appropriately. These subclasses can be grouped to main groups. Further, main groups can be grouped under associated groups. Clustering can be perceived as a part of the abstraction phase. During abstraction the relevant information is extracted and theoretical concepts are formed. Inductive content analysis is based on deduction and interpretation where conceptual view of the phenomenon under examination is derived based on empirical material. In abstraction the empirical material is attached to theoretical conceptions, and as a result for example the themes, models, and categories derived are described. In the end of a research when conclusions are made, the aim is to understand the studied people from their perspective, to understand what issues signify for the people. (Tuomi & Sarajärvi, 2002.)

## 4. The Study

In this section the study that was conducted is presented. First a short presentation about the University of Oulu is given. The second sub chapter describes printing at the university before the change in the print services and explains the background and reasons for the change. Finally, the user satisfaction survey that was conducted at the university in order to find out how the users experienced the changes in the print services is described.

### 4.1 University of Oulu

University of Oulu was founded in 1958 and is today one of the biggest universities in Finland. At the time of the study the university had 3000 employees and there were 16000 students studying in ten faculties. Scientific research was conducted in four focus areas (biosciences and health, information technology, cultural identity and interaction, and environment, natural resources and materials) and four development areas (business and economy, steel research, research-based teacher education, and mining and mineral field). The University of Oulu also had many agreements of cooperation with several top level universities in the world. (University of Oulu, 2014.)

### 4.2 Printing at the University of Oulu

A print service renewal project was conducted at the University of Oulu starting in 2012. A survey examining print infrastructure was held and the results from the survey indicated that improvements could be made, and cost savings, increased performance and higher quality in printing achieved. The renewal was performed in 2014 with Canon as the service provider. Canon introduced their service solution to the university as Managed Print Services.

Print infrastructure in the University of Oulu consists of Linnanmaa campus, Kontinkangas campus, and remote units in Kajaani, Oulanka, Raahe, Nivala and Sodankylä. Users of the print services can be divided into three main user categories: students, employees of the university, and visitors. (University of Oulu's material, 2012-2013.)

Before the change in the print services the user categories were defined having some special attributes:

- The students mainly used the printers located in classrooms and self-study rooms.
- The employees printed from their workstations or used thin client devices. It was possible for some of the printed material to be confidential.
- The visitors used their own devices that they brought with them for printing.
- All the groups could also have smartphones and tablet computers in their use. (University of Oulu's material, 2012-2013.)

Before the change the printing of the employees was handled by IT Administration Services via Windows print servers. The students had an allotted print quota of 100 free



of charge black and white double-sided prints per month. The print quota of students was managed with PaperCut software, and there was a separate Windows domain for the students. (University of Oulu's material, 2012-2013.)

Service desk was available for the employees as well as for the students. The yearly amount of service desk requests was about 46 000 tickets, and there were approximately 320 technical users in the system. The software in use was ManageEngine ServiceDesk Plus that was used for administrating the tickets. The customers were able to either call to the service desk or send email requests. (University of Oulu's material, 2012-2013.)

A survey examining printing at the University of Oulu was conducted at the turn of the year 2012-2013 in order to find out what is the state of the print infrastructure. The main finding was that there were a lot of various kinds of printing devices at the university. Based on the results, and when compared to other universities, it was noticed that cost savings could be achieved by more efficient use of printing devices. (University of Oulu's material, 2012-2013.)

In the survey it was discovered also that there were 976 printing devices in use at the university. Table 1 presents the number of devices on a more detailed level. These devices represented 382 different models and were from 17 different manufacturers. For example the total number of printers was 651 and they represented 202 different models. (University of Oulu's material, 2012-2013.)

**Table 1.** Amount of devices before the change (University of Oulu's material, 2012-2013).

Device	Total number
Multifunction printers	187
Copying machines	11
Printers	651
Fax machines	44
Scanners	83

In 2012 the approximated amount of printed pages at the university was about 1,2 millions per month, from which only 4,7 percent were double-sided. Table 2 presents a more detailed view to the page amounts. The numbers are based on use during one month. (University of Oulu's material, 2012-2013.)

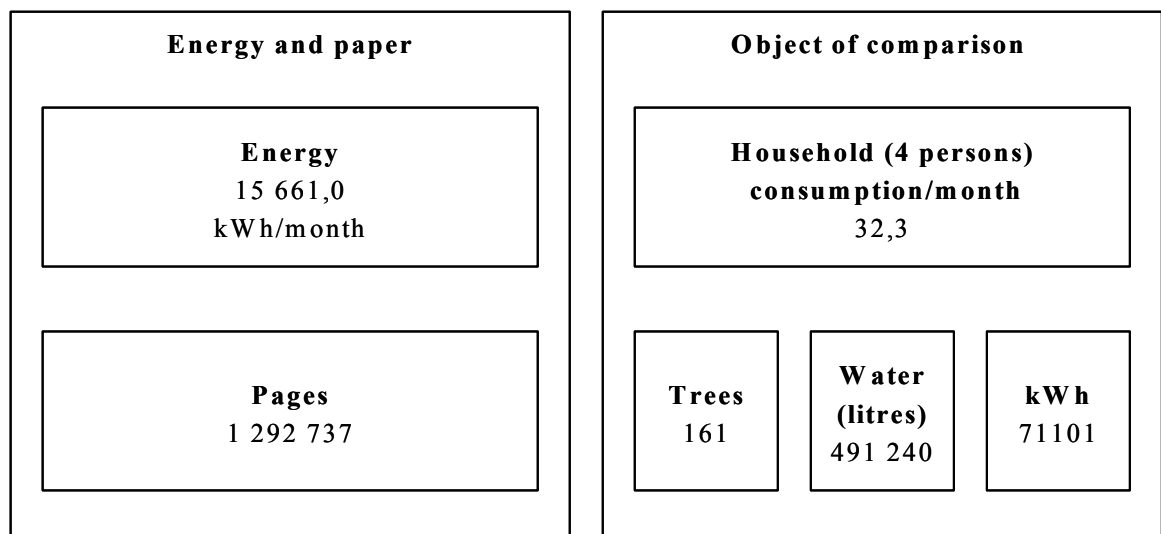
**Table 2.** Estimated amounts of pages in one month before the change (University of Oulu's material, 2012-2013).

	Black and white	Colour
Multifunction printers	681 637	127 893
Copying machines	2 115	
Printers	392 143	34 509
Fax machines	430	
Scanners	8 200	8 100
Total	1 084 505	170 522

Full capacity of the multifunction printers was not utilized, and in several situations there were separate devices for different functions. There were many scanners and the scanning function of multifunction printers was not widely used. Fax machines were almost unutilised or broken, and there were only a few inkjet printers in use. Also, paper and ink cartridge collection and recycling was nonexistent. (University of Oulu's material, 2012-2013.)

In table 3 the totals have been slightly miscalculated. The numbers are taken from material provided by the university so they are presented in the table as they were in the source document. The real total for black and white pages is 1 084 525, and for colour pages 170 502.

In the survey environmental effects of printing were also examined. In figure 5 the approximated amounts of energy and paper consumption in one month at the University of Oulu are presented. The amount of energy used per month was 15 661,0 kWh per month, and paper 1 292 737 pages per month.



**Figure 5.** Energy and paper consumption and objects of comparison (University of Oulu's material, 2012-2013).

The approximated amount of energy consumed at the University of Oulu for printing in one month was calculated equivalent to the energy consumption of 32,3 four person households in one month. The approximated amount of pages printed in one month was calculated to require 161 trees, 491 240 litres of water, and 71101 kilowatt-hours of energy to be produced. It was also estimated that if the print services were renewed at the university, it would be possible to reduce the environmental effects of printing. For example, the energy consumption could be decreased to 8 872,0 kWh per month, and paper to 987 024 pages. When compared with the four person household, the consumption was calculated as decreasing to 18,3 households per month. Because the use of paper would decrease, the amount of resources needed for its production would decrease too, trees to 123, water to 375 069 litres, and energy to 54 286 kWh. (University of Oulu's material, 2012-2013.)

