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The open source software alternative

Factors and their impact on the decision-making process at Swedish municipalities

Master's thesis within Informatics

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Title:	**The open source software alternative – Factors and their impact on the decision-making process at Swedish municipalities**
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Abstract

Arguably, the Schumpeterian ideology of "creative destruction" saying that eventually even the most secure monopoly will be destroyed by a new technology, a new idea, or a shift in tastes could be applied to open source software. Currently, the proprietary software holds a strong position in the software market. Nevertheless, one could see a surge in articles and acceptance among organisations concerning open source software.

Proprietary software companies like Microsoft are still gaining ground within the Swedish municipalities. Although one get the impression that municipalities generally are positive toward open source software, the decision-making process often results in choosing a proprietary software alternative. However, one could question which are the underlying factors and to what extent are these factors affecting the decision-making process of municipalities integrating or migrating into open source software?

In order to study this phenomenon, we chose a quantitative approach using a questionnaire as the tool for data gathering. The sample consisted of 100 randomly selected municipalities. A pre study was made through an interview in order to strengthen the accuracy of the questionnaire which later on was sent out to the IT manager at each municipality in the sample.

The organisational-, environmental-, user- and system level are four main factors affecting the decision-making process concerning open source software. Among these, the organisational factor was the only one which had a significant negative impact on the decision-making process concerning open source software. The importance of being able to integrate different software increases the need for compatibility which, according to the IT managers, is facilitated using a standardized software environment offered by for example Microsoft.

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1 Introduction

The introduction chapter will help the reader to get to know the subject better and understand how it fits into its broader context. The problem and purpose will then be used for narrowing the subject and directing the focus towards the particular phenomenon that will be discussed throughout this thesis.

1.1 Background

Following IBM's unbundling decision in 1969 to separate the operating system software from the hardware, Välimäki and Oksanen (2005), stress the emergence of a software product market. Throughout the years, different operating system platforms have emerged but also vanished. Moreover, Välimäki and Oksanen argue that Microsoft and its MS-DOS, which later became the Microsoft Windows, early on became the de facto standard for operating systems and have also played a major role in shaping the software business of today in terms of business models, licences agreements etc. The dominant position of Microsoft can however be questioned based on if you are talking about server operating systems or desktop operating systems. Bitzer (2005) claims that WindowsNT possessed a market share of 41.9 percent (in 2003) in the server operating system sector while the Linux platform (Appendix 1) has a 38 percent market share at the same time. If one, on the other hand, focuses on operating systems for the desktop environment, Välimäki and Oksanen (2005) claim that Windows possess a 95-98 percent market share while Linux only have 0.2-0.4 percent. Although the accuracy of these two investigations may be questioned since they are not using the same sample sizes, it is still interesting to see the fundamental differences in terms of market shares between these two technologies when it comes to the degree of successfulness in penetrating different markets.

Organisations have traditionally relied on commercial software products to support their operations (Goode, 2004). Alternatives to the "traditional" view on software development and distribution have however existed for decades. Richard M Stallman founded the Free Software Foundation (FSF) 1984, which were supposed to encourage the development of free software. Nevertheless, it was not until Linus Torvalds, then a 21- year old student from the University of Helsinki, made his first Linux operating system available on the Internet in the early 90s that the open source movement got publicly known. Linux became the kernel of the open source operating system project that was started by the FSF in 1984. His decision to make it publicly available for free although he could have sold it, created the emergence of a new philosophy concerning software ownership and development. It has been argued that, perhaps Torvalds greatest contribution was not creating Linux but giving it away for free. This decision has raised questions such as why giving away software for free when you could charge money for it? Further, West and Dedrick (2001), question the concept if software really can be owned?

In the past few years, open source software (OSS, Appendix 1) has, according to Fuggetta (2003), become one of the most discussed topics among software users and practitioners. Furthermore, Fuggetta argues that the increased interest in OSS could be motivated by at least three factors: the success of products such as Linux and Apache, which are gaining increasing market shares; the uneasiness about the Microsoft monopoly in the software industry; and, finally, the increasingly strong opinion that the "traditional" approach to software development are failing to provide a satisfactory answer to the increasing demand for effective and reliable software applications.

A traditional example of a proprietary licence model when it comes to ownership of software is the Microsoft End User License Agreement (MS EULA). This approach offers only the right to use the software, not to copy, distribute or modify it. While Edwards (2005) argues that the proprietary licensing agreement could be seen as situated on one of the extremes of a spectrum, the General Public License (GPL) is then on the other side of that spectrum, stating that software should be free and not something that you can own. In the middle there is e.g. the Berkeley Software Distribution (BSD) licence which could be viewed as something in between. These specific approaches outline different ways on how to handle license agreements between developers of software and their intended customers. Since developing complex applications requires extensive resources, it could be difficult to see how firms could make money based on giving away their software for free. On the other hand, if you purchase a software package, then should you not be able to do what you want with it? The software industry is different from many other industries in the sense that often you do not really own what you purchase, but you are allowed to use it. If you would have owned it, then you would be able to do whatever you want with it, such as having access- and being able to modify the source code. This discussion originates in intellectual property law which has previously justified software corporations in their way of "protecting" what they perceive as theirs. The development of OSS however presents an alternative business model which questions the former and, argued by some, will revolutionize the software industry forever (Välimäki & Oksanen, 2005; Lerner & Tirole, 2001).

1.2 Problem

Organisations, according to Goode (2004), perceive value in their hardware and software and are therefore prepared to invest substantial amounts in IT acquisitions and maintenance in order to stay efficient and effective. Moreover, Goode argues that the commercial software model recently has come under threat in two ways. First, acquisition and maintenance costs could be significant, e.g. licenses, updates etc. Second, adopters have encountered increasing difficulties in quantifying the benefits of IT acquisitions. If companies are unable to quantify the benefits, Goode (2004) argues that they must be unable to justify the costs for any software.

Perhaps, it is the Schumpeterian ideology of "creative destruction", developed by Schumpeter (1934) and reproduced by Bitzer (2005), saying that eventually even the most secure monopoly will be destroyed by a new technology, a new idea, or a shift in tastes. Arguably, the OSS movement, with its new technology and innovative way of looking at software ownership and software development could be seen as a challenge to the traditional actors within the software market. At this point of time, the proprietary developed software model constitutes a monopoly, or at least is in an oligopoly position, acknowledging the recent penetration of open source developed software. However, could it be the case that open source creates a "crack in the armour" of the proprietary model resulting in a course of events which leads to the "creative destruction", presented by Schumpeter (1934)?

Although one could see a surge in articles presented in scientific journals, magazines etc., in recent years concerning open source, it is still a new area of research and the development moves in a striking speed which means that there is an extensive amount of open source subjects yet unexplored. Subjects that have been explored within the open source area are mainly of a juridical or technological character. Thus focusing on advantages and disadvantages of the open source developing model, security and privacy limitations and opportunities of OSS, or in what ways OSS differs from the proprietary model in terms of licensing, ownership, etc. There is however a certain amount of research guided by business related

aspects of OSS as well. Goode (2004), for example, outlines different management barriers when it comes to the adoption of OSS. Although, management barriers concerns technology acceptance and factors for evaluating OSS, we found no research specifically covering this area. Moreover, an extensive amount of research on technology acceptance have been published, e.g. by Davis (1989) who developed a model explaining the acceptance of new technologies. These studies are important when trying to understand the acceptance of new technology adoption. However, there is a lack of research made concerning factors that affect the evaluation and justification process of OSS and how technology acceptance theory could be used to explain this phenomenon.

Two camps have been established: those who advocate the possibilities of introducing OSS into companies and those who do not. Dahlgren (2005) argues that traditional software developers clearly sees a risk with the recent popularity of OSS and argues that it could never replace the proprietary model since it is not as solid and does not offer the same degree of documentation and maintenance. The other camp, however, argues that OSS can drastically reduce the IT cost in terms of licenses etc., and offers an increased degree of freedom since you are allowed to change the source code and distribute it to others. Clearly it is hard to predict which camp that offers the most reasonable arguments since their entire existence affects their arguments. Still, as mentioned by Olsson (2005), it is better to have an open mind and study the possibilities of using OSS such as Linux, MySQL and Apache. Consequently, it is wrong to invest in OSS without understanding the drawbacks of this technology.

Not long ago the dissatisfaction with Microsoft's expensive license upgrades was a hot issue, especially within municipalities. OSS alternatives were discussed as a possible alternative and were on equality with commercial proprietary products. The saving potentials were however considered to be significant. The common opinion is that OSS is satisfactory and cheap; nevertheless the municipalities are not willing to migrate into OSS. Some of the reasons that are mentioned are: high costs for education, insufficient competence on the software, and the striving for homogeneity (Berg, 2005). These reasons might to some extent have emerged from insufficient investigations. It might also be because of convenience reasons; no one will hang the decision-maker for choosing Microsoft since it is a well known actor on the software market and already used in many organisation. Moreover, a common notion might be that if everyone else is using Microsoft products, then we must use it to.

It is possible to question the degree of objectivity, which should be an important part of the foundation when making decisions regarding software alternatives. The common apprehension at municipalities is that open source is a good and cheap alternative but carries high costs in terms of education and lack of competence (Berg, 2005). One easily gets the impression that choosing Microsoft could be a convenience decision in the sense that it is a well accepted and widely used alternative which means that it is easy to justify and probably could be seen as a "safe" choice. Thus one could argue that, based on the discussion above, there is a need to study relevant factors in order to evaluate and justify the possibility to migrate or integrate into using OSS.

Based on the problem discussion above, we formulate the following research questions:

- Which factors have an impact on the outcome of deciding if to migrate or integrate into open source software at municipalities?

- To what extent are these factors affecting the Swedish municipalities when it comes to deciding if to migrate or integrate into open source software?

1.3 Purpose

The purpose of this thesis is to identify factors and their impact on the decision-making process when it comes to Swedish municipalities migrating or integrating into using open source software.

1.4 Perspective

Investigating enablers for evaluating and justifying a migration or integration into open source developed software; one could argue the phenomenon could be viewed from different perspectives. We have come up with four alternative perspectives, but acknowledge the possibility that other perspective most certainly do exist:

- The IT managers' perspective and what he or she perceives as the most relevant factors for evaluating a potential migration or integration to open source developed software.

- The IT managers' perspective within a municipality and what he or she perceives as the most important factors when evaluating a potential migration or integration to open source developed software.

- The end users' perspective meaning what they think is the most important factors when evaluating the possibility of starting to use open source developed software.

- The software developers' perspective and what they believe are the most important factors for the customer to take into consideration when evaluating the possibility of a migration or integration into open source developed software.

The first two mentioned perspectives could at a quick glance seem almost identical. However, one could argue that substantial differences do exist between these alternatives. This may justify separating them into two specific perspectives. By IT manager, we are referring to e.g. a Chief Information Officer, or someone who are responsible for IT investments. The main difference between an IT managers in a company compared to a municipality in terms of perspective is that their business drivers differs. While firms are profit driven, municipalities' major concern regards stability, cost efficiency and what is best for the district in which they operate. Furthermore, one could argue that these differences could affect how one are viewing the two different perspectives. Throughout this thesis, our sole focus will be on IT managers' perspective within municipalities. This means that the other suggested perspectives are only used with the intention of showing that other perspectives do exist and that they differ from the one we intend to focus on.

1.5 Definitions

The open source subject constitutes a territory with a number of abbreviations and technical expressions. Therefore, one could argue for a description of important words related to the subject early in the thesis in order to simplify the understand ability and decrease the possibility for misunderstandings. The definitions are derived from scientific journals but formulated by us. Thus, the definitions may not be scientific; they are however adequate in understanding how the terms are used within this thesis. Since the list of definitions constitutes a rather long list, we have chosen to put it in Appendix 1.

1.6 Interested parties

Since our empirical study concerns municipalities, this is the most obvious group of interested parties. IT departments within municipalities need to be able to justify their software investments, e.g. choosing between an open source application and a proprietary software alternative.

Knowing which factors that play a major role for municipalities when evaluating their purchasing needs in terms of software could also be of interest for software developers. This could, for example, help guiding the OSS developers to more accurately emphasise on aspects that are of interest for municipalities.

One could argue that several target groups could have an interest of a model illustrating the use of OSS within an organisation and which factor that needs to be taken into consideration. Developing a generic model could have been an alternative. Though, it would probably be problematic since creating a generic model applicable to all kinds of organisations and authorities is almost impossible, as the business structure, demands and needs are different.

2 Frame of references

The frame of references is divided into two sections. The former section (2.1-2.2) introduces the subject and illustrates how open source differs from traditionally "proprietary" software products. This part is an introduction to the specific topic in order to create a theoretical foundation. The latter section (2.3) is more precisely directed towards our study. Here, four main areas have been identified as means for studying open source software at municipalities.

2.1 Pinpointing the concept of open source

The Open Source Initiative (OSI), which is an organisation dedicated to managing and promoting the open source definition, presents the following definition of open source:

"Open source promotes software reliability and quality by supporting independent peer review and rapid evolution of source code "

(OSI, 2005-04-13)

The definition presented by the Open Source Initiative is of the abstract kind. This is probably intentional since a broader definition is easier to fit with different kinds of OSS alternatives. However, if one is interested in a precise definition, covering every aspect of the subject, one runs the risk of loosing the meaning of the definition and going too deep into technicalities. Dixon (2004), on the other hand, succeeds in presenting a definition that we believe is neither too detailed nor too abstract.

