Martti Karjalainen

Large-scale migration to an open source office suite: An innovation adoption study in Finland

ACADEMIC DISSERTATION

To be presented, with the permission of the Faculty of Information Sciences of the University of Tampere, for public discussion in the B1097 Auditorium of the University on October 15th, 2010, at 12 noon.

DEPARTMENT OF COMPUTER SCIENCES
UNIVERSITY OF TAMPERE

A-2010-4

TAMPERE 2010

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Electronic dissertation
Acta Electronica Universitatis Tamperensis 997
ISBN 978-951-44-8216-8 (pdf)
ISSN 1456-954X
http://acta.uta.fi

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Finland

ISBN 978-951-44-8197-0
ISSN 1459-6903

Tampereen yliopistopaino Oy
Tampere 2010

Abstract

This study investigates the largest transition in Finland to an open source office suite and to an open standard for office documents. The IT environment of the open source OpenOffice.org migration involves more than 10 000 workstations in the Finnish Ministry of Justice and its administrative sector.

Methodologically, the research is a longitudinal innovation adoption study covering the 7-year time span from 2003 to 2010. The study applies and tests the organizational innovation adoption process model originally developed by Everett Rogers. In addition to the theory-testing approach, the study includes artifact-building and artifact-evaluation activities of design research. The research view of the study introduces a participatory researcher's implementation perspective where the researcher as a staff member of the organization has been in charge of the adoption of the innovation in the organization.

The findings of the study provide contributions both to IS research and practice. The events of the study give reason to suggest that the characteristics of the open source software with low-cost licenses call for improvements in the organizational innovation adoption stage model. The findings suggest that the predefined order of stages in the innovation process and sharp distinctions between stages should not be expected in organizational innovation adoption. As a new model and method, the study provides a complementary framework for the instrumentation and documentation of the open source innovation process in the organizational context. The study confirms several results from previous research and practice, especially the importance of top management support, systematic open source skill building and the presence of innovation champions in the adoption of open source solutions.

For IS practice, the study shows that the transition to an open source office suite is feasible in a large-scale context and that substantial benefits can be achieved as the result of the transition. For the user organizations of open source software, lower cost has been the most commonly cited benefit and one of the main reasons for adopting open source. Other often cited considerations include strategic goals like the facilitation of more sovereign IT governance and the reduction of vendor dependence through open source solutions and open standards. The study addresses several practically important issues involved in the adoption of open source, e.g., the analysis of software functionality and interoperability, cost evaluations, installation and configuration issues, local language support issues, additional tools to support the migration, user training and support, technical support, and software usage measurements. The evaluation of costs in the study indicates that the migration to the open source office suite platform will benefit the target organization of the study with impressive cost savings when compared to the deployment of a comparative proprietary office suite platform. The study applies numerous best practice approaches which together with the rich insight provided by the research should benefit other organizations considering open source office suite adoptions both from the perspectives of management and implementation.

Keywords: Innovation adoption, open source migration, office suite, OpenOffice.org, ODF

Tiivistelmä

Tutkimus innovaation käyttöönotosta siirryttäessä avoimen lähdekoodin toimisto-ohjelmistoon suuressa suomalaisessa organisaatiossa

Tutkimus kohdistuu suurimpaan Suomessa tehtyyn avoimen lähdekoodin toimisto-ohjelmiston ja asiakirjojen avoimen tallennusmuotostandardin käyttöönottoon. Tutkimuksen kohteena oleva OpenOffice.org -ohjelmiston käyttöönotto oikeusministeriön ja sen hallinnonalan tietoteknisessä ympäristössä käsittää yli 10 000 työasemaa.

Tutkimusmenetelmänä on seitsemän vuotta ajanjaksolta 2003-2010 kattava pitkittäistutkimus, jossa sovelletaan ja testataan Everett Rogersin organisaatioympäristöön kehittämää innovaatioiden käyttöönoton prosessimallia. Teoriaa testaavan tutkimusotteen lisäksi tutkimuksessa käytetään suunnittelututkimuksen menetelmiä artefaktien rakentamisessa ja arvioinnissa. Pitkittäistutkimus esittelee ohjelmiston käyttöönoton toteutukseen keskittyvän näkökulman, jossa tutkija on organisaation jäsenenä ollut avainasemassa tutkimuksen kohteena olevan innovaation käyttöönotossa.