However, there were some attributes that were found positive in the situation before the change in the print services. For example the locations of the devices were optimal in the sense of usage. Most of the printers could be used for duplex printing, and they were equipped with additional paper trays. In addition, only 13,6 percent of all printed

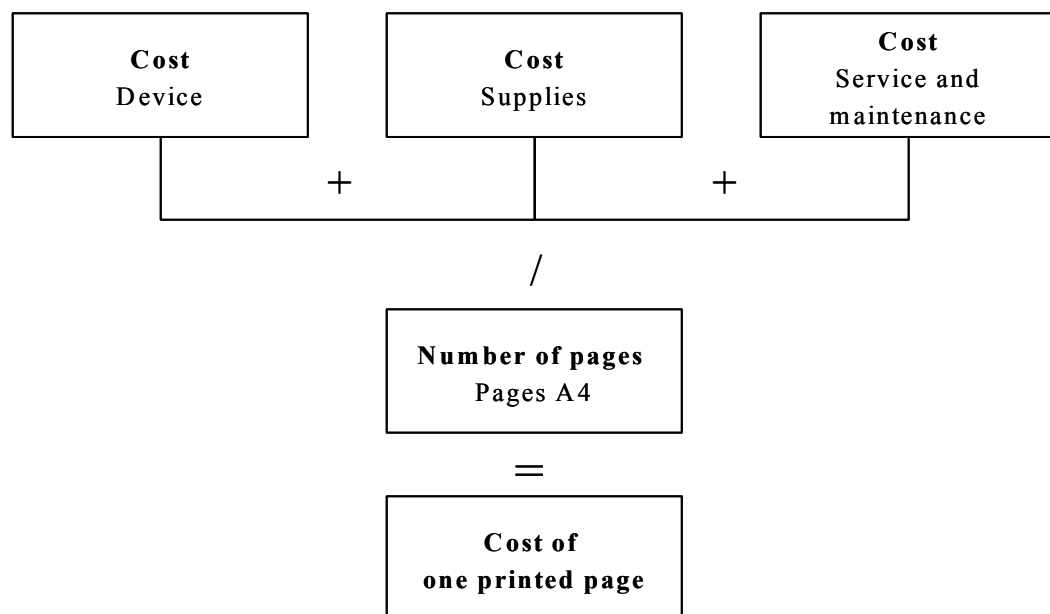
pages were four colour prints. Also the ecological values of printing were well understood. (University of Oulu's material, 2012-2013.)

All in all, based on the survey some development areas were identified:

- Connecting all the devices to network would improve usability and management.
- Four colour printing and an option for scanning should be introduced to all places where they are needed.
- Reduction of overlapping devices and cutting up expenses could be achieved by increasing the use of multifunction printers.
- With logging in to printing devices and workflow scanning, information security could be enhanced, unnecessary printing reduced, and document handling optimised.
- Paper and ink cartridge recycling would decrease environmental load.
- Some of the devices were getting old and their features were not up to date. (University of Oulu's material, 2012-2013.)

Based on the survey implementing a new service solution for printing was presumed to benefit the university in many ways. Overall easiness of use and usability would be improved because all devices could be managed and monitored remotely, ink shortage and other service requests would be made automatic, only one single driver would be used for all devices, and secure printing with the possibility to release the printing job at any device would be taken into use. Secure printing would enhance information security because it would be less likely that users would forget to collect their prints. Also, it would be easier to optimize the print infrastructure based on usage. Nevertheless, one great benefit would be lower total cost of printing. (University of Oulu's material, 2012-2013.)

The costs of printing were calculated including both direct and indirect costs. Direct costs included for example purchase and maintenance expenses, and indirect costs energy and paper expenditures, for instance. Total cost of ownership was calculated as the cost of one printed page (see Figure 6). (University of Oulu's material, 2012-2013.)



**Figure 6.** Cost of one printed page (University of Oulu's material, 2012-2013).

The cost of one page could be calculated by adding together all costs and dividing the sum with the number of printed pages (University of Oulu's material, 2012-2013).

So, the aim of implementing the new print service solution was to optimize the amount and locations of printing devices and to standardize the models in use, and also to create a printing policy that would support print operations. By improving the print infrastructure it was expected to achieve cost savings, higher quality in print services and increase performance. (University of Oulu's material, 2012-2013.)

Based on the results of the printing survey at the university some principles for the new print service solution and a printing policy for the university were then established. The main targets of the printing policy were defined as:

- Operational reliability of the print infrastructure
- Information security of the print infrastructure
- User satisfaction
- Print quality
- Cost efficiency
- Cost awareness
- Environmental friendliness (University of Oulu's material, 2012-2013.)

In the printing policy the necessary courses of action to reach the targets were also defined. They were specified and named as follows:

- Location of the printing devices and optimization of the print infrastructure
- Development and customization of the print infrastructure
- Efficient, secure and economical printing
- Data protection and information security
- Personal devices
- Secure printing/ FollowYou-printing
- Student printing
- Service personnel
- Purchase of supplies, ink and paper
- Environmental friendliness
- Standardized printing devices
- Usage of print services

Performance indicators with target values were also designated for each course of action so that they could be measured. For example, the target for personal devices was that there would be none in use. If someone happened to have special needs then the issue would be talked over in a meeting of print services' steering group. For the secure printing/ follow you printing the target was that secure printing would be default in all devices so that no personal printing devices would be in use. In addition, increasing the amount of double-sided pages to approximately 20 percent of all printouts was one of the objectives. (University of Oulu's material, 2012-2013.)

Finally in the summer of 2014 the print service renewal was conducted and Canon's Managed Print Services solution was implemented. The solution was a comprehensive print service administered by the service provider. The implementation included all hardware and software required for printing, copying and scanning, and also delivery, support and maintenance services for the whole solution. A monitoring system that enabled controlling the print infrastructure and a new kind of service desk were implemented, new devices were delivered and set up, two service advisors were present

at the university to help with the new service, and the responsibility of ordering and delivering print supplies was transferred for Canon. Also training sessions were held for the users, and quick use instructions tailored for the University of Oulu were delivered. (Canon material, 2013.)

The monitoring system was for reporting and remote care purposes. With the system it became possible to collect information about the printing devices. It enabled for example following printing amounts and automatic support requests concerning the printing devices. For instance, the system was capable of alarming the service provider about low level of toner on a specific device and thus enabled the delivery of refill in time. (Canon material, 2013.) Also, more information concerning the cost of printing became available. It was possible to start following actual costs, and therefore also examination of possible savings achieved with the print service implementation was enabled (see Appendix A).

### 4.3 The survey, data collection and analysis

The aim of the survey conducted in this research was to find out how the users, in this case the personnel of the University of Oulu, experienced the changes made in the print services in the summer of 2014. Since the number of people working at the university was high, a survey was perceived as a suitable way to collect data. Surveys can reach many people and they enable asking several questions at once, so therefore it is possible to collect a vast pool of data rather effectively (Hirsjärvi et al., 2009). Interested parties and initiators of the survey were the service provider Canon and the university's IT administration. They provided a draft version of a user satisfaction questionnaire that was to be sent to the personnel, and it was then refined into a final version. The questionnaire was meant to be sent for the users even without this research, but it was possible to modify the questionnaire to suit the aims of this study also. The possibilities to effect on the content of the questionnaire were limited, but in the end only one new question that concerned the users' experiences about the print services before the change had to be added.