"Open source software is offered to users with open access to the source code and the end users should be freely able to modify, copy, or redistribute the software they have legally acquired".

(Dixon, 2004, chapter1, paragraph 3)

This is the definition that will be used throughout this thesis since it is considered by us to be on the accurate abstraction level and clearly pinpoints what open source stands for. However, if one is interested in the full (long version) definition of the term open source, presented by the OSI, it is available in Appendix 2.

The debate about the definition of open source is considerable. There are, according to Fuggetta (2003) and Dixon (2004) two different interpretations that are currently used: "free software" and open source software. Further, Fuggetta (2003) argues that the differences between these two concepts are minimal. We will, in this thesis, consider the two terms (open source software and free software) as identical but will refer to the subject as OSS. The argument for the term "open source" is that "free software", according to Fuggetta (2003), makes some people uneasy. The Free Software Foundation argues that you should think of "free software" and OSS as in free speech, not free beer. This means that the terms specify that once you have obtain the software, you are free to modify it, redistribute it etc.; still it could cost money to purchase it. In this sense, one could argue that the term OSS gives a more accurate perception of the meaning and what you are allowed to do than the expression "free software". For example, the term OSS does not give the same associations of that the software necessarily needs to be free to obtain. Instead, the emphasis is on the freedom aspect in terms of that it allows a user to modify the source code, distribute it to others etc.

2.2 Proprietary Software vs. Open Source Software

Our intention with this section is to give the reader an insight into the differences between open source licences and closed source licenses and also to show internal differences between two different types of open source licenses. The Microsoft End User License Agreement (MS EULA) is a proprietary license provided by Microsoft, and the General Public License (GPL), together with the Berkeley Software Distribution (BSD) are two examples of open source licenses.

There are several open source licenses; the OSI has approved 58 different kinds of licenses. The licenses must fulfil the demands of OSI's Open Source Definition (see Appendix 2), however this thesis will not go further into the definition aspect. The main issues in the definition are free access to the source code and free redistribution.

During the discussion of the licenses, different roles in software development will be brought up. The different roles are the maintainer, who is responsible for releasing new versions of the software and the user-developer which is a user that uses the software and also makes modifications and improvements in the software. Users are people who just use the software and might give feedback, not source feedback, to the maintainer or user-developers of missing or faulty features.

2.2.1 Microsoft End User License Agreement

MS EULA is a contract that gives the license for an end-user the right to use software after approval of the agreement. Edwards (2004) means that software under this form of license is not "open" to the user. The source code is regarded as a trade secret and the software provided to the user as a binary program. Furthermore the owners of the software are only able to use the software on one computer. The MS EULA license states that distribution and copying are strictly forbidden.

Edwards (2004) argues that the communication between maintainer and users are insufficient within the MS EULA agreement since the relation is governed by the market mechanism. The maintainer will only implement a missing feature or fix a faulty feature if the cost is lower than the future income generated by the feature.

2.2.2 General Public License

GPL is according to Edwards (2004) far more permissive than the MS EULA. The users are able to copy, modify and distribute the software in almost any way. Though there is a regulation that the form of license can not be changed, another requirement is that modifications, such as added features or fixed defects are sent back to the maintainer of the software for approval and implementation which result in a new release of the program. Nevertheless, a user-developer can choose not to go public with his modifications, but then the modified software can only be for private use.

Development under this type of license, you could say there are three different roles. The maintainer, who is the original releaser, is responsible for new releases of the software. The maintainer gets input in terms of source code, which consists of changed or new features from user-developers. The user-developers get non-source code feedback from users who reports about defects or requests about new features.

Edwards (2004) argues that modifications are mostly derived from maintainers' and user-developers' private needs. There is a possible scenario when modifications clash, for example there might be two user-developers who are working on a new feature without knowledge about each other's work. Suppose that one of the user-developers finishes his modification and sends the code to the maintainer for approval and implementation. The maintainer releases a new version of the software including the user-developer's new feature at the time the other user-developer have finished his modification. This modification is incompatible with the first user-developer's modification. The maintainer has two choices, rejection of the last feature or be responsible for an integration of the last modification. This scenario could, according to Edwards (2004), be avoided through coordination, the user-developers could post in a forum what they intend to develop, and perhaps then could even work together.

2.2.3 Berkeley Software Distribution

The BSD license is an open source license which, according to Edwards (2004), gives the user-developer the freedom to do modifications and distribute the software in any way he wants. The difference from the GPL license is that the user-developer can distribute the software as closed source under another license. When the user-developer changes the license type, he becomes the maintainer of the software. The connection with the user-developers is disconnected. Furthermore, the maintainer is able to implement modifications that are implemented in the original software.

The relation between the maintainers and the user-developers becomes spoilt, as it is possible for the user-developers to wait for software to mature and then distribute it as proprietary software without any compensation to the maintainer.

Edwards (2004) argues that BSD has lower incentives for user-developers to make and distribute modifications compared to GPL. Although user-developers are sending modifications to the maintainer it might be because of personal interest, the user-developer wants the software to mature with the intention to later release the software as proprietary software. There is a possibility that this type of license leads to competition between user-developers to be the first one distributing the software as closed source.

2.3 Classification of open source software factors

The classification of literature relevant to this study is divided into four main factors: organisational-, environmental-, user- and system level. This classification builds upon an earlier classification made by Goode (2004) in the sense that we use the same four main factors. One could argue that since Goode (2004) studies Australian firms while our study concerns Swedish municipalities, using the same classification would not be appropriate. However, this is not the case since our factors consists of a number of sub factors which differs from the ones presented by Goode (2004). The intention with this classification is to reflect upon different sides of the OSS phenomenon in order to be able to answer our research questions as accurately as possible. Moreover, each sub factor has derived through the literature review in order to establish a theoretical body suitable to this study.

2.3.1 Organisational Level

This section will bring up factors at the organisational level which have an impact on the adoption of a new technology. Chircu and Kauffman (2000) argue that when firms estimate value potential of a technology they have to consider the impact their own organisation and the industry have on a possible IT investment.

Furthermore, Chircu and Kauffman (2000) outline industry- and organisational barriers as factors that limit the value of the IT investment. When evaluating an IT investment in a given industry, a potential value is estimated. The potential value is, according to Chircu and Kaufman (2000), the maximum value a firm or organisation can obtain from an investment in a certain environment. The potential value will never be reached in reality, as it will only reach that value if the implementation is 100 % successful, which is not that likely. During the conversion process the potential value will decrease to a realized value.

2.3.1.1 Industry

The value potential of an IT investment is, according to Chircu and Kauffman (2000), often limited by lack of resources, costs, and path -dependencies of co-specialized assets that are necessary to gain the benefits of the technology. An example could be that existing competences and capabilities constrains the renewal process.

There are certain types of technologies that, according to Chircu and Kauffman (2000), are favoured by a specific industry. In these cases, the favoured technologies are compatible with the pre existing technology while other technologies are not compatible. This could be seen as a barrier that emerges from the industry structure which inhibits the dispersion of new innovative technologies.

Furthermore the standardization of complementary technologies is an issue that might limit the value of a potential technology; an example is that the success of DVD discs is dependent on that people have DVD players.

2.3.1.2 Organisation

The same IT investment can lead to different estimated value potential depending on the characteristics of the organisation. Examples of characteristics that might limit the value potential, according to Chircu and Kaufmann (2000), are organisational routines and norms, market and product expertise and human capital. A new IT implementation might lead to 'sunk costs' which means that investments done in existing technology and human capital will be lost, which might hinder the adoption in many organisations.

It is important to redesign current business processes around the new IT's capabilities to maximize the benefits of the implementation. The alignment of business processes and IT can, according to Chircu and Kauffman (2000), create inefficiencies and trade-offs that end up embedded in organisational routines, this might lead to a limitation of the potential value of IT.

2.3.2 Environmental Level

Competition is stated by Thong (1999) as an important factor that affects companies in their business environment. It is generally assumed that adoption of innovations is more likely in a highly competitive environment since the uncertainty is high which increases the need for adoption of innovations. However, one could argue that municipalities act in an

environment where the competition is fairly low, as a consequence there is no need for adopting innovations.

We have chosen to focus on the management when it comes to the environmental level. According to Thong (1999), the characteristic of the management are crucial in the decision-making process in the adoption of IT.

2.3.2.1 Management

The driving force for an IT innovation can, according to Pinsonneault and Kraemer (1993), be personal interest among decision-makers concerning technology. It could be argued that they see an opportunity to promote their interest and strengthen their position in the organisation through the technology.

Thong (1999) argues that the CEO's innovativeness is an important issue for the adoption of IT in small businesses. One could argue that the innovativeness of the decision-makers in municipalities also is an important issue. Thong (1999) brings up two extremes: adaptors and innovators. The adaptor is looking for solutions that have been tried and understood. One could argue that an adaptor is not likely to adopt an OSS alternative. The innovator decision-maker on the other hand is trying to find solutions that change the structure in which the problem is embedded. These solutions have not been tried before and are therefore risky.

Moreover, Thong (1999) stresses the knowledge of the CEO and its impact on adoption. Many businesses delay adoption of innovations until knowledge barriers to adoption are lowered or circumvented. As lack of knowledge is an adoption barrier it is important to acquire the knowledge to overcome it, one could argue that this is a strategic issue in terms of that the responsibility is on the management function. The knowledge will lower the adoption barrier and this will lead to greater probability of adopting the innovation. Ettlie (1990), (retrieved from Thong, 1999), has found that CEOs with more knowledge of an innovation are significantly more likely to implement an aggressive technology adoption.

The lack of knowledge also has impact on decision-makers as they believe that they have no use for a certain technology because they do not have knowledge of the benefits. Thong (1999) argues that if the decision-makers get educated in the subject they might realize that their business could gain improvements and they are more likely to adopt the technology.

Goode (2004) has conducted a study of management rejection of OSS. Further, Goode (2004) identified a number of management barriers when it comes to adopting the use of OSS:

- Lack of relevance
- Lack of support
- Minimal or no requirements
- Insufficient resources
- Commitment to Microsoft

According to Goode (2004), managers are concerned that if no equivalent to commercial software support exists, companies using OSS run the risk of having to support their own software applications using company resources. This is however not entirely true since

companies such as Red Hat Linux and VA Linux do exist, which entirely make money on providing services such as support, installations etc. These companies may however be less well known. Minimal or no requirements means, according to Goode (2004), that management is unwilling to explore new software models. In this case it could be important to have a technology champion within the function who has the knowledge and is willing to promote the new software models. Insufficient resources could be manifested in the way that one does not want to invest in education and training of using entirely new software environments when the users already are familiar with e.g. the Windows platform. Moreover, since Microsoft is such a big player on the software market, Goode (2004), argues that there are actors who feel committed to using their products and therefore reject all other alternatives.

2.3.3 User level

Behavioural elements such as the adoption and acceptance of innovations are important factors when trying to understand the users' relationship to information technology. The user level consists of factors that influence the usage of information technology. Further, the OSS issue is here related to the wider user acceptance discussion.

2.3.3.1 User acceptance

Davis (1989) and Bugozzi and Davis (1992) have developed a technology acceptance model (TAM) in order to describe the acceptance of information technology in performing tasks. TAM has throughout the years received extensive empirical support and has been modified on a number of occasions by e.g. Lai & Li, 2005; Yang & Yoo, 2003; Amoako-Gyampah and Salam, 2003) in order to be applicable to ERP systems, Internet banking etc.

The TAM model consists of two important factors that influence the usage of information systems (IS): perceived usefulness (PU) and perceived ease of use (PEU). Davis (1989) defines PU as the degree to which a person believes that using a particular system would enhance his or her job performance. This is related to job effectiveness, productivity and relative importance of the system to one's job. PEU, on the other hand, refers, according to Davis (1989), to the degree to which a person believes that using a particular system would be free of effort, in terms of physical and mental effort as well as ease of learning. It is, according to TAM, these two beliefs (PU and PEU) that determine one's intention to use a particular technology. Furthermore, the TAM model uses behavioural intention such as IS usage and attitude toward certain behaviour as functions of PU and PEU. The TAM model was, according to Davis and Venkatesh (1996), primarily designed to understand the casual chain linking external variables to its user acceptance and actual use in a workplace. Figure 2-1 illustrates the original TAM model, developed by Davis (1989).