Tutkimuksella on sekä teoriaa että käytäntöä palvelevia tuloksia. Tutkimuksen perusteella on perusteltua esittää muutoksia tutkimuksessa testatun innovaatioiden käyttöönoton prosessimalliin. Avoin lähdekoodi alhaisine lisenssikustannuksineen vaikuttaa prosessimalliin tutkimuksen mukaan niin, että vaiheiden ennalta määrätty järjestys ja vaiheiden selkeä erottelu ei ole aina perusteltua. Tutkimus on tuottanut avoimeen lähdekoodiin pohjautuvien innovaatioiden käyttöönottoon tarkoitetun täydennetyn prosessimallin ja siihen liittyvän dokumentointi- ja analysointikehyksen. Tutkimus vahvistaa useita aikaisempia tutkimustuloksia, jotka korostavat mm. organisaation johdon tukea, avoimen lähdekoodin vastaanottokyvyn kasvattamista ja organisaation sisäisen muutosagentin merkitystä.

Käytännön tuloksena tutkimus osoittaa, että avoimen lähdekoodin toimisto-ohjelmistoon siirtyminen on toteutettavissa myös suuressa organisaatiossa ja että siirtymisellä on saavutettavissa merkittäviä etuja. Kustannusten pienentäminen on organisaatioiden useimmin esittämä etu avoimen lähdekoodin käyttöönotosta. Muita usein esitettyjä tavoitteita ovat strategiset edut, kuten tietohallinnon itsenäisen aseman tukeminen ja toimittajariippuvuuden vähentäminen avoimen lähdekoodin ratkaisuilla ja avoimilla standardeilla. Tutkimuksessa käsitellään useita avoimen lähdekoodin käyttöönotossa tärkeitä näkökohtia, kuten ohjelmiston toiminnallisuutta ja yhteentoimivuutta, kustannusten arviointia, ohjelmiston asennusta ja konfigurointia, monikielisyyden tukea, käyttöönottoa tukevia lisäosia, käyttäjäkoulutusta ja -tukea, teknistä tukea ja ohjelmiston käytön seurantaa. Tutkimuksessa raportoitujen tulosten mukaan kohdeorganisaatio saavuttaa merkittäviä kustannussäästöjä avoimen lähdekoodin toimisto-ohjelmistoon siirtymisellä verrattuna kaupallisen toimisto-ohjelmiston käyttöön. Tutkimuksessa sovelletut käytännön menetelmät ja monipuolinen toteutuksen ja sen hallinnan kuvaus ovat avuksi muille organisaatioille, jotka harkitsevat avoimen lähdekoodin toimisto-ohjelmistoon siirtymistä.

Avainsanat: innovaation käyttöönotto, avoin lähdekoodi, avoimen lähdekoodin käyttöönotto, toimisto-ohjelmisto, OpenOffice.org, ODF

Acknowledgments

First of all, I wish to thank my supervisor Professor Emeritus Pertti Järvinen for all his support and encouragement during the course of this study. In spite of the deficiencies of my early manuscripts five years ago, he immediately believed in this research project and gave me the motivation I needed. His professional, quick, and detailed responses have managed to keep my research on track. Quite frankly, the dissertation would not have been completed without his support and guidance. The patience and kindness he has shown has amazed me so many times. Thank you Pertti, I have been in good hands and fortunate enough to be given the opportunity to be your student.

I would also like to thank all postgraduate students in the doctoral IS research seminar of the University of Tampere. Professor Emeritus Pertti Järvinen has managed to attract surprisingly many practitioners to join the postgraduate program. The doctoral seminar has provided a supportive research community whose constructive comments and criticism has managed to sharpen my thinking on the research topic and to improve my study. Especially the steady flow of completed dissertations by IS practitioner students during the years has been a great inspiration and encouragement to me. The dissertations have showed in practice that scientific research projects can also be completed by practitioners in spite of so many other obligations competing of their time.

I like also to express my deepest gratitude to the reviewers, Professor Veikko Seppänen of University of Oulu and Doctor Kris Ven of University of Antwerp, who provided me valuable comments and constructive criticism. I also want to thank my opponent, Professor Hannu Jaakkola of Tampere University of Technology, for his comments and reviewing of my work. I am also greatly thankful to many other scientists for the contributions they have provided to this doctoral thesis. Especially, I want to name Professors Brian Fitzgerald, Mike Newman, and Karlheinz Kautz. They have read my early manuscripts and given me valuable feedback and advise which has helped me to open new viewpoints and to improve the research.