The questionnaire (see Appendix B) was held to the employees of the University of Oulu in February 2015. It was sent 5<sup>th</sup> of February 2015 and time for responding was given until 20<sup>th</sup> of February 2015. An email notification to remind people about responding to the questionnaire was sent 16<sup>th</sup> of February. The questionnaire was sent to each member of the personnel of the university. The actual amount of email addresses that the questionnaire was sent was 2950. The personnel of the university was multicultural and not everyone spoke Finnish. Therefore the questionnaire was written in two languages, in Finnish and English.

Webropol 2.0 was used to create and execute the survey. Webropol is an online survey and analysis software. It can be used to create graphs and charts of survey results, and the result can be transferred to MS Office applications, for example to Excel, Word and PowerPoint. (Webropol, 2015.)

The number of people who responded to the survey was 486, which makes a response rate of 16,5 percent. However, there were a couple of respondents who did not answer to all questions. The data was examined quantitatively and qualitatively. This was possible because of the nature of the collected data. The questionnaire consisted of open ended questions and closed-ended questions which were radio button -type questions. The total number of questions in the questionnaire was nine. The first seven were closed questions and the two last ones were open ended questions. The open ended questions were the questions that were used to collect the main data for this research, and hence

the emphasis was on qualitative analysis of the responses to the open questions. Less attention was paid to the closed-ended questions. Quantitative analysis was used only as a support for the results of the qualitative data analysis.

The analysis of the data started by first exporting the questionnaire responses from Webropol 2.0 to an Excel file. The responses to closed-ended questions were presented as tables including mean values or graphs. Thus the data was ready for analysis. Still, more informative tables that included also percentage values and clearer graphs were created for easier presentation of the results in this thesis.

Qualitative content analysis was perceived as a suitable means to analyze the responses to the open ended questions. Inductive analysis process, consisting of reduction, clustering, and abstraction phases, described by Tuomi and Sarajärvi (2002) was implemented. The analysis started with the reduction phase by scanning the responses to form a preliminary picture of the contents. This way the most common themes were found out. After that the responses were reviewed more closely one by one, and keywords based on each response were created and written down. The result was a long list of keywords that were reviewed, and the keywords that seemed to belong to the same theme were then clustered to form a class. Finally, three higher level classes were created in the abstraction phase: devices, secure printing and support services. The devices class included responses that were somehow related to location or functionality of the devices. Issues that were connected to secure printing, such as logging in to the devices or unnecessary printing, were included in the secure printing class. The support services class included all responses that were related to support services, training or instructing. Some kind of manifestations of user resistance were also searched from the open ended questions while going through the responses.

## 5. Findings

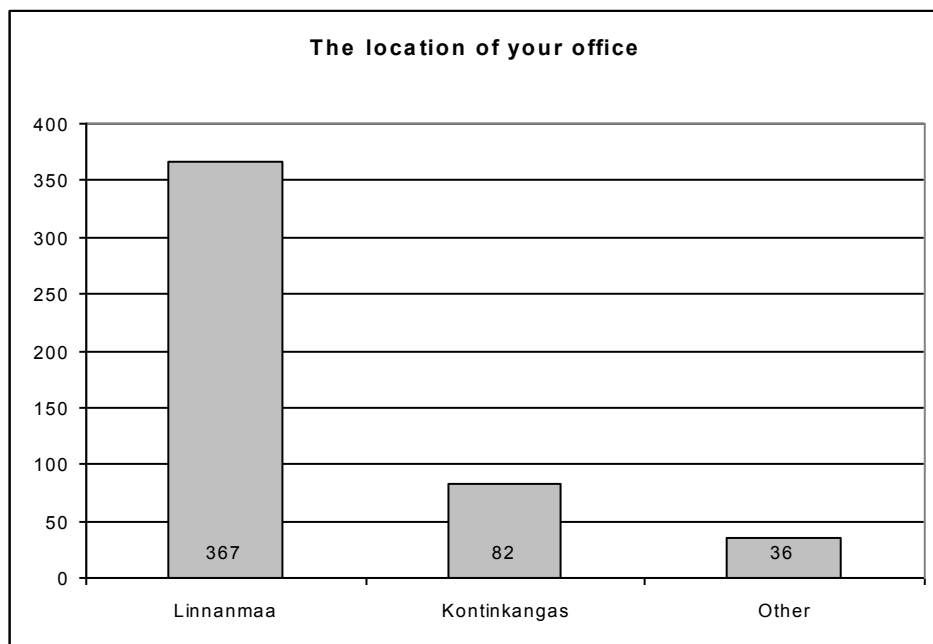
In this chapter the findings based on the questionnaire are presented. The responses to the closed-ended questions will be reviewed in the first sub chapter and the responses to the open ended questions in the following chapter. The findings are explained one question at a time, and a short summary presented in the end of both chapters.

### 5.1 Closed-ended questions

The first question of the survey was used to query the respondents where their office was located:

*Question 1. The location of your office.*

The total number of responses to the question was 485. Figure 7 shows how many of the respondents were located in Linnanmaa, Kontinkangas or some other location.

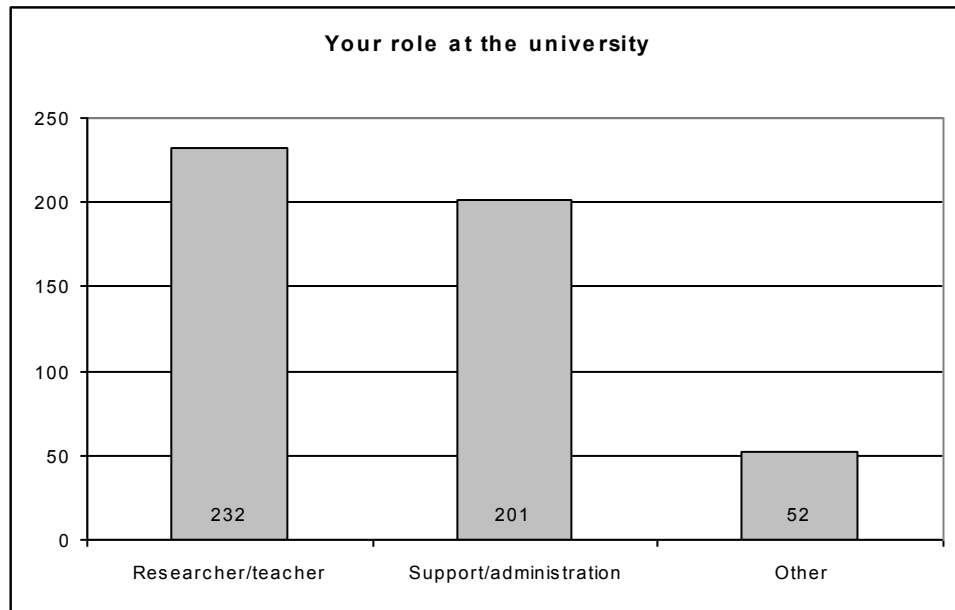


**Figure 7.** The office locations of the respondents.

The percentage of respondents located in Linnanmaa was 75,67 percent, in Kontinkangas 16,91 percent, and in other locations 7,42 percent. Most of the people who answered to the questionnaire were located in Linnanmaa. Linnanmaa campus was the largest unit of the University of Oulu so this was not surprising.

The second question of the questionnaire was aimed to discover the roles of the respondents at the university:

*Question 2. Your role at the university.*



**Figure 8.** Respondents' roles at the university.

The total number of responses to the question was 485. Figure 8 represents the distribution of the responses. Most of the respondents were researchers and teachers (47,84 %) but almost as many were support and administration personnel (41,44 %). 10,72 percent of the respondents belonged to neither of these groups.