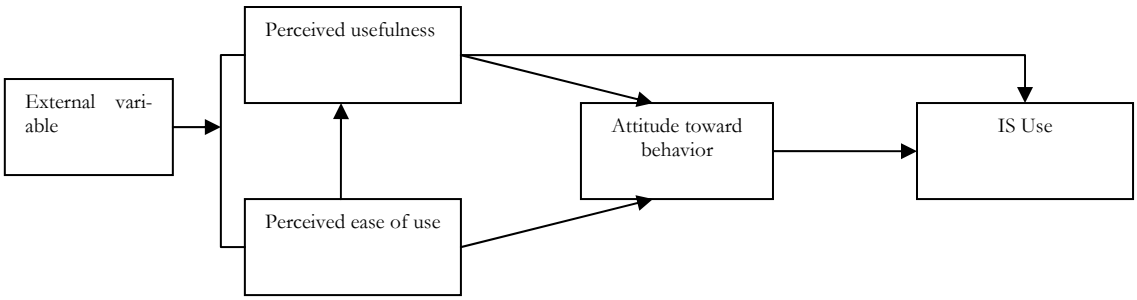

Figure 2-1 Technology Acceptance Model (TAM), (Davis, 1989).

Applying the TAM framework to this study, the external variable could be OSS. This variable subsequently affects the degree to which users perceive the usefulness and ease of use of OSS. Depending on the outcome of PU and PEU, a certain attitude is formed which in return affect the usage of the specific OSS.

2.3.4 System level

The system level addresses issues such as security and risk, when it comes to OSS, but also in which ways this innovative and distributed development process affects the quality of the software products.

2.3.4.1 Security and risk

The security and risk barrier concerning OSS is an important and widely discussed topic that needs to be analysed further in order to determine its suitability for municipalities. Generally, it is argued that open equals safer according to the Linux community (Hunter, 2004). The argument for this is that the open source approach reduces the threat posed by bugs in the code by exposing it to wide scrutiny, unlike the Windows operating systems where the source code is a commercial secret.

Moreover, Hansen, Köhntopp and Pfitzmann (2002) extend this argument by suggesting that for a wide use of IT systems in information societies there should not only be a feeling of security from the users' side , but also an actual security claim that is made subject to validation. Hansen et al. (2002), claim that both are true when it comes to open source. Open source enhances software's transparency since it allows access to the source code which means that, in principle, anyone is able to check an open source software for its specified functionality, or whether it contains any Trojans or other types of infected code. This may be true in theory, but it is questionable to argue that the regular users have the proper knowledge to examine the source code of an OSS in order to determine if it consist of infected code or not. Therefore, it is more likely as suggested by Hanson et al. (2002) that, in many open source projects, bug databases are run, where users can send bug reports. As soon as the problem is fixed, the users will be informed. On the contrary, the disclosure of the source code and the criteria for its design has, according to Hanson et al. (2002), for a long time been considered necessary conditions for security. The concept of "security by obscurity" is however questionable since reverse engineering could still be used to find security holes. The Opensource.Org, for example, states that problems are being found and fixed instead of being kept secret until the wrong person discovers them.

2.3.4.2 Quality

Although, OSS is often scrutinised by a large number of people, it could lull people into a false sense of security (Hansen et al., 2002). The intention of the Internet community might not always be obvious. For example, it could be widely left to the chance to what extent a source code is being evaluated by users. Since OSS developers rarely get any monetary compensation for the time and effort they put in, one might have a hard time understanding what is in it for them? What motivate programmers are instead mainly ego gratification incentives which steams from the desire of peer recognition (Lerner & Tirole, 2000; Hars & Ou, 2001; Lakhani & Hippel, 2003). Other drivers are future job offers, shares in commercial open source companies, future access to the venture capital market. The idea that improvements are driven by the developers' personal motivation is also supported by Hansen et al. (2002), who see this as an advantage compared to proprietary programs. Then, there are no market pressures to release a new software version within a time frame, al-

though the product might not be considered as entirely completed. Although, there are other personal drivers besides monetary rewards, one needs to acknowledge that this factor is important and might as well work as good as any other driver such as community recognition etc. A programmer, for example, could work for a proprietary software firm during the days, driven by the monetary rewards, and on his free time work with OSS development. Both fulfil different needs and could be equally important in terms of personal needs and self actualisation.

Fuggetta (2003) presents a cause-effect diagram, Figure 2-2, illustrating how open source developed software creates high quality software and customer satisfaction.

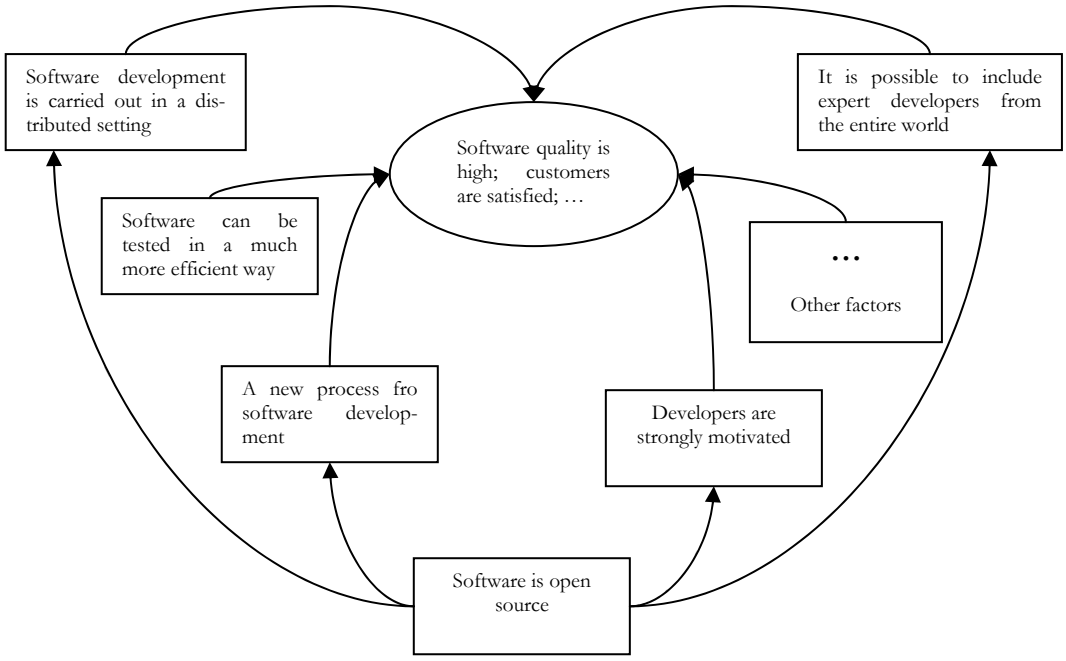

Figure 2-2 Cause-effect diagram. Fuggetta, 2003

Figure 2-2 illustrates that there are a number of factors affecting the level of software quality. Moreover, the open source developing approach allows multiple users being able to simultaneously test and improve the code. A widely performed inspection of the code in search of bugs etc. is also performed. This distributed setting together with the ego gratification incentives, creates a process for software development where high software quality is produced.

2.3.4.3 Training and education

Although OSS presents obvious cost advantages in terms of not having to spend money on licences, alternative costs may arise due to training and education etc. Chircu and Kaufman (2000) identify resources and knowledge as two potential barriers which could hinder the value creation of IT investments. Further, training and other efforts to increase "organisational awareness" of how to obtain value is, according to Chircu and Kaufman, correlated with the degree of resources put into the project. Building and retaining human capital through training and human resources, policies help organisations eliminate the knowledge barrier (Chircu and Kauffman, 2000). When trying to integrate or migrate the organisation's software platform into using OSS, obstacles most certainly will arise. As stated by

Ward and Bawden (1996), if change is to be successfully implemented within an organization and complexity and uncertainty associated with that change are to be minimized, one need to carefully think through the whole implementation process. Changing software therefore requires, among other things, investments in training in order to minimize the knowledge barrier. Goode (2004) mentions there seem to be a notion that OSS is only free to those who do not value time. Although, this might be to exaggerate, the statement certainly carries some truth. If one is not willing to acknowledge the importance of training and knowledge creation and is not ready to put resources into it, one should carefully consider staying with the old information systems and applications. Certainly all new software purchases require training, going from a Microsoft product to another Microsoft product compared to an OSS alternative, probably is a bigger step since the environment has fundamentally shifted.

2.4 Discussion of the frame of reference

The four main factors that are being used in our classification (organisational, environmental, user and system) have been presented with the intention to elucidate our way of categorising OSS related factors for this study. These four main factors followed by the sub factors are used as a foundation when creating relevant questions for our survey. Moreover, we are aware that the classification used, is not covering every single aspect of the phenomenon, e.g. legal- and cost structural aspects are two alternative factors that could have been discussed further. It would have been possible to put the former of these two under environmental factors, and the latter under system factors. However, including the mentioned factors (legal- and, cost aspects), one could argue, would have shifted the focus away from our intended purpose, negatively affecting the consistency of the thesis. For example, the reader would then probably have expected cost efficiency analysis examining the savings that could be made by choosing an OSS alternative.

Subsequently, these factors followed by their sub factors all have a certain level of impact on the decision-making process regarding municipalities' possibility to migrate or integrate into using OSS. Although, they may not be equally important in the eyes of an IT manager within a municipality, they still mirror a certain impact on the decision-making process. As stated in our research questions (1.2), this impact and to which extent it is facilitated is then studied. The reasoning taking place above is illustrated in Figure 2-3. The statements in the questionnaire have emerged from different parts in the theoretical framework. Statement one to four have emerged from the organisational factors, statement five to seven concerns environmental factors, eight to ten is statements that have emerged from factors concerning user level and eleven to fourteen is statements concerning system level.

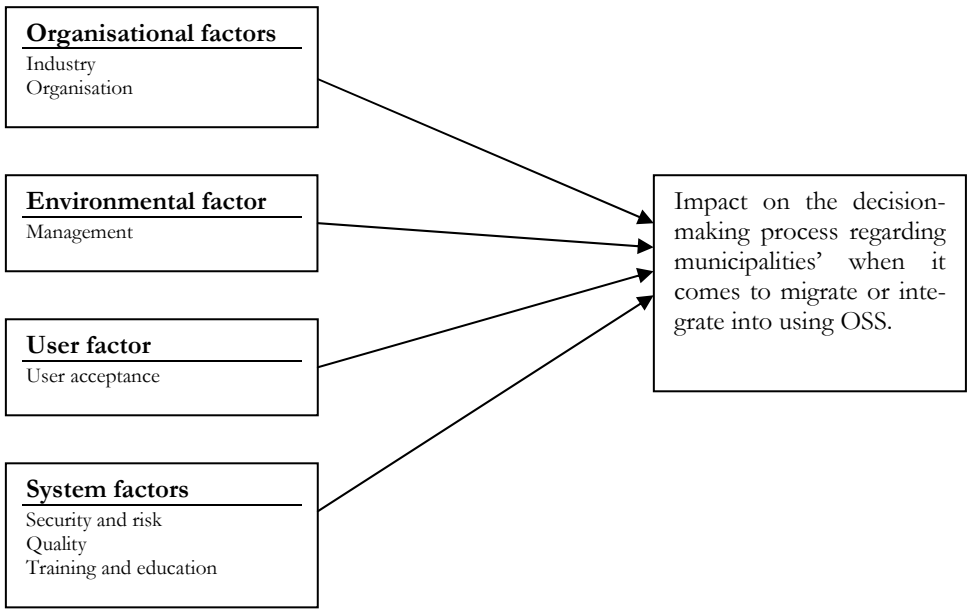

Figure 2-3 Research model

The main argument for presenting the theoretical framework according to Figure 2-3 is because it allows us to not only visualising what theory that is being used but also how the different parts are related to each other. The factors, illustrated on the left side of the model together with their impact on the decision-making process concerning OSS illustrated on the right side, directly steams from the two different research questions presented in chapter 1.2. This is done with the aim to show how the theory is used in order to guide our research.

2.5 Proposal for aspects to measure

As suggested by the research model, Figure 2-3 presents four main factors that could be viewed as a foundation or starting point when approaching the aspects we intend to measure. These factors will help deepening the level of understanding regarding to which extent organisational-, environmental-, user- and system factor affect IT managers when evaluating and justifying the possibility to migrate or integrate into using OSS. Based on the theoretical framework and the stated research questions (1.2) we present the following propositions:

P1. We will study which impact organisational factors have on the decision-making process of IT managers, within municipalities, when it comes to migrate or integrate into using open source software.

P2. We will study which impact environmental factors have on the decision-making process of IT managers, within municipalities, when it comes to migrate or integrate into using open source software.

P3. We will study which impact user factors have on the decision-making process of IT managers, within municipalities, when it comes to migrate or integrate into using open source software.

P4. We will study which impact system factors have on the decision-making process of IT managers, within municipalities, when it comes to migrate or integrate into using open source software.

The proposals presented above all steam from the factors displayed on the left side of Figure 2-3. The right side of Figure 2-3 could be seen as functions of the organisational-, environmental-, user-, and system factors, each affecting the decision-making process to some extent. Furthermore, these functions are of an analytical nature and therefore will not be discussed further in this chapter but will instead be used as a foundation when presenting our empirical findings and analysing our results.

3 Methodology

This chapter will discuss and motivate the research design and approach for this thesis. Moreover, measurements of the study's trustworthiness together with justifiable data gathering techniques will be brought forward in order to present a strong case.

3.1 Research design

Social research, according to de Vaus (2001), needs a design or a structure before data collection or analysis can commence. Further, de Vaus argues that the function of a research design is to ensure that the evidence obtained enables us to answer the initial question as unambiguously as possible. This means that one needs to specify the type of evidence needed to answer the research questions or to accurately describe some phenomenon. Basically, the question that needs to be answered is: What evidence do I need to collect?