There are numerous people in the Ministry of Justice to whom I am thankful for the support and open-mindedness they have shown. Especially during the early stages of the study, the support shown by the top management of the ministry was of utmost importance. For the support shown during the years 2005-2006, I am especially grateful to Permanent Secretary Kirsti Rissanen, CFO Harri Mäkinen, CIO Kari Kujanen, and the chairman of the IT governance co-operation board Esko Sorvali. During the actual implementation of the OpenOffice.org migration, numerous staff members and colleagues in the ICT Service Centre and in the Ministry of Justice and its administrative sector have surprised me with their positive attitude and willingness to practical activities to support the migration. I gratefully acknowledge their support.

I am thankful to my wife Päivi for the patience and support she has shown during the past years. To her, this research must have looked like a project that was never going to end. My absent-mindedness in practical matters during these years has been evident but she has tolerated it all. My children Kalle and Kaisa have been an inspiration to me through their optimism and practical touch with the complexities of life. My grandchildren Ella and Eeli always unmistakenly knew when I needed a break and provided the much needed distraction throughout the thesis process.

Finally, this research is especially dedicated to the memory of my deceased son Kimmo who died in 2003 at the same time when this study was commenced. Memories live, keeping the past not quite past.

Hämeenlinna, in September 2010

Martti Karjalainen

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Abbreviations

API	Application Program Interface
CAD	Computer Aided Design
CAL	Client Access License
CAM	Computer Aided Manufacturing
CERT-FI	Finnish national Computer Emergency Response Team
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CIO	Chief Information Officer
CNIPA	National Centre for ICT in the Public Administrations (Centro Nazionale per l'Informatica nella Pubblica Amministrazione)
COM	Component Object Model
COSPA	Consortium for Open Source Software in the Public Administration
COSS	Finnish Centre for Open Source Solutions
DGME	Directorate General for the Modernisation of the State (Direction Générale de la Modernisation de l'Etat)
FAQ	Frequently Asked Questions
FICORA	Finnish Communications Regulatory Authority (Viestintävirasto)
FLOSSMETRICS	Free/Libre Open Source Software Metrics
FLOSSPOLS	Free/Libre/Open Source Software: Policy Support
GNOME	GNU Network Object Model Environment
GPL	GNU General Public License
HTML	Hypertext Markup Language
ICT	Information and Communication Technology
IDA	Interchange of Data between Administrations
IDABC	Interoperable Delivery of European eGovernment Services to public Administrations, Business and Citizens
IS	Information Systems
ISA	Interoperability Solutions for European Public Administrations
ISO	International Organization for Standardization

IT	Information Technology
JHS	Public Administration Recommendations (Julkisen hallinnon suositukset)
JUHTA	Advisory Committee on Information Management in Public Administration (Julkisen hallinnon tietohallinnon neuvottelukunta)
KDE	K Desktop Environment
KuntaIT	Finnish Local Government IT Management Unit
LGPL	GNU Lesser General Public License
LiMux	Linux for Munich
LinEx	Linux for Extremadura
LTSP	Linux Terminal Server Project
OASIS	Organization for the Advancement of Structured Information Standards
ODF	Open Document Format
OGC	Office of Government Commerce
oopfin	Finnish OpenOffice Portable
OOXML	Office Open XML
OSD	Open Source Definition
OSI	Open Source Initiative
OSOR	Open Source Observatory and Repository for European public administrations
OSOS	Open Source Office Systems
OSS	Open Source Software
PDF	Portable Document Format
PEGSCO	Pan-European eGovernment Services Committee
RTF	Rich Text Format
SGML	Standard Generalized Markup Language
SuPer	Finnish Union of Practical Nurses (Suomen lähi- ja perushoitajaliitto)
TAC	Telematics between Administrations Committee
TAM	Technology Acceptance Model
TAM2	Technology Acceptance Model 2
TAM3	Technology Acceptance Model 3

TIEKE	Finnish Information Society Development Centre (Tietoyhteiskunnan kehittämiskeskus)
TRA	Theory of Reasoned Action
TCO	Total Cost of Ownership
UNO	Universal Network Objects
URL	Uniform Resource Locator
ValtIT	State IT Management Unit (Valtion IT- toiminnan johtamisyksikkö)
VBA	Visual Basic for Applications
W3C	World Wide Web Consortium
XML	eXtensible Markup Language
XSLT	Extensible Stylesheet Language Transformations

1 Introduction

In this chapter we discuss the background and motivation for the study. The chapter begins with a section presenting the conceptual grounding to open source. This is followed with a section giving an overview of open source solutions and the role of office suite software in the desktop platform. Next, the benefits and challenges in open source adoption are discussed. The following section presents the objectives and motivation for the research. The chapter ends with a section describing the organization of the study.