The third question concerned the respondents' experiences of the print services:

*Question 3. Your experience of the use/functionality/usability of print services (1 = Bad, 5 = Excellent).*

**Table 3.** Respondents' experiences of the use/functionality/usability of print services.

	1	2	3	4	5	Total	Mean
Answers	14	30	64	236	142	486	3,95
	2,88 %	6,17 %	13,17 %	48,56 %	29,22 %		

Table 3 shows that most of the respondents were content with the use, functionality and usability of print services. The mean value of 3,95 reveals that the respondents were mostly satisfied with the service. 77,78 percent answered 4 or 5, and only 44 respondents (9,05 percent of the respondents) answered 1 or 2 on the scale of 1 to 5.

With the fourth question the skills of the respondents were inquired:

*Question 4. Assess your own skills with utilizing the features of printing devices (1 = Bad, 5 = Excellent).*

**Table 4.** Respondents' assessments of their skills with utilizing the features of printing devices.

	1	2	3	4	5	Total	Mean
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Your skill level	1 0,21 %	19 3,94 %	154 31,95 %	247 51,24 %	61 12,66 %	482	3,72
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Table 4 shows that overall the respondents felt like they were quite capable of utilizing different features of the printing devices. Almost 64 percent of the respondents assessed their skills over average and only 4,15 percent of them assessed their skills below average.

Next, the quality of printing devices was asked from the respondents:

*Question 5. Assess the quality of printing devices (1 = Bad, 5 = Excellent).*

**Table 5.** Respondents' assessments of the quality of printing devices.

	1	2	3	4	5	Total	Mean
The sufficiency of features in printing devices	8 1,65 %	18 3,72 %	52 10,74 %	205 42,36 %	201 41,53 %	484	4,18
The quality of prints	2 0,41 %	8 1,65 %	37 7,61 %	221 45,47 %	218 44,86 %	486	4,33
The speed of printing	34 7 %	45 9,26 %	95 19,55 %	176 36,21 %	136 27,98 %	486	3,69
The functionality of printing devices	7 1,45 %	32 6,61 %	76 15,7 %	220 45,45 %	149 30,79 %	484	3,98
The location/amount of printing devices	19 3,93 %	22 4,55 %	57 11,8 %	211 43,69 %	174 36,02 %	483	4,03

On the whole the quality of printing devices was good based on the responses (see Table 5). The speed of printing got the lowest mean value, but being 3,69 it was still over average. Even though 16,26 percent of the respondents assesses the speed below average and 19,55 percent average, more than 64 percent assessed the speed of printing better than average or excellent. The quality of prints was assessed over average by little more than 90 percent of the respondents. Most of the respondent were also satisfied with the printing features in the printing devices. Over 40 percent assessed them excellent. Also, the respondents were quite happy with the functionality of the printing devices. The locations and amounts of printing devices were also assessed better than average even though about 8,5 percent of the respondents assessed the amounts and locations below average.

In the sixth question the respondents were asked about the quality of support services:

*Question 6. Assess the quality of support services (1 = Bad, 5 = Excellent).*

**Table 6.** Respondents' assessments of the quality of support services.

	1	2	3	4	5	Total	Mean
Reachability	13 3,04 %	36 8,41 %	155 36,21 %	168 39,25 %	56 13,08 %	428	3,51

Skills	4 0,94 %	8 1,88 %	134 31,53 %	181 42,59 %	98 23,06 %	425	3,85
Service orientation	7 1,66 %	26 6,16 %	136 32,23 %	165 39,1 %	88 20,58 %	422	3,71
Overall rating of support service	4 0,94 %	27 6,37 %	135 31,84 %	194 45,75 %	64 15,09 %	424	3,68

The quality of support services was assessed by the respondents better than average in all questioned attributes (see Table 6). Most of the respondents rated the quality in all of them 4, but many also gave the average grade of 3. About third of the respondents thought that the quality of support services was average, and about forty percent better than average but not excellent. The division of the responses was the same in all four of the questioned attributes.

In the last closed-ended question the respondents were asked to assess the print services on a school grade:

*Question 7. Which school grade would you grant to print services? Use a scale of 4-10.*

**Table 7.** Respondents' assessments of print services on a school grading scale of 4-10.

4	5	6	7	8	9	10	Total	Mean
4 0,84 %	12 2,52 %	28 5,87 %	45 9,43 %	134 28,09 %	223 46,07 %	31 6,5 %	477	8,28

Total number of responses to the question was 477 from which 46,07 percent granted the print services the grade 9 (see Table 7). The mean value of the grades was 8,28. The school grade 8 in Finnish school system is equivalent to "good" (Perusopetusasetus, 852/1998).

In summary, based on the responses to the closed-ended questions, the respondents were quite content with the print services. Most of the respondents were located in Linnanmaa campus and were researchers and teachers or support/administration personnel. The print services were assessed functional and usable, and the respondents felt that their skills with utilizing the features of the printing devices were average or better than average. The quality of printing devices was assessed good, the most happy the respondents were with the quality of prints, and the least happy with the speed of printing. The support services were rated average or better than average by most of the respondents. Finally, the users graded the print services as eight on a school grading scale of 4-10.

## 5.2 Open ended questions

Users' responses to open ended questions numbers eight and nine of the survey provided a little more in-depth information about the users' experiences of changes in the print services. While the purpose of the closed-ended questions as well as question number eight was to clarify how the users experienced the print services after the

change, question number nine was used to find out how the users experienced the print services before the change. The open ended questions were:

*Question 8. Give written feedback about the print services as a whole. Good and bad qualities, own experiences, etc.*

*Question 9. With your own words, describe your experiences of the printing services before the change in the services last summer. Describe also how the change in the services has affected your work.*

The number of responses to question number eight was 374 and to question number nine 370. In the responses there were both positive and negative feedback. Next, the findings from the open ended questions grouped in classes are presented with example extracts from the responses.

## **Devices**

In many of the responses the quality of prints was assessed better with the new print service.

“With the renewal the quality of prints and their [print services] reliability has clearly increased.”

In the responses one frequently acknowledged feature of the print services was the possibility to scan and send the file to own or someone else’s email.

“Also scanning directly to email is fast and handy.”

Many complimented that scanning had also become better after the change in the print services.

“Scanning has become remarkably easier and faster.”

The scanning option was also perceived as a means to reduce printing on paper.

“The need to print papers has reduced significantly because documents can be conveniently scanned directly to email.”

Many of the respondents felt that the operational reliability of the printing devices had increased after the change.

“After the change the printing devices have become better, they are easy to use and above all function significantly better than before.”

However, in several responses it was mentioned that the devices were slow or had become slower than before.

“The device is slow, the earlier printer was much faster.”

The locations of the devices divided the opinions of the respondents. Some were pleased with the way they were located.

“The printer is close, it’s easy to go there.”

Others felt that the devices were moved too far away from them.

“Neither the amount nor even the locations of the printing devices correspond to the need which they have.”

Actually, there were some who found it positive that the devices weren't located too near.

“It does not matter that the printer is a little farther away, at least you get to take short walks throughout the day.”

A few however expressed a need for a personal device because of the nature of their job. They felt that it was necessary for them to have their own printer so that they would not have to leave a customer or a student alone while they were collecting the prints somewhere else.

“In my work as a ... I need a personal printer because I cannot run many times during a meeting with a student to another floor to print some papers.”

Printing with other than Windows operating system was experienced problematic by some of the respondents.

“I'm a Mac user and occasionally there has been troubles. Problems also with drivers, I'm not able to send black and white prints to the device.”

“When printing from Linux, document properties (e.g. colour/black and white) do not always seem to be passed to the printer but you have to set them by hand on the printer.”