Our research questions are of an explanatory nature in terms of that we intend to describe which factors municipalities use when evaluating and justifying the possibility of using OSS. But also try to comprehend why they are doing it the way they are. According to Björklund and Paulsson (2003), explanatory studies could be used when you are in search of deeper knowledge and you intend to both describe and comprehend a certain phenomenon. Moreover, knowledge regarding municipalities deciding variables, when it comes to open source, are crucial in order to later on being able to understand the importance and meaning of each factor and how it is related to the other factors. Therefore, one could see a need for an explanatory study where a descriptive "foundation" is laid out which then facilitates finding evidence of a more comprehensive nature.

3.2 Choice of research approach

Järvinen (2000) stresses that the reason for taking a research approach instead of a research method as a unit of analysis is the limitations of human information processing. It has been determined that the human short term memory is restricted to 5 ± 2 observational units, thus using a research approach, it could contain several research methods but still belong to a certain approach. Within Järvinen's taxonomy of research approaches, the theory-testing approach is one of the categories. The theory-testing approach is used for empirical studies where the theory, model or framework is either taken from the literature, or developed or redefined for that study. Methods that could be applied are laboratory experiment, survey, field study, field experiment etc.

Since our intentions are to study municipalities throughout Sweden and given the intended purpose one could argue that deductive reasoning, using theory-testing, is the most suitable research approach. Testing different propositions, derived from the theoretical framework, could therefore be used when trying to confirm or falsify the theory. Further, the municipalities could be seen as a homogenous group with similar needs and interests which speak in favour of accurately being able to generalize the results. The quantitative research approach acknowledges the importance of being able to generalize the results to a wider population. Although, dividing research into quantitative and qualitative terms have become increasingly criticised e.g. by Byrman (1997) and Gomm (2004) given that quantitative research not necessarily needs to generate quantitative information, our study could still be argued to be of a quantitative nature. Our proposals for aspects to measure (see 2.5) are derived from the theoretical framework which in turn is derived from the literature re-

view. Data will be gathered and analysed numerically in order to be generalized to a wider population.

An alternative approach could be to pursue the path of qualitative research. The fundamental characteristic of qualitative research is, according to Byrman (1997), the will to see, express occurrences, norms and values through the eyes of the study object. Further, the approach emphasises the need to "dig deep" into a certain subject in order to understand persons and their actions in its social context. Using a qualitative research approach and e.g. conduct interviews, would make it possible to find formerly unknown factors, not found in previous literature, which could affect IT managers' decision regarding open source within municipalities. Being able to spontaneously coming up with new questions based on the study object's answer is another advantage of interviews. However, one could argue that a rigorous and thought through theoretical framework increases the chances of a quantitative research approach which manages to use appropriate questions in order to be able to fulfil the purpose. Basically, one could argue that it is possible to "dig" relatively deep using a quantitative research approach as long as one is using the right questions.

3.2.1 Survey

Even though one is pursuing a quantitative research approach, there are still a number of possible routes to consider, e.g. observations, experiments, questionnaires etc. (Holme & Solvang, 1991). For this study a questionnaire, derived from the theoretical framework and the pre study, was used. The pre study is further explained in section 3.3. One of the strengths with using a questionnaire is, according to Björklund and Paulsson (2003), the possibility to gather a relatively large amount of primary data. A weakness, according to Björklund and Paulsson (2003), is however the risk of the respondents misinterpreting the questions. Nevertheless, since our sample consists of IT managers which presumably are knowledgeable in IT infrastructural issues, we are relatively confident that they will understand our questions.

Gomm (2004) argues that the use of closed as opposed to open questions can certainly give rise to different answers about the same matters. Closed questions forces the study object to choose between a number of alternatives when answering a specific question while open questions are unstructured making it possible for the respondent to freely express his or her point of view on a certain topic. Our questionnaire is composed of closed questions based on a number of reasons. As suggested by Gomm (2004), closed questions can be constructed to force respondents to make themselves comparable with others by expressing an opinion or belief. Our intention is to be able to generalize the results to a wider population and therefore we believe closed questions are a suitable alternative. Moreover, forcing the study object to choose between a number of alternatives makes it possible to quantify the results in order to perform statistical tests and generalize the results.

There are different question formats available; however we will use a likert scale illustrating beliefs and opinions such as *strongly disagree, disagree, uncertain, agree, and strongly agree*. According to Zikmund (2000) using a likert scale, respondents indicate their attitudes by checking how strongly they agree or disagree with carefully constructed statements that range from very positive to very negative toward the attitudinal object. Moreover, Zikmund states that each alternative response is assigned a weight in order to be measurable. In our survey, *strongly disagree* is assigned with the numerical value of one ranging to *strongly agree* with the numerical value of five. Hence, a disadvantage with using likert scale summated rating methods, according to Zikmund (2000), is that it is difficult to know what a single sum-

mated score means. Thus, identical total scores may reflect different "attitudes" because of the different combinations of statements endorsed. We are aware of this problem and have therefore carefully formulated our statements as homogeneously as possible, e.g. each statement generates a low number if one is positive towards OSS solutions, while a high number indicates a negative point-of-view towards OSS. However, formulating the statements as described above, the disposition becomes slightly negative. For example, each statement is formulated negatively against OSS and positively against proprietary software. Unfortunately, this is necessary in order for the study object to either agree or disagree with a certain statement. Further, Zikmund (2000) also acknowledges this problem but states that as long as the researchers are aware of the phenomenon, it should not be seen as a significant barrier for receiving accurate responses.

3.2.2 Sampling

The population for this research is 290 municipalities, which is the total number of municipalities in Sweden. One could argue that the population is rather small and all elements should be included in the survey. However we do believe that it would have been too demanding in terms of time and resources needed. Holme and Solvang (1991) argue that there often is suitable to take a sample as it is too expensive and time-demanding to examine a whole population. Furthermore, Holme and Solvang mention that an investigation of a sample can give more accurate results than an investigation of the population, this because too many elements and information decreases the researchers' ability to keep a high level of concentration throughout their entire study.

Our intention is to be able to generalise the results to the entire population which means that the sample therefore has to be representative (Holme and Solvang, 1991). Creating a representative sample for a population, you must be able to calculate the probability for each element included in the sample. This is the distinction between the two kinds of sample: non-probability and probability sample. There are, according to Holme and Solvang (1991), different kinds of probability samples, e.g. stratified sample, quota sample and cluster sample. A stratified sample is when you divide the population into a number of groups which are called stratums. The stratums are decided with some strata variable, so that similar elements are in the same stratum.

The sample that is suitable for this thesis is a stratified sample. One could argue that there are two different purposes for using stratified sample, one is to analyze differences between diverse groups, and the other is to make sure to spread your sample in case of that one group is overrepresented. According to Körner and Wahlgren (1998), a random sample can create a deceptive sample since it could be derived from a population where the distribution of, for example, large-, medium, and small size organisations is uneven. This is because the probability for a large organisation to be picked is small. The purpose of using a stratified sample is therefore to make sure that the different stratums of the population is equally represented in the sample. According to Holme and Solvang (1991) a stratified sample is suitable when a certain number of elements are desired. We believe that there is a difference between municipalities in terms of knowledge, usefulness and pre-usage of OSS. One could argue that these issues are affected by the size of the municipality since demands of the IT infrastructure together with their use of applications are different. The number of inhabitants reflects the size- and the demand of the municipality and therefore the size will be used as the strata variable. The sampling frame is retrieved from The Swedish Association of Local Authorities and Regions, (2005).

According to Aczel and Sounderpandian (2002), a sample of 30 or more elements is large enough to get a distribution of the sample mean which represents a normal distribution of the population from which the random sample is drawn. We have chosen to draw a sample of 100 elements since we believe we will receive a response rate of at least 40 % which will give us at least 40 elements.

The four strata are found in Table 3-1. According to Holme and Solvang (1991), there are two choices when deciding how many elements from each stratum that should be included: proportional and non-proportional. Proportional sample is when the proportion between different stratums in the sample is the same as in the population. The only point in taking a proportional stratified sample is, according to Gomm (2004), that you indeed got the same percentage from each stratum. For this thesis both types of sampling could be a feasible option. However, we have chosen to make a non-proportional sample as we have an equal interest in large municipalities as in smaller ones. The sampling is still a probability sample as the probability for each element to be chosen is known, which according to Aczel and Sounderpandian (2002) is called sample proportion.

Table 3-1 Stratified sample

Type of municipality	Inhabitants	Number of municipalities in the stratum	Sample proportion	Picked elements
Large	50 000 +	42	0.60	25
Medium-size	50 000 – 25 000	56	0.45	25
Small	25 000 – 12 500	83	0.30	25
Tiny	12 500 - 0	109	0.23	25

To decide what elements that should be in the sample, we applied a systematic sampling procedure which, according to Sekaran (2003), is that you draw every nth element in the population with a randomly selected start point. First we gave all elements a number from one to the last number in the stratum, then a starting point for each stratum was selected with help of the random function in Microsoft Excel. Then we picked every fourth for large, every third for medium-size-, every fourth for small- and every fifth for tiny municipalities. The cause for using different numbers for the different stratums is that the number of the picked elements divided with the number of the municipalities in the stratum had to be odd. The list of the chosen municipalities can be found in Appendix 3.

3.2.3 Qualitative supporting quantitative

A qualitative research approach could, according to Bryman (1997), be used in a pre study in order to further tune the instrument of the quantitative study, in our case the questionnaire. An obvious function of this, stressed by Bryman (1997), is that the qualitative research approach then could act as a source for developing new ideas and formulating propositions and hypothesis.

Although one could argue that the theoretical framework is accurate for placing this study in a suitable context, the pre study (chapter 4) further helps when narrowing the focus of

the research and more specifically generate primary data concerning the municipalities. For example, the theoretical framework is applicable to our area of concern, although being on a higher abstraction level than the pre study. The pre study on the other hand has the intention, as argued by Bryman (1997), to generate new ideas and possibly cover issues that have gone by unnoticed throughout the literature review. Moreover, performing an interview will in a way help us see the research questions through the eyes of one of our study objects. Hopefully, this will simplify formulating the questions for the questionnaire, creating a higher degree of precision. Arguably we will then have a better understanding of the terms that are being used when discussing the topic of OSS and municipalities.

Another purpose with the pre study was to be able to use it as another source of information when conducting the analysis. One could argue that by using complementary techniques and information sources during the data gathering procedure, one are strengthening the trustworthiness of the discussion that are taking place in the analysis.

3.3 Data gathering procedure

After deciding that we were going to e-mail our survey to the municipalities, included in the sample, we needed to make sure that we possessed valid e-mail addresses to respective IT-manager. Therefore, we called the receptions at every municipality and asked about the e-mail address to the IT-manager. Otherwise, sending the e-mail to the contact address of each municipality, we believe the response rate would be significantly lower due to the need of forward the message to the right person. The response time would probably also had been longer.

Initially, we decided to e-mail our questionnaire on the afternoon, Friday the 29th April. However, we realized that there was a considerable risk that the IT-managers would not open the e-mail before Monday morning, the following week when reading and clearing their e-mail accounts from spam etc. Moreover, this could lower their chance of responding since the e-mail could have gone by unnoticed or it could be associated with a spam e-mail. Therefore we decided to send our questionnaire at noon, Monday the 2nd May, when the inbox is relatively empty.

The questionnaire was a MS Word document on approximately 300 Kb which led to a risk that the answers would be rejected since the inbox would turn up full. Therefore we signed up for an e-mail account with over 2 gigabyte inbox. To get a serious impression we signed up magisteruppsatsinformatik@gmail.com.

Sending all e-mails at one particular occasion could cause the e-mails getting blocked in a spam filter. Furthermore, we did not want to expose the IT-managers' e-mail addresses to each other because of privacy reasons. Therefore, we decided to send four separate e-mails, each containing 25 respondents. The e-mail, consisting of a questionnaire (Appendix 4) together with an introduction text (Appendix 5) was sent as a blind carbon copy making the addresses invisible.

To increase the trustworthiness of the survey it was important to receive as many responses as possible. For that reason, after one week we sent a reminder (Appendix 5) to the respondents who had not yet answered. This turned out to be a good idea since we received ten additional responses resulting in a final amount of 37 responses (response rate 37 %). The answers received from each respondent are displayed in Appendix 6. Moreover, the questionnaire was created in Swedish and after the results had been received translated into English. It is possible that the translation, to some extent, changed the content of the ques-

tionnaire, we are aware of this issue but do not see it as a significant problem due to the fact that the questions derived from the theoretical framework.

3.4 Trustworthiness

Validity, reliability and objectivity could, according to Björklund and Paulsson (2003) be seen as three measurements of a study's trustworthiness. De Vaus (2001) stresses that two concepts, internal and external validity, are fundamental when developing a research design. The former, internal validity, concerns to which extent the results are in tune with the applicable theory. The latter, external validity refers to the extent to which the results from a study can be generalized beyond the particular study.

Internal validity is reached by both conducting an interview prior to the questionnaire, in order to minimize the risk of missing any important factor, and building the questionnaire based on earlier theories and models such as the TAM model which have received extensive empirical support.