1.1 The concept of open source

Open source software (OSS) and open standards are becoming increasingly important as organizations seek to improve the interoperability of information technology (IT) systems and decrease the overall IT expenditures.

The term *open source* was coined in 1998 in the wake of the announcement to publish the source code of the popular Netscape web browser (Woods and Guliani, 2005, p. 10). The new term was an attempt to avoid the linguistic uncertainty with the English term free software (free meaning "free to be modified by anyone" or free meaning "no money charged"). The original term *free software* was defined by Richard Stallman, the founder of the Free Software Foundation, as software protecting the following four freedoms for its users (Woods and Guliani, ibid., p. 9):

- The freedom to run the program, for any purpose (*freedom 0*);
- The freedom to study how the program works, and adapt it to your needs (*freedom 1*);
- The freedom to redistribute copies of the program so you can help your neighbor (*freedom 2*);
- The freedom to improve the program, and release your improvements to the public, so that the whole community benefits (*freedom 3*).

In the definition of free software, access to the source code is a precondition both in freedom 1 and in freedom 3.

The new term open source was also an attempt to make a distinction to the somewhat political nature of the freedoms and promote more the idea of collaborative, community-based software development with guaranteed access to the source code. The Open Source Initiative (OSI), a California-based public benefit corporation, was founded in 1998 to maintain the open source definition (OSD) and

to review and approve licenses as OSD-conformant. The open source definition containing 10 criteria and the approved licenses are available from the website (OSI, 2010) maintained by OSI. The first three criteria dealing with free distribution, source code and derived works expose the key concepts in the definition, and they are reproduced below.

- *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.
- *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.
- *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.

Other criteria, not reproduced here in detail, specify additional requirements. The following titles from the definition give an indication of the general contents of the additional seven criteria.

- *Integrity of The Author's Source Code*
- *No Discrimination Against Persons or Groups*
- *No Discrimination Against Fields of Endeavor*
- *Distribution of License*
- *License Must Not Be Specific to a Product*
- *License Must Not Restrict Other Software*
- *License Must Be Technology-Neutral*

Open source software is copyrighted by its authors, and is made available under copyright licenses that comply with the OSD criteria. On 23 June 2010, altogether 66 licenses were listed as being approved by the OSI. The list includes, e.g., the first open source license, known as GPL (GNU General Public License), the European Union Public License (available in 22 official languages of the European Union), and licenses from major IT companies including IBM, Microsoft, and Nokia.

1.2 Open source solutions in the IT environment

The number of projects which develop open source software is impressive. The website of SourceForge.net[1], which can be considered the world's largest OSS project repository, included more than 230 000 registered software projects in 2009. And SourceForge.net is not the only potential source of open source projects. However, only a small percentage of the more than 200 000 projects are in a mature state capable to provide productized services including ready-made installation scripts or wizards, regular software releases, engineering and user documentation, and support forums for developers and users. The EU-funded FLOSSMETRICS project (Daffara, 2009) estimated that a minimum of 13 000 open source projects could be considered as still active in 2009 and 5000 of those could be considered as stable or mature.

Famous examples of popular OSS solutions include, e.g., the Linux operating system, the Apache web server, the Mozilla Firefox web browser, the MySQL database, Perl and PHP scripting languages, and the OpenOffice.org office productivity suite.

Studies indicate considerable adoption of open source solutions. Glott and Ghosh (2005) reported the usage of OSS in European public sector organizations in a survey conducted by MERIT, University of Maastricht. The survey was part of the EU-funded FLOSSPOLS project, and the survey involved 955 public sector organizations in 13 EU countries in the third quarter of 2004. The survey reported (p. 17) that 79% of the organizations were using OSS. From the organizations using open source solutions, 47% reported deployment of Linux with also MySQL (34%), Apache (33%), Firefox (26%), PHP (24%), and OpenOffice.org (22%) reaching shares of more than one fifth (p. 19). Even if the results of the survey indicate considerable adoption of open source solutions, Glott and Ghosh note (p. 19) that the FLOSSPOLS survey does not indicate that OSS has become a standard in organizations. The survey rather shows that the majority of public sector organizations have some usage of OSS, but the usage within most organizations is not widespread. The authors also note (p. 19) that OSS has an important role on the servers as operating system and for Internet applications, but the impact on desktop level applications remains quite untapped.