### **Support services**

Support services received both positive and negative comments in the questionnaire. Many of the respondents greeted that the devices functioned better than before, and that there was no need for them to do any maintenance work with the devices anymore.

“The devices I use have always been in function.”

“Before the current print services the devices were immoderately too often broken or there was some kind of malfunction, paper jam, no ink, and all sort of things. ... Luckily we have reached the current service level!”

Many respondents had, however, noticed that paper runs out of the devices.

“In addition, in the copying machine there is room for only about 500 papers, it runs out often, the same as paper in general. It is frustrating to search for a copying machine where there is paper.”

“The only thing I have had to do is adding paper.”

Still, there were also some who were pleased with the paper maintenance of the new print services.

“Printing has functioned confidently, there has always been paper, ink, etc. and there has been no paper jams.”

In many responses the need for more guidance was brought up. The users seemed to have problems with the use of the devices, especially with selecting correct settings when printing something more special than basic A4 prints. Some of the users seemed

to have problems for example with the stapling option of the devices. Some had tried to make it work unsuccessfully and some could not find the option at all.

“There should be proper and clear instructions for the devices and their use near them. There should also be clearly laid out directions in the proximity of the devices about where to report problems.”

“Yet I haven’t been able to set the printer to staple.”

“In our device there is no stapling which we need at the service point all the time.”

“What I’d hope for (I don’t know if there is such service already) is that there would be help available if you need to print something more special such as booklets or address labels.”

“Unbelievably complex devices. There is no chance to find out how to print transparencies even by reading the manuals.”

Printing in libraries at the university received some comments too. The respondents, who in this case were presumably working in the libraries, felt that they were too much in charge of helping people with printing. Also, in a few comments printing for people from outside the university without ID card was considered problematic.

“The guidance with customer devices (written instructions) has stayed totally on the shoulders of the library even though they were asked many times.”

“The library serves also people from outside the university, still the print services have been designed only for the use of the people at the university (students and employees).”

“Visiting researchers cannot print what they need by themselves even if you’d give them your computer’s passwords. What so dangerous could they print that researching had to be interfered this way?”

### **Secure printing**

One of the most frequent issues that came up in the responses was secure printing. The users had both good and bad experiences of it. Secure printing meant that the user had to go to the printing device and release the printing job by logging in to the device by entering user name and password or by showing an RFID identifier in a card reader. The RFID identifier was either a card or a sticker.

Proponents of secure printing felt that it has enhanced the security of printing.

“The use of ID card in printing is good – now prints wont get mixed. Before you had to be careful not to take someone else’s papers with you.”

“The security of printing (confidentiality) is important to me because we handle a lot of confidential information in our work, so printing with your own ID card is no doubt an improvement.”

Many respondents also noticed that unnecessary printing had reduced because of secure printing. The new devices had displays where after logging in the user selected the printing jobs and then started the printing. Therefore the unnecessary printing jobs could be deleted before they were printed out.

“It’s an extremely good feature that the printer does not print until you log in to the printer (no unnecessary prints).”

Because secure printing required the users to go to the device, also the amount of forgotten papers at the printers was reduced.

“There are no more thick stacks of printed papers at the printer that nobody has collected.”

After the change in the service some had started also paying more attention to their printing needs and amounts. Even though quite a few respondents had noticed the decrease in unnecessary printing, just a few mentioned eco friendliness in their responses.

“When printing you see what it is going to cost, and now you evaluate more carefully what you start to print.”

“Now I think even more carefully do I really need this document on paper or is an electronic version enough. This is because now the amounts of printing are followed to some extent. This I think is a positive change because hopefully now people do not print everything like they used to do.”

“Perhaps the amount of printing has diminished a little, which, of course, is a good solution ecologically.”

“Due to the prints being double-sided (which is quite fine because it saves nature) you need to be more careful when printing.”

The possibility to release printing jobs at any device and at convenient time was perceived very positive.

“It is excellent that you can print out your prints anywhere and when you want at a suitable time.”

This was also seen as a possibility to avoid waiting and queuing.

“If there has been queues, I have been able to proceed to another device.”

Others however felt that with the new system printing wasted more time than before because of logging in to the devices and waiting for the papers to be printed. Some of the respondents also mentioned a problematic combination of slow devices and the slower printing process.

“Printing has slowed down; you can not anymore start the printing job and collect the print at a suitable time (you have to wait next to the device and wait for it to print).”

“It is extremely inconvenient that the printer does not print the papers right away when you send them but you have to stand next to it and wait after you have activated printing.”

“Two big problems are slow printer and that, that printing requires logging in to the printer which on its part requires standing next to the printer while it prints. Printing long documents takes too much working time when the printing has to be started with logging in, wait while the slow printing finishes, and finally log out.”

Some had experienced problems with larger printing jobs because of automatic log out. The respondents wrote about unfinished printing jobs that they were not able to continue after the log out. The need to stand next to the device and keep it from not logging the user out was also seen as wasted working time.

“A bad feature: When printing a document with several pages (more than 30 pages), the printing stops unfinished when the printer logs the user out. It seems like it is not possible to continue the printing job.”

Logging in to the devices was experienced cumbersome by some of the respondents. In addition, some found the use of the ID card in printing inconvenient because of the possibility of not having it with you.

“Logging in is very anguishing sometimes. You succeed approximately on the 10<sup>th</sup> attempt. This causes unnecessary rise in blood pressure.”

“It is a bit bad thing that the printer functions with the ID card. If you forget to take it with you, you cannot print anything.”

In some responses it was mentioned that the print queue of the printing jobs had too short time limit for the deletion of the printing jobs.

“It is an extremely big problem that printing jobs disappear from the print queue if they are not immediately printed. It has happened often that you have to find a document from somewhere again when you haven’t remembered to print it on time. There should be at least one week’s notice, or rather two.”

In summary, positive issues related to the new print service were increased security of printing, the possibility to release printing jobs at any device, and reduced unnecessary printing. Also the possibility to scan and send the file to email was experienced very positive. The devices were also seen functioning better since there seemed to be less paper jams and other problems with them. Negative sides that came up in the responses were the difficulties with the use of the devices and their settings, the slower speed of the devices, and the slower printing process as a whole.

## 6. Discussion and Implications

The aim of this research is to examine how the employees of the University of Oulu experienced the changes that were made in the print services. The old print services were administered by the university, and the new implemented service was a managed print services solution of an external service provider. A user satisfaction questionnaire was sent to the users in which the users' experiences of the changes were enquired. The questionnaire consisted of open ended and closed-ended questions, and the data gathered enabled analysis with quantitative and qualitative methods. However, the emphasis was on the qualitative analysis of the open ended questions.

The objective of the print services' renewal at the University of Oulu was to increase the performance of printing and reduce costs. Indeed, organisational performance can be improved by implementing new information systems (Joshi, 2005), and it is possible that introducing managed print services reduces costs (Handley et al., 2010). But, according to Gorla and Somers (2014), success of a new information system should be measured somehow so that the value it creates can be found out. One commonly used measure for information systems success is user satisfaction (Bokhari, 2005). Sometimes if users use a new system it can be perceived as a proof of satisfied users (Bokhari, 2005). However, after the change in the print services at the University of Oulu the users had no choice but to use the new print services if they wished to use the printing devices at the premises. Therefore, in this case, it would have been unreliable to regard use as a sign or a proof of satisfied users. Thus, a user satisfaction survey that was conducted at the university to find out how the users, the personnel, experienced the change in the print services, was reasonable.