The ability to generalize the results to a wider population is high when it comes to other municipalities throughout Sweden since they act according to similar needs and could therefore be seen as homogeneous group. Problems however arise when it comes to other countries since they might have other legal systems and cultural values and our sample only consists of municipalities within Sweden. According to our study, this is a minor problem since our study focus on examining Swedish municipalities which means that other countries is outside our area of demarcation.

A reliability measure is, according to de Vaus (2001) one that gives the same "reading" when used on repeated occasions. Björklund and Paulsson (2003) argue that using different methods could be a way to increase a study's reliability. Our study consists of two different techniques for data gathering, interview and questionnaire. This speaks in favour of the reliability of our study since using different methods increases the chance on receiving the same results on repeated occasions. The interview is further discussed in the Pre study (chapter 4) while the results from the questionnaire are presented in Collected data and statistical analysis (chapter 5).

Objectivity concerns to which extent the researcher's values affect the study (Björklund & Paulsson, 2003). Our knowledge prior to this study, regarding OSS, was relatively limited. None of us is a major advocate of neither the open source movement nor the proprietary software developers, the subject however interests us on general level. This increases the objectivity in terms of that we do not intentionally want to present a more favourable picture of either of the two alternatives. Choosing to conduct an unstructured interview, meaning that we will not try to direct our study object into answering questions based on our beliefs, also affects the level of objectivity. We could for example have chosen to interview a consultancy firm regarding how they perceive firms evaluating open source products. However, we would then run the risk of loosing our objectivity and perform our research according to how the consultancy firm does it.

A quantitative research using a theory testing approach, one could argue, a certain level of objectivity is automatically generated. Testing the various propositions is the result of what the population has answered. Therefore, the level of subjectivity is minimized and the researcher is not able to physically affect the study objects since there is no face-to-face contact. We are however aware that a researcher could affect the results by the way the questions are formulated. By critically applying the theoretical framework to our study, but also

applying another survey technique, we argue that this potential risk is however relatively small.

4 Pre study

The pre study consists of an interview with Janne Dicander that took place at the city hall of Jönköping the 21st of April 2005. The purpose of the interview was to discuss the research issues emerged from the theoretical framework and also to get an insight into an IT department of a municipality.

4.1 Interview

The pre study for this thesis is an interview with Janne Dicander, CIO within the municipality of Jönköping and project leader for "Sambrukplattformen", a common platform for public e-services, which purpose is to:

- Lower municipalities' costs for development and drift of e-services.
- Decreasing the lead-time for development and implementation of e-services.
- Give inhabitants and companies access to public services 24 hours

The view on OSS is, according to Dicander (personal communication, 2005-04-21) diverse in different municipalities, it is much related to individual qualities. In some municipalities where there is a real enthusiast and/or a person possesses high competence of OSS, the willingness to adopt is higher or the adoption of OSS has already been done. Generally, software markets are governed by the suppliers of proprietary software, companies that are excellent in selling their products. Dicander states that it is the "trade of industry" which has opened the door for OSS at municipalities. A continuous increase in OSS among firms positively affects the adoption and acceptance process. Moreover, when OSS gain market shares within the private sector, it also affects the public sector raising the acceptability of OSS among decision-makers within different municipalities.

There is, according to Dicander, a need within municipalities to be better purchasers, earlier in the purchasing process where the specification of requirements still is on a functional level, i.e. what a system has to be able to do. Dicander states that the specification of requirements should be on a detailed level, requiring high expenses which speak in favour of municipalities sharing the costs for these investments. Another issue that justifies a shared cost and development of requirements of specification is that all municipalities need the same foundational systems.

The trend has, according to Dicander, been that IT managers at municipalities have been focusing on the IT-infrastructure and not on the organisation. The distribution of costs on the development of supporting software has been 75 percent on IT and 25 percent on organisation. There is however exceptions where IT managers have an overall organisational perspective. This perspective is important in order to straighten out the skewness in distribution of costs at municipalities.

Nowadays all municipalities are carrying their own IT projects. If various municipalities cooperate with the development, an extensive amount of money could be saved. Further, Dicander says that municipalities need to own their source code, but the drift and support should be outsourced to professionals. One could argue that it is suitable to develop systems under some kind of OSS license. There are no major difference in cost for support and maintenance of proprietary and OSS, the major difference is the license cost for proprietary software. One could also argue that there is a greater freedom with OSS as you otherwise are closely bound to a supplier of proprietary products.

Below, Figure 4-1, illustrates the different levels of software through the perspective of a municipality. The user is only interested in the usability of the system, and therefore does not care if the servers or the enterprise operating system (EOS) is on an OSS or a Microsoft platform. Most users are familiar with using the Microsoft environment on their desktops, e.g. Windows XP and MS Office. In these cases, the license costs are considerable. According to Dicander, one have to critically evaluate if it is possible to justify these license costs since only approximately 10 percent of the functions in MS Office are used by the personnel at a municipality. In these cases, an OSS alternative could instead be preferable.

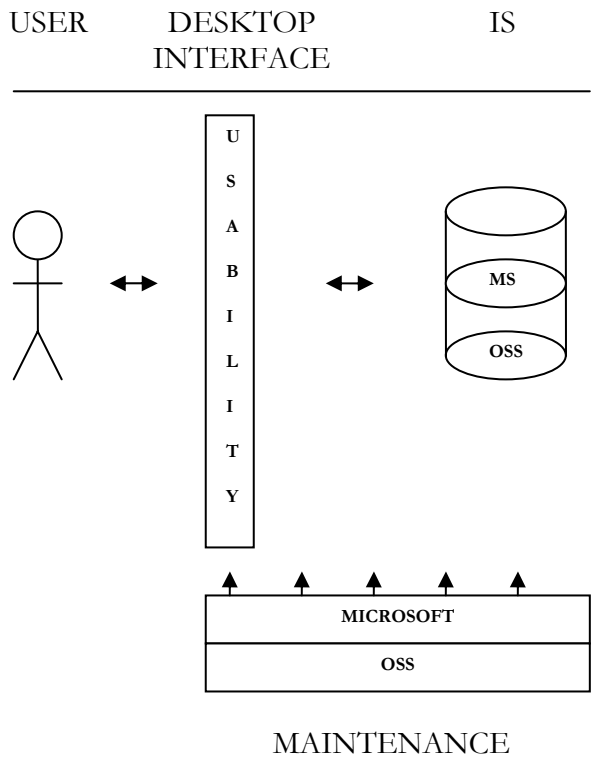

Figure 4-1 Overview of the system interaction at a municipality

Under existing circumstances, municipalities generally contain a large number of different systems which are overlapping each other, i.e. there are different systems that have functions that other systems can perform. Moreover the systems can not communicate horizontally, which can be referred to as the drainpipe effect. The service oriented architecture (SOA) is a solution for the municipalities in order to solve the problems regarding the drainpipe architecture. The idea behind SOA (see Figure 4-2) is that by using modules, one could customize the environment, using only the modules which one is in need of. The systems are integrated through small "taps" which is an interface that make communication possible no matter if the system is on a Microsoft or an OSS platform. However, the chances that an OSS is chosen increases since the municipalities are not bound to a few large actors within the software market but instead could choose the alternative which to the largest extent fulfils their specific need. In this case, there is a power shift between the supplier and customer putting the municipalities in a better position when it comes to negotiations.

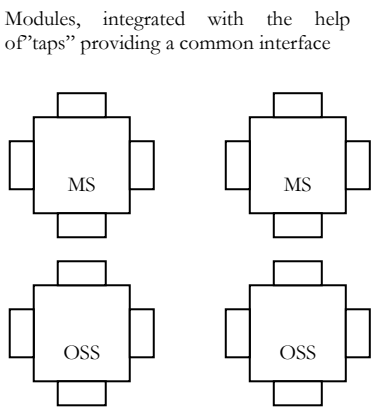

Figure 4-2 Service Oriented Architecture (SOA)

5 Collected data and statistical analysis

This chapter is the result of the collected data that was conducted with the help of a questionnaire. It was sent to municipalities through the use of e-mail. A description of the procedure will be presented followed by the statistical results.

5.1 Results from the survey

The response rate for the questionnaire was 42 percent. However, there is a drop-out of five respondents because of three different reasons. They could not open the file due to older versions of MS Office, the IT department is outsourced, or they forgot to attach the questionnaire to the e-mail. This gave us 37 responses with satisfied filled in questionnaires, this is the actual sample size which is used in the calculations and in the statistical analysis.

As discussed in the methodology chapter, the intention with a stratified sample was to facilitate a spread. Moreover, a satisfied dispersion between the different types of municipalities was achieved which could be seen below in Figure 5-1.

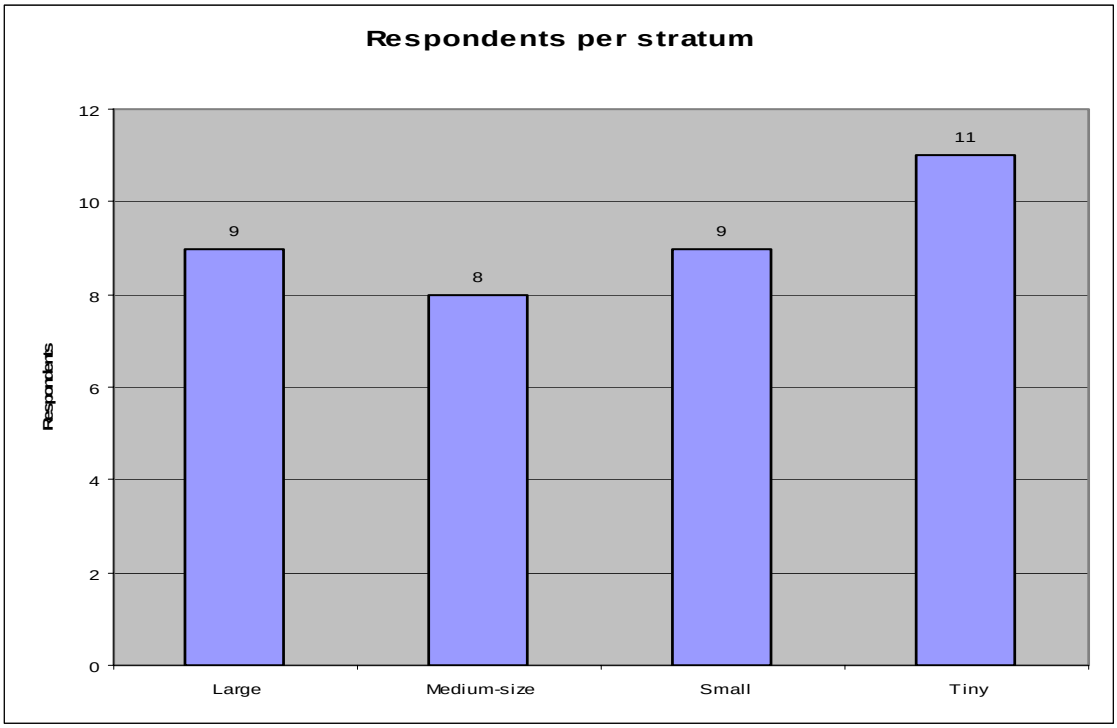

Figure 5-1 Respondents per stratum

The results of the conducted data will be presented in tables in the following subchapters: organisational-, environmental-, user-, and system factors. Each table consists of mean value, standard deviation and confidence interval. The following paragraph will explain the formulas used when calculating our statistical values.

The standard deviation (S) for a random sample is a measure of how close all the various values are clustered around the mean in a set of data. When the values are tightly bunched together the standard deviation is small and when they are spread apart the standard deviation is large. We have used the following formula to calculate the standard deviation:

$$S = \sqrt{\frac{n\sum x^2 - \left(\sum x\right)^2}{n(n-1)}}$$

Formula 1 Standard deviation for sample

In statistics the true population standard deviation, σ is rarely known. When we wanted to evaluate the confidence interval we had to estimate σ, which can be done with the sample standard deviation *s*. Standard deviation (see formula 1) and mean value $\overline{X}$ can always be calculated from the sample data. The use of standard deviation adds more unreliability, particularly as we are using a small sample size. To fulfil a 95 % confidence level we had to widen the interval. This was done by using Student's t distribution, instead of standard normal distribution. To get the true value we used the degree of freedom value (d.f.) which is sample size-1 (n-1). In our case d.f. is 37-1=36. In this case $t_{.025}$ is 2.0273, which is calculated from the table "Values and Probability of t Distributions" (Aczel and Sounderpandian, 2002).