The research question of this study was:

*How have the users experienced the change in the print services?*

Overall, it is possible to state that the change in the print services was experienced positively by most of the respondents. A few of the responses included quite harsh feedback while in others there were comments that expressed great contentment. Quite many of the respondents, however, had found both positive and negative aspects of the new service, and there were also several users who mentioned that the change had not effected their work that drastically. The users graded the new print services on a school grade as 8, which is good. Of course, there was no issue that all the respondents agreed upon. Still, the results of the survey imply that there might be a positive relationship between implementing a managed print services solution and user satisfaction. Even though people experienced problems with the print services the general feeling was rather positive.

The most appreciated qualities of the new print services were the increase in the security of printing, reduced unnecessary printing, and the possibility to scan files and send them directly to own or someone else's email. In the responses also the possibility to release printing jobs at any device at the university's premises was greeted. The respondents also thought that the devices functioned better than before. It is however uncertain whether this is because of new devices that do not yet suffer from the defects that come with time and usage, or because of higher quality of support services, or possibly both.



Because of secure printing the users had also noticed that the surroundings of the devices had become more uncluttered due to less forgotten printouts.

The most critiqued features were the difficulties with the use of the printing devices and finding correct settings, slower devices, and the overall slowness of the new printing process. More guidance was hoped for in several responses.

The possibility to influence on the content of the questionnaire was limited. The number of questions was kept low so that also the time required to answer the questionnaire would stay low. It was perceived that a questionnaire that is easy and fast to fill up would attract more users to answer. However, more detailed information, for instance about the user, could have provided some useful insights. For example, some of the respondents had noticed that paper runs out from the printing devices, but some of them had totally opposite experiences. If the faculty of the respondents had been asked in the questionnaire, it might have been possible to find out if the running out of printing paper was a problem in some particular location. The problem area could have been identified and corrective actions taken.

From the responses to the questionnaire it was possible to deduce that not everyone had the same needs concerning the printing services. As was mentioned already, some of the responses included comments about the difficulty of using the printing devices. The users were unsatisfied if they felt that the effort to make a device execute a desired task was too great compared to the result. This is in line with Au et al. (2008) who have stated that users have different needs concerning information systems, and the benefits, as well as the effort required to gain the benefits, influence on user satisfaction. For example, some of the respondents had experienced problems with finding the correct settings to print transparencies. Such task should be an easy one to carry out with a device that is meant for such purposes, so if the use of the device turned out to be more complex than was expected, the users got frustrated. The dissatisfaction the users experienced was probably even emphasised if the problem had not existed with the old print services.

According to Mahmood et al. (2000), in order that users accept an information system, it should have a positive impact on their job performance. From the results of this study it is possible to find support for their argument. Based on the responses to the user satisfaction survey, the biggest problems with the new print services turned out to be difficulties with the use of the devices and slower printing process. Both of these have a negative impact on the users' job performance. As for the possibility to release printing jobs at any device and better functioning devices, which were perceived as positive outcomes of the new print services, they increase the job performance of the users. Based on the positive overall result of the survey it can be stated that in this case the positive impacts seem to surpass the negative ones.

It is quite interesting that secure printing, which was greeted a lot due to the increased security and reduced excessive printing, was also denounced for slowing down the process of printing. In this case also the distinct needs of users probably made a difference. Someone who does not need to work with confidential material does not necessarily appreciate the increased security because with it the printing slowed down due to logging in. It is also understandable that the size of the printing jobs people executed affected user satisfaction. The time required to print one paper did not increase a lot along the change in the print services, but the time required to print a sizeable print job apparently did. A person standing next to a printer waiting for a printing job to be finished is likely to become tense if he or she is in a hurry, because the person's job performance is negatively affected by the print service. Furthermore, if the device logs

the user out in the middle of the printing job and it has to be started all over again, it is quite possible that the user starts to feel really irritated.

It should be noted that the users had used the new print services only about half a year when the user satisfaction survey was held. It is possible that the users had not yet had enough time to get used to the new service. Bokhari (2005) has suggested that there is a positive relationship, even though not necessarily a strong one, between system use and user satisfaction. This means that there is a possibility for user satisfaction to increase when time passes. For example, some of the users had experienced difficulties remembering to take their ID card with them before walking to the printing device. It is likely that over time taking the ID card along becomes a habit, and thus the cause of the decrease in user satisfaction fades away, or at least the frequency of the problem grows smaller.

Interestingly, some of the respondents had changed their opinion about the print services already during the first half year. One respondent wrote that “Scepticism has quickly changed to a positive surprise. For once it was possible to find a renewal executed at the university that works”. So even though the expectations of the respondent had been rather negative, the passing of time and getting familiar with the new services had rather quickly influenced on the respondent’s assessment of the services. According to Au et al. (2008), users’ expectations of an information system are not a dominating factor affecting user satisfaction, but when the system is new the expectations may have a bigger role in influencing user satisfaction. Hence, the findings of this study support their argument to some extent.

One main reason for failing successful implementation of an information system is user resistance (Jiang et al., 2000; Kim & Kankanhalli, 2009; Markus, 1983). According to Lapointe and Rivard (2005), resistance can occur if users feel threatened somehow, and implementation of new information technology is something that can be perceived as a threat. The findings of this research support the existence of resistance in the implementation of the new print services. Hence, the new print services solution was perceived as a threat at least by some of the users. Hirschheim and Newman (1988) have categorized resistance behaviour into three classes: aggression, projection and avoidance. There was no proof of aggression behaviour in the responses, but that of course does not mean that it has, or has not, happened. It is possible that attacking the new print services by causing injuries somehow, for example by breaking a printing device on purpose, has happened, but confessing something like that in a survey could have been seen as playing with fire.

However, signs of projection behaviour were visible in the responses. When the users were asked in the questionnaire how the change in the services has affected their work, one respondent answered “My work has become more difficult, and waiting and collecting prints takes time”. The user clearly blames the system of causing problems in his or her work. The responses also revealed avoidance behaviour. One respondent avoided using the new print services by printing at home: “...End result: I print at home with my own printer...”. Avoidance behaviour was identifiable in only a few responses but the signs of it shouldn’t be taken lightly. Resistance in general is often perceived as a problem even though it can help uncovering possible problems in the implementation of an information system (Markus, 1983). Closer analysis of the signs of resistance could reveal where in the print services improvements should be made.

It has been proposed that with a suitable strategy it is possible to alleviate user resistance (Jiang et al., 2000). In the responses to the questionnaire there were some in which more guidance was hoped for, and because the use of the devices was not that straightforward for all, a participative strategy proposed by Jiang et al. (2000) might be

suitable in this case. More training and clearer instructions could help reducing user resistance. Training is important for the users not only because it improves their skills, but also because it builds up their confidence with the use of a new system (Kim & Kankanhalli, 2009). In addition, to alleviate user resistance, it is substantial that a change has the support of the management (Hirschheim & Newman, 1988; Jiang et al., 2000; Kim & Kankanhalli, 2009). From the responses to the user satisfaction survey it was not possible to see whether the managers' attitudes towards the services differed from the others, but more important is how the management behaves and what impression they give when talking about the print services with other people. If the employees notice that the management does not support the change, they are not likely to do so either (Hirschheim & Newman, 1988).

Even though some resistance existed, and all users did not feel comfortable with the new print services, the presence of resistance does not directly indicate that the implementation of the new print services was not successful. According to Bokhari (2005), the happiness of the users is not the only reason why information systems are created, and print services certainly have other purposes also than delighting the users. For example, user satisfaction is not the only measure for the effectiveness of an information system (Melone, 1990), and increasing the performance of the print services was one of the aims of the renewal at the University of Oulu. Also, even though user satisfaction has an effect on information systems success, there are other factors and variables that effect on it too (see e.g. DeLone & McLean, 2003; Petter et al., 2013). Nevertheless, based on the findings of the survey, it is possible to state that the change in the print services was successful from the user satisfaction perspective.

Green IT is quite a hot topic today (Bose & Luo, 2011; Joumaa & Kadry, 2012; Murugesan, 2008; Watson et al., 2010), and environmental friendliness was also one of the main targets mentioned in the printing policy of the University of Oulu. According to Kalochristianakis et al. (2013), when a print management system is implemented, users develop more environmental friendly printing habits because they become more aware of the costs of printing. This happened also at the University of Oulu. When the cost of printing became visible for the users on the printing devices, some of them started to question their printing amounts. Thus the costs of printing became more real and tangible for the users than before and they printed less. This is consistent with Bose and Luo (2011), who state that environmental impacts of information systems can be reduced by behavioural changes.

Reducing the cost of printing was one of the main objectives of implementing the new print services, and it was achieved (see Appendix A). Hence, the results of this research support Handley et al. (2010), who stated that implementing managed print services may lead to cost reductions. At the University of Oulu savings were calculated being approximately 45 000 euros per month at the beginning of the year 2015. Thus, the savings in one year could be more than 500 000 euros. Interestingly, based on the printing amounts of the first quarter of 2015, the number of printed pages seemed to be decreasing month by month. It could be that when people got familiar with using the new print services the amount of mistakes they made decreased and therefore the amount of faulty printouts decreased, too. In addition, as was already mentioned, greener printing habits can reduce printing amounts too, but embracing these new manners can take some time. Also, duplex printing increased from 4,7 percent to approximately 70 percent, which exceeded expectations. This was probably due to duplex printing being a default setting in the new devices.

Finally, as a conclusion, some practical steps can be proposed based on the results of the study in order to improve the implemented print services and user satisfaction. Firstly, more training or possibly clearer instructions for use could be provided for the users.

Also, it could be assessed whether the time limit the printing jobs stay in the printing queue should be prolonged. The inconvenience of automatic log out during a large printing job should also be noted and acted upon. In addition, some attention could be paid to the sufficiency of paper in the devices since the print services solution in question should be a comprehensive one and, therefore, the users should not have to take care of paper maintenance.

As for research methods, according to Lyytinen (1987), case study method is the best when pursuing to collect rich data on information systems and problems in them. In this case study the data that was collected was rich, too. There were many issues the users brought up in the responses to the open ended questions, but the biggest problems and the most positive issues were still quite apparent. The questionnaire was sent to every employee of the university, so it is possible to say that the sample was representative, and that the responses represented the experiences of the entire personnel. Also, because users are generally direct with their comments about the information systems they use (Bokhari, 2005), and because the respondents were assured of their anonymity in the survey, it is quite likely that they answered truthfully to the questions.

Both qualitative and quantitative data analysis were conducted in this research. It is acceptable to combine qualitative and quantitative methods in a same study (Bryman, 2006; Gable, 1994; Kaplan & Duchon, 1988; Venkatesh, Brown, & Bala, 2013), and data analysis is one of the research phases where this can be done (Bryman, 2006). As Venkatesh et al. (2013) have pointed out, using both methods can offer new insights and ways to study phenomena in information technology research. However, one weakness of survey as a data collection method is that the response rate may remain low (Hirsjärvi et al., 2009). The response rate of the survey in this research was 16,5 percent, which in light of the results, the representativeness of the sample, and the richness of the data can be considered good for qualitative analysis. The amount of responses to the open ended questions was 374 for question number eight and 370 for question number nine, so the quantity of data was satisfactory. However, for quantitative analysis the response rate was too low and therefore, in fact, no conclusions could be made of the responses to the closed-ended questions. After all, the emphasis of this study was on the open ended questions and qualitative research, so less attention was paid to the results from the closed-ended questions.

Still, in this study, the use of both qualitative and quantitative methods had a purpose. If the response rate had been higher, it could have been possible to access even a vaster view of the users' experiences and feelings due to employing both of the methods. The qualitative analysis of the open ended questions revealed the users' more personal feelings and thoughts, whereas quantitative analysis of closed-ended questions could have provided a reliable general view of the users' experiences.

## 7. Conclusions

This chapter concludes the research. The aim of this research was to examine how the personnel of the University of Oulu experienced the change in the print services. A user satisfaction questionnaire that consisted of nine questions about the services was sent to the employees, with which their experiences were surveyed. The research was a qualitative case study but also quantitative data analysis was conducted as a support for the qualitative analysis. Next, the findings, contributions, future research topics, and limitations of the study are presented.

### 7.1 Findings

The findings of the study revealed that the users were satisfied with the new print services. Some of the new features were highly appreciated but also a few relatively clear areas of dissatisfaction existed. The most valued qualities of the new print services were the increased security of printing, reduced unnecessary printing, and the possibility to scan a file and send it directly to own or someone else's email. Also, the capability to release printing jobs at any device at the university's premises was greeted. Respondents also thought that the printing devices functioned better than before.

The issues that received critique the most were the users' difficulties with the use of the printing devices and finding the correct settings, the slowness of the devices, and the slower printing process as a whole due to secure printing. The users hoped for more guiding with the use of the devices.

Many of the respondents had, however, found both positive and negative aspects, and several mentioned that the change hadn't had a great effect on their work. From the user satisfaction point of view it is possible to say that the change in the print services was successful. It is quite impossible to receive unanimous acceptance when changes are made in information systems, but the findings of the study support the conclusion that the users were mainly satisfied with the print services after the change.

### 7.2 Contributions

When searching for information about managed print services, it becomes clear that not much scientific research has been done concerning the matter. More research is needed though, because the markets of managed print services are global and growing as well (Handley et al., 2010). When the literature review of this thesis was made, no studies were found in which user satisfaction was examined after a change in print services. Hence, this study contributes to science by adding knowledge about managed print services, and on a more detailed level about how personnel of a university experienced a change from print services managed by the university to managed print services provided by an external service provider. Also, the results imply that there might be a positive relationship between implementing a managed print services solution and user satisfaction.

The findings of this research can help the University of Oulu and Canon to improve the print services at the university. Even though the results showed that the users were

mostly satisfied with the new services, there were some concerns and problems that could be acted upon. Some practical steps were proposed that could be taken to improve the new print services and user satisfaction. Also, the questionnaire that was sent was the first in a series of user satisfaction surveys that will be held for the personnel in the future. Hence, the questionnaire and the derived findings act as a baseline for the forthcoming surveys.

The results of this research can be of help in other projects in which the aim is to successfully implement print services. Even though this study focused on one case in a university context, the results should be generalizable to other environments too. User satisfaction, user resistance and information systems success are rather universal subjects in the research of information systems, so this research expands the knowledge in those areas also in the context of print services.

### 7.3 Future research

This research focused on the experiences of the personnel of the University of Oulu, and user satisfaction of the employees is planned to be surveyed periodically every year. It is an essential task to do so that the emerging problems can be discovered in time and appropriate actions can be commenced. Also, because the users only had used the new print services for about half a year before the first user satisfaction survey was held, it is possible that the users hadn't had enough time yet to form all-round opinions of the services. However, the change in the print services affected the students of the university as well, so it might be interesting to also examine how they experienced the change. After all, majority of people at the university are students and therefore they should not be ignored.

The research provides some information about the impact of outsourcing on print services, but it could be studied further. Outsourcing can have impact on user satisfaction, and further, to the success of an information system (Gorla and Somers, 2014). Since there is not much scientific research done concerning managed print services, the outsourcing factor should be studied more in detail.

This research was a case study and the focus was on one case that was examined closely. It is possible that multiple-case research would provide interesting insights too about managed print services because it enables cross-case comparison (Darke et al., 1998). For instance, useful information could be uncovered from a comparison made between organisations from different industries. Managed print services can be implemented in many kinds of environments and the experiences of the users may differ. In academia, it might be interesting to compare how the students and employees in different universities have experienced changes in print services.