Formula (2) is adopted from Aczel and Sounderpandian (2002) and is the example which we have used to calculate the population mean (μ) with a 95 % confidence interval. The confidence interval is an interval on both sides of the mean value. It measures the insecurity or impact in which randomness contributes to when calculating the mean value. The reason for using this equation is to predict the likeliness of that the "true" mean value within a certain interval is close to our mean value of our random sample. Therefore, the smaller confidence interval, the bigger likeliness that chance has a small impact on our mean value.

$$\mu = \overline{X} \pm t_{.025}\frac{S}{\sqrt{n}}$$

Formula 2 Confidence interval for μ when standard deviation for population us unknown

5.1.1 Organisational level

The statements concerning the organisational level are in general carrying relatively high mean values. Statement number one showed the highest mean value (4.46) throughout the entire study. 21 respondents or 57 % strongly agreed, 13 (35 %) respondents agreed, 3 (8 %) were neutral. There were no respondents who chose to disagree or strongly disagree regarding this statement. Statement number two illustrated that 5 respondents or 14 % strongly agreed, 21 (57 %) respondents agreed, 10 (26 %) were neutral, while only 1 (3 %) respondent disagreed. No respondent chose to strongly disagree regarding this statement. Statement number three had 8 respondents or (22 %) who strongly agreed, 24 (65 %) respondents agreed, 3 (8 %) were neutral, 2 (5 %) disagreed, while zero respondents strongly disagree. Statement number four presented the lowest mean value (3.63) within the organisational level, it could however be seen as quite positive in terms of that neutral is exactly 3. Further, this statement had 5 respondents or 14 % who strongly agreed, 20 (54 %) respondents agreed, 7 (19 (%) were neutral, 4 (10 %) disagreed, while only 1 (3 %) strongly

disagreed regarding if existing investments make it hard to justify a decision to change into using OSS.

Table 5-1 Organisational level

Nr	Statement	Mean value	Standard deviation	Confidence interval for μ
1	To be able to integrate the new software with the existing system is an important factor in the decision-making process.	4.46	0.65	4.24 - 4.68
2	The level of compatibility is in general greater for proprietary software in comparison with open source software, which has a negative impact in the decision-making process.	3.80	0.70	3.56 - 4.04
3	The strive towards a standardized software environment within the municipality results in that well established products often are favoured (e.g. Microsoft Office), which have a negative impact on the acquisition of open source software.	4.06	0.73	3.81 – 4.30
4	Investments made in existing technology and human capital makes it hard to justify a decision to change into using an open source solution.	3.63	0.95	3.31 – 3.95

5.1.2 Environmental level

The statements regarding the environmental level are in general leaning towards the positive side. However, statement number five presents a negative mean value (2.69), the standard deviation is nevertheless considerably high due to a wide spread among the respondents' answers regarding if they emphasise the latest and most innovative software solution. Statement number five had zero respondents who strongly agreed, 8 (22 %) agreed, 13 (35 %) were neutral, 12 (32%) disagreed, while 4 (11%) strongly disagree. Statement number six had the highest mean value within this table and showed that 4 respondents or (11 %) strongly agreed, 25 (68 %) agreed, 6 (16 %) were neutral, 2 (5 %) disagreed, while zero respondents strongly disagreed. Statement number seven had 2 respondents or (5 %) who strongly agreed, 27 (73 %) agreed, 5 (14 %) were neutral, 3 (8%) disagreed, while zero respondents strongly disagreed regarding the level of competence in OSS in comparison with proprietary software.

Table 5-2 Environmental level

Nr	Statement	Mean value	Standard deviation	Confidence interval for μ
5	The fast changing IT-market makes us emphasize on the latest and most innovative software solution.	2.69	0.94	2.37 - 3.00
6	It is important that the software is well established, solid and widely used in other organisations before we decide to adopt it in our organisation.	3.83	0.69	3.60 - 4.06
7	We do not possess the same level of knowledge in open source software in comparison with proprietary software which has a negative impact on the decision-making process concerning open source software.	3.74	0.68	3.51 – 3.97

5.1.3 User level

The statements regarding the user level could be seen as relatively homogenous in terms of the small differences in both mean values (3.43, 3.57, 3.14 and 2.91) and in standard deviation (0.64, 0.73, 0.83 and 0.92). This shows that the population has similar perception regarding user level factors concerning OSS. Statement number eight had zero respondents who strongly agreed, 18 (49 %) agreed, 16 (43 %) were neutral, 3 (8 %) disagreed, while zero strongly disagreed. Statement number nine showed that 1 respondent or 3 % strongly agreed, 22 (59 %) agreed, 10 (27 %) were neutral, 4 (11 %) disagreed, while zero strongly disagreed. Statement number ten had 1 respondent or (3 %) who strongly agreed, 13 (35 %) agreed, 14 (38%) were neutral, while zero strongly disagreed that there are greater costs associated with personnel training in OSS in comparison with proprietary software. Statement number eleven had 1 respondent or 3 % strongly agreed, 9 (25 %) agreed, 12 (33 %) were neutral, 15 (36 %) disagreed, while only 1 (3 %) strongly disagreed. 1 respondent chose to not answer this statement which meant that we calculated our statistical values with minus one respondent for this statement.

Table 5-3 User level

Nr	Statement	Mean value	Standard deviation	Confidence interval for μ
8	The lack of substitutes to proprietary software in the open source market has a negative impact on the decision-making process concerning open source software.	3.43	0.64	3.21 – 3.65

9	The lack of professional support of open source software has a negative impact on the decision-making process concerning open source software.	3.57	0.73	3.32 – 3.82
10	Greater costs for personnel training in open source software in relation to proprietary software have a negative impact on the decision-making process concerning open source software.	3.14	0.83	2.86 – 3.42
11	The software market is characterised by strong relations between customer and supplier which has a negative impact on the decision-making process concerning open source software.	2.91	0.92	2.60 – 3.22

5.1.4 System level

The statements regarding the system suggest that the respondents to a larger extent disagree than agree that this level negatively affect the decision making process concerning OSS. Two out of three mean values are negative (2.63, and 2.89) wile one is slightly positive (3.32). Statement number twelve presented zero respondents who strongly agreed, 2 (6 %) agreed, 20 (54 %) were neutral, 15 (40 %) disagreed, while zero respondents strongly disagreed. Statement number thirteen had zero respondents who strongly agreed, 5 (14 %) agreed, 22 (59 %) were neutral, 10 (27 %) disagreed, while zero respondents strongly disagreed. Statement number fourteen showed that 1 respondent or 3 % strongly agreed, 14 (39 %) agreed, 15 (41 %) were neutral, 6 (17 %) disagreed, while zero strongly disagreed with that the lack of professional education of OSS has a negative impact on the decision-making process concerning OSS. 1 respondent chose to not answer this statement which meant that we calculated our statistical values with minus one respondent for this statement.

Table 5-4 System level

Nr	**Statement**	**Mean value**	**Standard deviation**	**Confidence interval for μ**
12	Open source software does not in general reach similar level of security as proprietary software which has a negative impact on the decision-making process concerning open source software.	2.63	0.59	2.43 – 2.83
13	Open source software does not in general reach similar level of quality as proprietary software which has a negative impact on the decision-making process concerning open source software.	2.89	0.63	2.67 – 3.10

14	The lack of professional education of open source software has a negative impact on the decision-making process concerning open source software.	3.32	0.78	3.06 – 3.59

5.2 Comments

The tables presented above indicate that the organisational level has the highest total mean value, while the system level has the lowest. Statement number eleven and fourteen each had one unsatisfied answer due to the lack of a chosen alternative. We believe the respondent simply forgot to fill in this answer. Since the unsatisfied answer present such a small percentage of the total amount of answers we will not further analyse the underlying cause, but only do our statistical calculations with minus one respondent. Moreover, we therefore argue that this small defect will not have a significant impact on our results.

6 Analysis

In the analysis, we will relate our frame of reference and pilot study to the results received from the questionnaire. Further, a discussion will be presented with the intention of clarifying the level of impact organisational-, environmental-, user- and system factors have on the decision-making process of migration or integration into open source software.

6.1 Organisational level

P1. We will study which impact organisational factors have on the decision-making process of IT managers, within municipalities, when it comes to migrate or integrate into using open source software.

As stated by Chircu and Kauffman (2000), the industry and the organisation are outlined as factors which affect the value of an IT investment. Furthermore, there are certain types of technologies (software) that are favoured by a specific industry as they are easier to integrate with existing systems. This statement is supported by our sample, thus presenting a mean value of 4.46 when it comes to the respondents' perceived importance of being able to integrate the new system with the existing system (5.1.1). Comparing this statement with the outcome of statement number two, IT managers within municipalities believe to a larger extent that the level of compatibility is in general higher for proprietary software in comparison with OSS (mean value 3.80). Based on these results, one could argue that the ability to integrate the new software have a considerable impact on the decision-making process.

Further, proprietary software is perceived as easier to integrate with the existing environment than OSS, negatively affecting the decision-making process concerning OSS. Dicander (personal communication, 2005-04-21) states that municipalities contain a large number of different systems overlapping each other, i.e. that systems independently have functions that the other systems can perform. With the evolvement of the SOA (4.1) as a solution for better being able to integrate different systems at municipalities, one could see that the integration issue is something that is taken seriously by the municipalities. SOA could be seen as a future solution concerning the software integration problem. Moreover, it is stated that this technology works independently if the underlying system is developed using either OSS or proprietary software. However, the IT managers, within municipalities, still present a unison front in terms of that it is easier to integrate proprietary software with the existing software environment compared to OSS. Arguably, it could be that our interview object possesses higher knowledge of these issues than the ordinary IT manager within a municipality since he deals with subjects similar to this in his role as project leader for "Sambruksplattformen".

According to Chircu and Kauffman (2000), there are certain technologies which are favoured by specific industries (2.3.1.1). Favoured technologies are compatible with pre existing technologies while other technologies are not compatible. IT managers, within municipalities, are of the opinion that they are striving towards standardized software environments where proprietary software in comparison with OSS are favoured (mean value 4.06). This behaviour could be seen as having a negative impact on the decision-making process regarding the use of OSS at municipalities. Furthermore, if municipalities previously have made investments in technology and human capital such as a certain proprietary software, the respondents, to a larger extent (mean value 3.63), believe that it is hard to justify a decision to change into using an OSS alternative. One could therefore argue that the organisa-

tional factor has a negative impact on the decision-making process regarding the use of OSS.

Conclusively, the organisational level, both the industry- and organisational factors, could be seen as factors which have a negative impact on the decision-making process when it comes to migrating or integrating to OSS. However, Dicander questions the importance of these integration questions in the future since municipalities are striving towards a common platform that could be developed and integrated independently of if one is using OSS or proprietary software. This is however a new vision which seem not yet commonly known by IT managers at municipalities throughout Sweden.

6.2 Environmental level

P2. We will study which impact the environmental factor has on the decision-making process of IT managers, within municipalities, when it comes to migrate or integrate into using open source software.

Generally, according to Thong (1999), adoption of innovations is more likely in environments characterised by a high degree of competitiveness (2.3.2). Municipalities are different in this way since they do not have any distinctive competitors. Therefore they do not possess the same need of imitating competitors or being in the front line of adopting new innovations in order to survive or to create a competitive advantage. The need to emphasise on the latest and most innovative software solution presents the second lowest mean value (2.69) of our study and therefore supports Thong's (1999) reasoning regarding the adoption of innovations. Instead there are, among municipalities, a desire of having software that are well established, solid and widely used by other businesses (mean value 3.89). This is understandable since a considerable number of people, both personnel within the municipalities but also ordinary people, are depending on the software in order to being able to perform their work properly or to have access to their interactive services. Most importantly, one could however argue that municipalities perceive less risk in using software which are widely adopted.

As indicated by the results in statement number six (5.1.2), software acceptance within the private sector seems to influence the software adoption within municipalities. Dicander (personal communication (2005-04-21) also acknowledges the private sector's impact on municipalities' adoption behaviour. Furthermore, since the "trade of industry" sees opportunities in the OSS alternative, it also increases the chance of municipalities starting to accept OSS as a plausible alternative to proprietary software.

Instead of focusing on external forces affecting the environmental setting, Pinsonneault and Kraemer (1993) state that it is the personal interest among the decision-makers regarding technology that will drive the adoption of IT innovations forward (2.3.2.1). Thus, having a knowledgeable and interested IT manager within the field of OSS, there is an increased chance that the municipality will seriously evaluate this alternative. However, IT managers within municipalities perceive, to a larger extent (mean value 3.74), that they do not possess the same level of knowledge in OSS in comparison with proprietary software (5.1.2) which has a negative impact on the decision-making process concerning OSS. Possibly, a low level of knowledge creates uncertainty which negatively influence the IT managers in the decision-making process concerning OSS. Moreover, this is a relatively strong figure with a low standard deviation suggesting that the knowledge factor needs to be taken seriously if OSS should be able to continue to grow within municipalities. Further, Dicander agrees with the argument regarding having a knowledgeable IT manager and claims

that the view on OSS is much related to individual qualities (4.1) in terms of that municipalities which possess a real enthusiast or a person highly knowledgeable in OSS are more likely to adopting OSS.

6.3 User level

P3. We will study which impact the user factor has on the decision-making process of IT managers, within municipalities, when it comes to migrate or integrate into using open source software.

There are a number of barriers that, according to Goode (2004), affect the acceptance of OSS. For example, if no equivalents to the proprietary software that one is using exist within the field of OSS, a lack of relevance from the IT managers within municipalities is established. Consequently, it is impossible to consider a migration or integration into using OSS since there are no justifiable alternatives. After all, most importantly the software alternative has to fulfil the fundamental need of the organisation. As stated by Davis (1989) the PU is associated with the degree to which a person believes that using a particular system would enhance his or her job performance (2.3.3.1). IT managers within municipalities believe, to a larger extent (mean value 3.43), that there is a lack of substitutes to proprietary software in the OSS market which has a negative impact on the decision-making process concerning OSS (5.1.3).