### 7.4 Limitations

Information systems success, user satisfaction and user resistance have been discussed a lot in the research of information systems and there is a vast pool of information available concerning the said issues. Hence, one possible limitation of this research is that including all related prior literature was not possible, and some interesting connections between previous studies and the findings of this study might now stay uncovered. Therefore in the future more in depth information could be generated by concentrating, for instance, merely on user resistance and how it is expressed by the users. Another related limitation is the amount of time. If there would have been more

time to analyse the responses to the open ended questions, the sentiments buried deeper in the them could have been revealed.

Even though some hints of a positive relationship between implementing a managed print services solution and user satisfaction were found the results should not be accepted without reservations. Based on the findings of one research it is not possible to make universally applicable conclusions, hence support for the proposition could be searched for in other forthcoming studies.

Unfortunately, there was a shortcoming in this research concerning the research methods. One weakness of surveys is that changing the questions is impossible after sending (Hirsjärvi et al., 2009). To question number six in the questionnaire, in which the respondents were asked to assess the quality of support services on the scale of 1 to 5, quite many respondents selected the average value of three. This is probably due to a flaw in the questionnaire because there was no option available for not having any experience about the support services. In that case it is probable that the respondents selected the value three from the scale if they had not needed the support services at all. Actually, some of the respondents even mentioned they had done so in the questionnaire. Therefore there might be a skew in the results of that question, and in reality there would be less average ratings in the users' assessments of the quality of the support services. However, since the response rate was low when considering the quantitative side of the research, the significance of the flaw is not remarkable.

Finally, it must be mentioned that the analysis of the research data is dependable on the researcher's interpretation (Benbasat et al. 1987). It is possible that even though the researcher should be neutral and objective, the interpretation is still influenced by the person. Having a research partner could help ensuring the correctness of the data analysis (Benbasat et al. 1987), but since a master's thesis is a personal endeavor, the responsibility of interpreting the results lies with the thesis worker alone.

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## Appendix A. Pages and costs table

	2012	2015	2015	2015
	October	January	February	March
<b>Nbr of pages (bw)</b>	1 043 974	1 037 023	1 001 808	981 162
<b>Nbr of pages (color)</b>	158 272	92 409	93 230	89 843
<b>Total nbr of pages (month)</b>	1 202 246	1 129 432	1 095 038	1 071 005

<b>Costs (bw)</b>	40 967 €	20 740 €	20 036 €	19 623 €
<b>Costs (color)</b>	26 206 €	10 165 €	10 255 €	9 883 €
<b>Total costs (month)</b>	66 964 €	30 905 €	30 291 €	29 506 €

<b>Paper costs</b>	6 997,07 €	0	0	0
<b>Energy costs</b>	1 372,48 €	152,24 €	152,24 €	152,24 €

<b>TOTAL COSTS</b>	<b>75 334 €</b>	<b>31 058 €</b>	<b>30 444 €</b>	<b>29 658 €</b>
<b>Savings</b>		44 276 €	44 890 €	45 676 €
<b>Cumulative savings</b>		44 276 €	89 166 €	134 842 €

## Appendix B. Questionnaire

### **Tulostuspalveluiden asiakastyytyväisyys selvitys**

### **Customer satisfaction survey of printing services**

Arvoisa vastaanottaja,

tervetuloa vastaamaan Oulun yliopiston tulostuspalveluja koskevaan asiakastyytyväisyyskyselyyn. Vastaamalla tähän kyselyyn voit auttaa meitä parantamaan palvelujamme.

Kyselyyn vastaaminen kestää vain muutaman minuutin. Kyselyssä kerättyjä tietoja tullaan käsittelemään luottamuksellisesti ja nimettöminä.

Yliopiston tulostuspalveluiden muutoksesta on tekeillä myös pro gradu -tutkielma.

Kyselyyn vastanneiden, sanallista palautetta antaneiden ja yhteystiedot luovuttaneiden kesken arvomme digitaalikameran. Toivomme kyselyyn vastattavan viimeistään 20.2.2015.

Canon Oy sekä Tietohallinto

Kaisu Hekkala, tietojenkäsittelytieteiden pro gradu -tutkielman tekijä

Dear respondent,

You are most welcome to respond to this customer satisfaction survey concerning the printing services at the University of Oulu. Answering this survey you can help us to improve our services.

Completing the survey will take only a few minutes. The information collected will be handled confidentially and anonymously.

A master's thesis is being made about the changes in the printing services.

A digital camera will be drawn among respondents who answer the survey including the open ended questions and leave contact information. We hope you to answer not later than 20.2.2015.

Canon Oy and IT administration

Kaisu Hekkala, MSc student, information processing science

**1. Toimipisteesi sijainti.**

The location of your office.

- Linnanmaa
- Kontinkangas
- Jokin muu / Other

**2. Roolisi yliopistolla.**

Your role at the university.

- Tutkija/opettaja / Researcher/teacher
- Tuki/hallinto / Support/administration
- Jokin muu / Other

**3. Kokemuksesi tulostuspalveluiden käytöstä/toimivuudesta/käytettävyydestä (1 = Huono, 5 = Erinomainen).**

Your experience of the use/functionality/usability of print services (1 = Bad, 5 = Excellent).

- 1 2 3 4 5

**4. Arvioi oma osaamisesi tulostuslaitteiden ominaisuuksien hyödyntämisessä (1 = Huono, 5 = Erinomainen).**

Assess your own skills with utilizing the features of printing devices (1 = Bad, 5 = Excellent).

- 1 2 3 4 5

**5. Arvioi tulostuspalveluiden laatua (1 = Huono, 5 = Erinomainen).**

Assess the quality of printing services (1 = Bad, 5 = Excellent).

- |   | 1                     | 2                     | 3                     | 4                     | 5                     |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Laitteiden ominaisuuksien riittävyys /<br>The sufficiency of features in printing devices | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Tulosteiden laatu /<br>The quality of prints  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Tulostamisen nopeus /<br>The speed of printing  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Laitteiden toimivuus /<br>The functionality of printing devices                           | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Laitteiden sijoittelu/määrä /<br>The location/amount of printing devices                  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

**6.** Arvioi palveluntuottajan tukipalvelun laatua (1 = Huono, 5 = Erinomainen).  
Assess the quality of support services (1 = Bad, 5 = Excellent).

	1	2	3	4	5
Tavoitettavuus / Reachability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Osaaminen / Skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Palveluhenkisyys / Service orientation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Yleisarvosana tukipalvelusta / Overall rating of support service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**7.** Minkä kouluarvosanan antaisit tulostuspalveluille? Arvioi asteikolla 4-10.  
Which school grade would you grant to print services? Use a scale of 4-10.

4 5 6 7 8 9 10

**8.** Anna sanallista palautetta tulostuspalveluista kokonaisuutena. Hyvät ja huonot ominaisuudet, omat kokemukset, jne.  
Give written feedback about the print services as a whole. Good and bad qualities, own experiences, etc.

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**9.** Kerro omin sanoin, minkälaisina koit tulostuspalvelut ennen kesällä tapahtunutta muutosta. Kuvaile myös, miten muutos tulostuspalveluissa on vaikuttanut työhösi.  
With your own words, describe your experiences of the printing services before the change in the services last summer. Describe also how the change in the services has affected your work.

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**10.** Kysymyksiin 8 ja 9 vastanneille: Jätä yhteystietosi arvontaa varten.  
For those who responded to questions 8 and 9: Fill in your contact details for the draw of the digital camera.

Etunimi / First name \_\_\_\_\_  
 Sukunimi / Last name \_\_\_\_\_  
 Sähköposti / e-mail \_\_\_\_\_