Dicander (personal communication, 2005-04-21) argues that the software market is governed by suppliers of proprietary software products, companies that are excellent in selling their products (4.1). Thus, OSS suppliers need to be better at communicating their existence and that they offer a substitute alternative to the proprietary software products.

The degree to which professional support is available could also be a determinant in terms of accepting OSS. Goode (2004) argues that if no equivalents to proprietary software support exist within the field of OSS, organisations run the risk of having to support their own software environments. Moreover, there is a common notion (mean value 3.57) among IT managers within municipalities that there is a lack of professional support regarding OSS which has a negative impact on the decision-making process concerning OSS (5.2.3). The lack of professional support available, one could argue resembles a factor which negatively affect the PEU (2.3.3.1) described by Davis (1989). Furthermore, Davis states that the PEU concerns to which degree using a particular system would be free of effort. Certainly, one could argue that not being able to receive a proper degree of professional support negatively affect the decision-making of choosing an OSS alternative. There are however a possibility that the perceived lack of professional support is an exaggeration of the actual situation. Perhaps, it is the IT managers' lack of knowledge, discussed in 6.2 which facilitate their point of view regarding available professional support. There is a visible spread in the respondents' answers (standard dev. 0.73) which further acknowledge the possibility that IT managers within municipalities are not united over the lack of professional support. One could argue that the diversification depend on the level of knowledge of the IT managers.

Insufficient resources is another factor which could be manifested in a way that could prevent municipalities investing in training and education for a new software, e.g. an OSS alternative, since they already possess the accurate knowledge in the existing software environment. There are however no prominent figures suggesting that this would be the case. IT managers within municipalities see no significantly greater cost (mean value 3.14) for personnel training in OSS in relation to proprietary software (5.2.3).

Finally, lack of relevance, inadequate support or insufficient resources is not the only ways in which user factors could affect the decision-making process concerning OSS. Additionally a psychological bond between the customer and the supplier may exist which directly affects the customer loyalty. Goode (2004) argues that large actors on the software market, such as Microsoft, could have such an impact on customers resulting in that they feel committed using only their products and therefore reject all other alternatives. This may be the case in some industries. However, as suggested by the results in 5.1.3, IT managers within municipalities do not see the software market as characterised by strong relationships between municipalities and certain suppliers creating a negative impact on the decision-making process concerning OSS (mean value 2.91). Nevertheless, one could not entirely disregard from the possibility that the IT mangers unintentionally possess a certain bond to a specific software supplier without being able to recognize it.

6.4 System level

P4. We will study which impact system factors have on the decision-making process of IT managers, within municipalities, when it comes to migrate or integrate into using open source software.

It has been argued that the open source approach equals a higher degree of security compared to proprietary software development since it exposes the source code to public scrutiny which dramatically reduces the threat posed by bugs etc. (Hunter, 2004). On statement twelve (5.1.4) regarding if IT managers within municipalities perceive that OSS do not reach the same level of security as proprietary software, the respondents answered that they do not see this as a general problem (mean value 2.63). This is the lowest presented mean value throughout this study but also the lowest standard deviation (0.59), suggesting that there are no significant dispersion among the respondents answers regarding this statement. The concept of "security by obscurity" discussed by Hanson et al. (2002) therefore could not be seen as a factor negatively affecting the decision-making process regarding OSS.

Since the developers of OSS rarely get any monetary compensation for their work, one could question what motivates the programmers developing software with a high level of quality. Lerner and Tirole (2000); Hars and Ou (2001) argue that other incentives do exist based on e.g. ego gratification (2.3.4.2). Moreover, IT managers within municipalities are close to neutral (mean value 2.89) regarding the level of quality reached by OSS in comparison with proprietary software. This suggests that the respondents neither agree nor disagree that the level of OSS quality could be seen as a factor negatively affecting the decision-making process regarding OSS. Arguably one could state that the respondents see no significant difference based on the quality aspect of either using OSS or proprietary software. Fuggetta (2003) outlines a number of factors affecting the level of software quality and agree with Tirole (2000); Hars and Ou (2001) concerning the importance of ego gratification as a motivational incentive for reaching a high level of software quality. Moreover, Fuggetta states that it is the distributional settings in terms of multiple users simultaneously testing and improving the code, widely performed inspections in search for bugs etc., associated with OSS development which facilitates the high level of software quality (2.3.4.2).

Dicander (personal communication, 2005-04-21) stresses that although municipalities need to own their source code, the drift and support should be outsourced to professionals (4.1). As suggested by Fugetta (2003) being able to test the software using a distributed setting could be an argument related to the demand of owning the actual source code. Further, when one owns the source code, it is easier for a municipality to not be dependent on a

single provider of IT support services. In this case, since the source code is a property of the municipality, it requires fewer resources to shift between IT consultancy firms compared to a proprietary software alternative because it is possible to see how the software is constructed and one are not tied to a "proprietary" licensee agreement. Another effect of the OSS approach is that there are no license costs which, according to Dicander, substantially diminish the IT costs for a municipality.

There is however other factors, besides license costs, that needs to be taken into consideration. Chircu and Kauffman (2000) identify resources and knowledge as two interrelated factors affecting the value creation of IT investments. When investing in OSS education, there is a need for professional educational services available. IT managers within municipalities perceive to a larger extent (mean value 3.32) that there is a lack of professional education negatively affecting the decision-making process concerning OSS. The difference are however modest suggesting that Goode (2004) statement regarding that there seem to be a notion among organisations that OSS is only free to those who do not value time to be an exaggeration. Arguably, the interest in the OSS area in terms of the surge in scientific articles and a continuous increase in adoption and acceptance of OSS within organisations, as stated by Dicander, certainly the availability of professional support will positively be affected. For example, more research together with an increase in companies specialized in OSS will enhance peoples' knowledge in the subject.

7 Conclusions

In this section we will present our conclusions based on the analysis presented in the previous chapter. The conclusions will follow the same order as the analysis and will be presented using bullet points in order to keep a high level of visibility together with a unison structure throughout the thesis.

- The organisational level, both the industry- and organisation factor, has a substantial negative impact on municipalities decision-making process regarding integrating or migrating into OSS. The importance of being able to integrate different software increases the need for compatibility which, according to the IT managers, is facilitated using a standardized software environment. Further, proprietary software such as Microsoft products could be seen as favoured by municipalities since earlier investments in technologies and human capital has been done which makes it hard to justify an open source alternative.

- IT managers, within municipalities, emphasise on having widely accepted software instead of the latest and most innovative software solution. At a first glance, this may seem as negatively affecting OSS since it has not yet reached the same level of market penetration as proprietary software. However, as OSS continues to grow, its acceptance will increase, thus positively affecting the decision-making process concerning OSS. Arguably, the knowledge factor could be seen as negatively affecting the integration or migration into OSS since there is a lack of competence among municipalities concerning this area.

- The user level has no significant impact on IT managers' decision-making process concerning integrate or migrate into OSS. There are however tendencies showing that there is a lack of substitute software, professional support, greater costs for personnel training, associated with OSS. One could believe that strong bonds exist between the customer and supplier of proprietary software creating aggravating circumstances for OSS. However, IT managers within municipalities do not see that the software market is characterised by strong bonds negatively affecting the integration and migration of OSS.

- Neither the security- nor the quality issue could be seen as factors negatively affecting the decision-making process concerning OSS. The distributed settings associated with OSS development therefore present a plausible alternative when IT managers within municipalities strive for software solutions characterised by a high level of security and quality. At this point in time, there is a lack of professional education available for municipalities. However, as the popularity of OSS surge, people specialised in this area will intensify enhancing the possibility to receive professional support in OSS.

The result of this research shows that the organisational level (industry and organisation) is the only factor presenting a uniform barrier toward IT managers', within municipalities, decision-making process of integrating or migrating into OSS. Further, the OSS phenomenon could be seen as being to a larger extent unexplored, compared to proprietary software, resulting in a lack of: relevance, professional support, compatibility and professional education. However, these are all factors which could diminish as a result of that OSS gradually strengthening its position on the software market.

As illustrated by Figure 7-1, a dispersion exists, showing that there is a difference in the degree of impact created by the four main factors. The organisational factors are the only one presenting a significant negative impact on the decision-making process concerning OSS in terms of sample mean values. Furthermore, the environmental- and user factor only show tendencies towards affecting OSS negatively. The system factors showing a sample mean value slightly below neutral suggest that no significant difference is found between OSS and proprietary software concerning security and risk, quality and training and education.

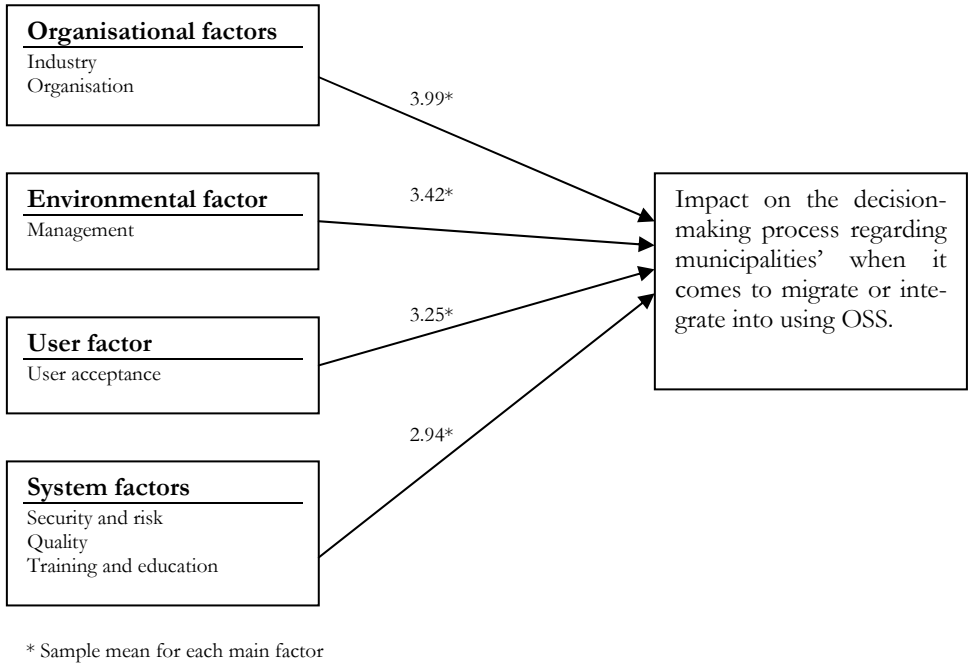

Figure 7-1 Research model with mean values

8 Final discussion

The final discussion will present a reflection of our course of action. Moreover, suggestions for further research together with suitable hypothesis will be presented with the aim to simplify the possibility for researchers to build upon our results for future studies.

8.1 Reflections

The purpose for this thesis is fulfilled in the sense that we have studied factors and their impact on the decision-making process within municipalities when it comes to migrating or integrating their software into OSS. We increased the internal validity through the pre study with Dicander (personal communication, 2005-04-21). Further, Dicander brought up the factors emerged from our literature study, in spite of the fact that we did not manoeuvre the interview. If there would have been more time available it would have been interesting to make interviews with a number of municipalities in order to strengthen the trustworthiness of the study.

The actual sample that was analysed consisted of 37 respondents, which could be argued as being too small. To be able to statistical secure the data to the normal 95 percent confidence level, we would have needed a larger sample. One could argue that the sample should have been left out and all elements in the population should have been studied. However, we do believe it would have demanded too much time, as we then would have to call all municipalities to be sure that we had the correct e-mail address. If we had sent the questionnaire to the entire population and received the same response rate, we would have had approximately 110 respondents. This would have increased the ability to generalise the result. Nevertheless, the results give a good indication on the factors and to what extent they have impact on the decision-making process concerning software solution. Furthermore, we state that the results are to a larger extent applicable for large municipalities since approximately 25 percent were involved in the study compared to in 10 percent in tiny municipalities. One could argue that we should have done a proportional stratified sample to reach an equal level of security of the result for each stratum. However, as discussed in 3.2.2, there are arguments suggesting that a non proportional stratified sample is just as accurate for our study.

A point of view that was revealed after collecting the data received from the questionnaire was that there is a possibility that the respondents' answers are more connected to either a server- or desktop perspective. To avoid this issue one could have developed two separate questionnaires. However, this would have been time consuming for the IT managers, consequently decreasing the response rate of the survey.

8.1.1 Suggestions for further research

- Is there a difference between the IT managers' attitudes concerning OSS in comparison with their actual decisions that they make? Perhaps they have a personal positive opinion regarding OSS but are not able to make decisions based on these opinions. This issue could be interesting to research further since it would increase the understandability of what IT managers are basing their OSS decisions on.

- Is there a certain type of company in terms of e.g. characteristics or type of industry that would benefit using OSS in their software environment? Is it possible to de-

velop a model that would, in a tangible way, conceptualize this business structure favoured by using an OSS alternative? This would facilitate an easier and more efficient decision-making process concerning migrating or integrating into OSS.

8.1.1.1 Hypothesizing

Usually, hypotheses are formulated from the theoretical framework and tested with conducted data, Sekaran (2003) referring to this as deductive research. However, Sekaran implies that hypotheses can be generated through the process of induction. That is when innovative insights occur based on the data gathered, and hypotheses are generated and tested later in a new research. Obviously, creating and presenting hypothesis violates with the purpose of this thesis. Nevertheless, one could argue that other contributions besides knowledge creation exist when it comes to scientific research. For example, the ability to present suggestions for further research that will build upon the results from this study. The following text will therefore suggest and motivate a number of hypotheses that could be tested later in a new research.

We found it interesting that some statement had a remarkable wider dispersion than other. One could argue that the reason for the wide dispersion is that there are two groups who are on the different side of the mean. These groups could be divided by either being adopters of OSS or non adopters of OSS. Therefore we suggest the following hypotheses for further research:

- *H1:* There will be a difference between adopter and non adopters regarding that investments made in existing technology and human capital makes it hard to justify a decision to change into using an open source solution.

- *H2:* There will be a difference between adopter and non adopters regarding that the fast changing IT-market which makes them emphasize on the latest and most innovative software solution.

- *H3:* There will be a difference between adopter and non adopters regarding that there are greater costs for personnel training in OSS in relation to proprietary software.

- *H4:* There will be a difference between adopter and non adopters regarding that the software market is characterised by strong relations between customer and supplier.

8.2 Acknowledgments

We would like to thank our tutor, PhD candidate, Britt-Marie Johansson for her guidance and obligingness during the work with this master thesis. Our gratefulness also goes to Janne Dicander, CIO within the municipality of Jönköping and project leader for "Sambrukplattformen", and finally the municipalities that took part in this study.

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Appendix 1

Apache The industry leading Web server in terms of market penetration. Apache is also developed as an OSS.

BSD The Berkeley Software Distribution is an OSS license which allows even greater degrees of freedom than the GPL. The main difference from the GPL is that it allows a user/developer to distribute his modifications and a modified program under a different license altogether. The freedom is larger in the sense that the individual may modify and distribute the software in any way he pleases – including a proprietary license.

Free software The expression originates from the GNU project and could be defined as the freedom to run, copy, distribute, study, change and improve the software. In order to do this you must be able to have access to the source code.

FSF Free Software Foundation, established by Richard M Stallman, in 1984, in order to encourage the development of free software. It assumes that source code could not be owned. The FSF definition of free software challenges most of the assumptions regarding intellectual property law.

GPL General Public License, which allows the licensee to copy, modify and distribute a program licensed under the GPL. Further it requires the source code to be available which facilitates the user to become a developer.

GNU GPL "GNU's Not Unix" is a GPL alternative. This license guaranties free access to- and use of Linux's source code, as well as free distribution of Linux to anyone interested.

Linux An operating system developed by Linux Torvalds in 1991 and was released for free the same year with the intention of being developed as OSS. The 0.10 version released 1991 had 100 users and consisted of 18,000 lines of code. 2003, the 2.6.0 version had over 30,420,000 users and consisted of over 6 million lines of code (Bitzer, 2005).

MS EULA The Microsoft End User License Agreement. The MS EULA is a proprietary license agreement which means that it strictly prohibits copying and distribution of the program covered by the license. Software distributed under MS EULA regard the source code as a trade secret.

MySQL A SQL compliant database management system. MySQL acts according to the GPL licence agreement and is the most widely spread open source developed DBMS in the world. It is developed and sold through the Swedish company MySQL AB.

OSS	Open Source Software means that the person, who has the right to use the software, also has the right to read and change the source code or hire someone to do it. Open source fundamental idea is that the software should be able to be improved and refined by the users.
Proprietary software	Programs that are being developed by a company with the aim to make money by allowing the customer to use the software, not access the source code, copy it or redistribute it.
SOA	Service Oriented Architecture is a solution for municipalities in order to solve the problem of having a large number of independent software systems. The idea behind SOA is that by using modules, one could customize the setting and at the same time use a common interface.

Appendix 2

The Open Source Definition

Version 1.9

Introduction

Open source doesn't just mean access to the source code. The distribution terms of open-source software must comply with the following criteria:

1. Free Redistribution

The license shall not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license shall not require a royalty or other fee for such sale.

Rationale: *By constraining the license to require free redistribution, we eliminate the temptation to throw away many long-term gains in order to make a few short-term sales dollars. If we didn't do this, there would be lots of pressure for cooperators to defect.*

2. Source Code

The program must include source code, and must allow distribution in source code as well as compiled form. Where some form of a product is not distributed with source code, there must be a well-publicized means of obtaining the source code for no more than a reasonable reproduction cost–preferably, downloading via the Internet without charge. The source code must be the preferred form in which a programmer would modify the program. Deliberately obfuscated source code is not allowed. Intermediate forms such as the output of a preprocessor or translator are not allowed.

Rationale: *We require access to un-obfuscated source code because you can't evolve programs without modifying them. Since our purpose is to make evolution easy, we require that modification be made easy.*

3. Derived Works

The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.

Rationale: *The mere ability to read source isn't enough to support independent peer review and rapid evolutionary selection. For rapid evolution to happen, people need to be able to experiment with and redistribute modifications.*

4. Integrity of The Author's Source Code

The license may restrict source-code from being distributed in modified form *only* if the license allows the distribution of "patch files" with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of software built from modified source code. The license may require derived works to carry a different name or version number from the original software.

Rationale: *Encouraging lots of improvement is a good thing, but users have a right to know who is responsible for the software they are using. Authors and maintainers have reciprocal right to know what they're being asked to support and protect their reputations.*

Accordingly, an open-source license ***must*** *guarantee that source be readily available, but* ***may*** *require that it be distributed as pristine base sources plus patches. In this way, "unofficial" changes can be made available but readily distinguished from the base source.*

5. No Discrimination Against Persons or Groups

The license must not discriminate against any person or group of persons.

Rationale: *In order to get the maximum benefit from the process, the maximum diversity of persons and groups should be equally eligible to contribute to open sources. Therefore we forbid any open-source license from locking anybody out of the process.*

Some countries, including the United States, have export restrictions for certain types of software. An OSD-conformant license may warn licensees of applicable restrictions and remind them that they are obliged to obey the law; however, it may not incorporate such restrictions itself.

6. No Discrimination Against Fields of Endeavor

The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.

Rationale: *The major intention of this clause is to prohibit license traps that prevent open source from being used commercially. We want commercial users to join our community, not feel excluded from it.*

7. Distribution of License

The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.

Rationale: *This clause is intended to forbid closing up software by indirect means such as requiring a non-disclosure agreement.*

8. License Must Not Be Specific to a Product

The rights attached to the program must not depend on the program's being part of a particular software distribution. If the program is extracted from that distribution and used or distributed within the terms of the program's license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the original software distribution.

Rationale: *This clause forecloses yet another class of license traps.*

9. License Must Not Restrict Other Software

The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open-source software.

Rationale: *Distributors of open-source software have the right to make their own choices about their own software.*

Yes, the GPL is conformant with this requirement. Software linked with GPLed libraries only inherits the GPL if it forms a single work, not any software with which they are merely distributed.

10. License Must Be Technology-Neutral

No provision of the license may be predicated on any individual technology or style of interface.

Rationale: *This provision is aimed specifically at licenses which require an explicit gesture of assent in order to establish a contract between licensor and licensee. Provisions mandating so-called "click-wrap" may conflict with important methods of software distribution such as FTP download, CD-ROM anthologies, and web mirroring; such provisions may also hinder code re-use. Conformant licenses must allow for the possibility that (a) redistribution of the software will take place over non-Web channels that do not support click-wrapping of the download, and that (b) the covered code (or re-used portions of covered code) may run in a non-GUI environment that cannot support popup dialogues.*

(Open Source Initiative. (2005). Retrieved 2005-03-21 from http://www.opensource.org/docs/definition.php)

Appendix 3

Large Municipalities	Medium-size Municipalities	Small Municipalties	Tiny Municipalties
Stockholm	Skövde	Nynäshamn	Ovanåker
Uppsala	Borlänge	Lindesberg	Askersund
Linköping	Piteå	Laholm	Borgholm
Norrköping	Trelleborg	Sala	Filipstad
Helsingborg	Enköping	Finspång	Sävsjö
Lund	Lidköping	Mora	Ånge
Borås	Sandviken	Kumla	Trosa
Sundsvall	Sigtuna	Lomma	Nora
Gävle	Alingsås	Tranås	Munkedal
Halmstad	Sundbyberg	Eksjö	Degerfors
Huddinge	Partille	Flen	Gnosjö
Karlstad	Värmdö	Vara	Emmaboda
Nacka	Värnamo	Klippan	Herrljunga
Växjö	Vellinge	Hedemora	Älvkarleby
Botkyrka	Falköping	Älmhult	Nykvarn
Luleå	Karlshamn	Orust	Berg
Skellefteå	Strängnäs	Hallstahammar	Älvdalen
Haninge	Gislaved	Hultsfred	Robertsfors
Karlskrona	Eslöv	Båstad	Karlsborg
Kalmar	Nässjö	Hörby	Laxå
Östersund	Boden	Hagfors	Vindeln
Solna	Ystad	Mörbylånga	Ödeshög
Falun	Arvika	Mönsterås	Skinnskatteberg
Örnsköldsvik	Ludvika	Åmål	Ydre
Trollhättan	Härnösand	Osby	Sorsele

Appendix 4

We are two students at Jönköping International Business School who are writing a master thesis about how municipalities in Sweden perceive the use of open source software. This questionnaire has through a random sample been sent to 100 municipalities throughout Sweden.

We are using some kind of open source software* in our server environment.

☐ Yes ☐ No ☐ Do not know

We are using some kind of open source software in our desktop environment.

☐ Yes ☐ No ☐ Do not know

The statements below concern the acquisition of software.

1) To be able to integrate the new software with the existing system is an important factor in the decision-making process.

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

2) The level of compatibility is in general greater for proprietary software** in comparison with open source software, which have a negative impact in the decision-making process.

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

3) The strive towards a standardized software environment within the municipality results in that well established products often are favoured (e.g. Microsfot Office) which have a negative impact on the acquisition of open source software.

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

** Open Source Software, e.g. some kind of Linux OS, Apache web server*

***Proprietary Software, e.g. MS Office, MS Server 2003*

4) Investments made in existing technology and human capital makes it hard to justify a decision to change into using an open source solution.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

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5) The fast changing IT-market makes us emphasize on the latest and most innovative software solution.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

6) It is important that the software is well established, solid and widely used in other organisations before we decide to adopt it in our organisation.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

7) We do not possess the same level of knowledge in open source software in comparison with proprietary software which has a negative impact on the decision-making process concerning open source software.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

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8) The lack of substitutes to proprietary software in the open source market has a negative impact on the decision-making process concerning open source software.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

9) The lack of professional support of open source software has a negative impact on the decision-making process concerning open source software.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

10) Greater costs for personnel training in open source software in relation to proprietary software have a negative impact on the decision-making process concerning open source software.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

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11) The software market is characterised by strong relations between customer and supplier which has a negative impact on the decision-making process concerning open source software.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

12) Open source software does not in general reach similar level of security as proprietary software which has a negative impact on the decision-making process concerning open source software.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

13) Open source software does not in general reach similar level of quality as proprietary software which has a negative impact on the decision-making process concerning open source software.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

14) The lack of professional education of open source software has a negative impact on the decision-making process concerning open source software.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

Thank you for your time!

Appendix 5

Subject: Master thesis survey within the field of informatics

Hi!

This e-mail has a document attached which is a questionnaire for a master thesis within the field of informatics at the International Business School of Jönköping. The questionnaire concerns open source software at Swedish municipalities and should not take more that 2-3 minutes to fill in.

Please save the attached document to disk. Answer the questions in the document, save it, and finally send it back to this e-mail address.

Thank you for your time!

Regards

Henrik Andersson och Tobias Karlsson

Second e-mail

Subject: Please help us to increase our reliability

This is a second dispatch of a questionnaire regarding open source software within Swedish municipalities that will take approximately 2-3 minutes to fill in. Further, we would really appreciate an answer since it would increase the reliability of our master thesis.

Thank you for your time

-Original message-

Hi!

This e-mail has a document attached which is a questionnaire for a master thesis within the field of informatics at the International Business School of Jönköping. The questionnaire concerns open source software at Swedish municipalities and should not take more that 2-3 minutes to fill in.

Please save the attached document to disk. Answer the questions in the document, save it, and finally send it back to this e-mail address.

Thank you for your time!

Regards/ Henrik Andersson och Tobias Karlsson

Appendix 6

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
1	0	0	3	13	21
2	0	1	10	21	5
3	0	2	3	24	8
4	1	4	7	20	5
5	4	12	13	8	0
6	0	2	6	25	4
7	0	3	5	27	2
8	0	3	16	18	0
9	0	4	10	22	1
10	0	9	14	13	1
11	1	13	12	9	1
12	0	15	20	2	0
13	0	10	22	5	0
14	0	6	15	14	1