The study on the economic impact of open source software (Ghosh, 2006) provides an extensive compilation and summary of several market research sources analyzing both European and worldwide market shares of open source software. Ghosh (ibid., pp. 21-22) cites, e.g., the IDC's 2005 Western European software end-user survey of 625 firms which shows that nearly 60% of respondents had "significant, some or limited" use of open source databases, over 40% of firms reported usage of open source operating systems, and about 30% of firms reported

1 http://www.sourceforge.net/ (cited 21 May 2010)

usage of open source personal productivity software. Considering worldwide market shares, Ghosh (ibid., pp. 32- 33) reports that the overall market share of Linux as a desktop operating system is 2%–5% and as a server operating system around 20% with open source web server software holding over 60% of the overall market. A summary of the worldwide findings reported by Ghosh (ibid., p. 18) is given below.

- Open source applications are first, second or third-placed products in terms of market share in several markets, including web servers, server operating systems, desktop operating systems, web browsers, databases, e-mail and other information and communication technology (ICT) infrastructure systems. Open source market share for operating systems and desktops is higher in Europe than in the US, followed by Asia.
- Open source market penetration is high with a large share of private and public organizations reporting some use of open source in most application domains. In the public sector, Europe has particularly high penetration, perhaps soon to be overtaken by Asia and Latin America. In the private sector, the adoption of open source software is driven by medium- and large-sized firms.

Ghosh, (ibid., p. 17) lists the following four overall factors accelerating the adoption of open source software: (1) availability of high-quality software, (2) low cost and low barrier to entry, (3) availability of customization and local support services, and (4) vendor independence and flexibility.

The yearly statistics on the Finnish government´s ICT presents information regarding ICT expenditure and personnel, as well as the IT hardware and software usage in Finnish government organizations. The statistics of 2008 (Ministry of Finance, 2009b) show that the government organizations had altogether 166 000 workstations with the share of Linux being 4%. Various versions of the Microsoft Windows operating system were the dominant desktop operating system in 2008 with a total share of 93%. In office productivity software, the share of OpenOffice.org was 16% with the various versions of Microsoft Office having the largest share of 83%. On the server software, the share of Linux was 22% from the total of 9400 servers used for file, print, database, and application services. Considering the Finnish public sector as a whole, including also the municipal organizations, Puhakka et al. (2006) conclude that while open source has gained considerable ground on the server side, the impact on desktop applications is still modest and lacks large-scale deployments.

1.2.1 Office suite software in the desktop platform

Woods and Guliani (2005) define the desktop platform in software layers with each layer depending on the functionality and services from the layer below and providing

functionality and services to the above layers. The key layers of the desktop are shown in Table 1-1.

Office application suite	Web browser	Messaging client	Desktop database
Desktop environment			
Desktop operating system			
Desktop hardware platform			

Table 1-1: Layers of desktop functionality, adapted from Woods and Guliani (2005, p.152)

The software solutions of the desktop platform can be based on either proprietary software or OSS solutions. Also a mixture of proprietary and OSS solutions is possible.

The desktop operating system, e.g., the proprietary Microsoft Windows or one of the several OSS Linux distributions like Ubuntu or Debian, defines the bottom software layer closest to the desktop hardware platform. It provides services to the desktop environment which refers to the graphical environment where the user does her work. In Windows, the desktop environment is tightly built-in with the operating system, while in Linux there are several choices, like KDE or GNOME. The office application suite (often also called personal productivity software) typically includes word processing, spreadsheet, and presentation software. The proprietary Microsoft Office is the dominant suite on Windows with OpenOffice.org being the most popular OSS choice which is available, e.g., on Windows, Linux, and Mac OS X operating systems.

Considering the functionality provided by the office application suite, Woods and Guliani (2005, p. 155) define a minimum set of key capabilities which every office application suite solution should provide. The minimum requirements for word processing, spreadsheet, and presentation software are shown in Table 1-2 below.

Word processing
Ability to generate simple office documents, such as memorandums and business forms
Option to generate complex office documents with embedded spreadsheets, charts, and tables
Sophisticated style sheet support
Auto correction and spell checking
Template support
Spreadsheets
Ability to generate simple formulas, charts, and statistics
Ability to include the option for conditional coloring of cells and data display customization using various fonts

Presentations
Ability to insert and edit rich text
Support for complex layouts of media objects
Functions for playing presentations with transitions and other effects
Publishing tools for exporting presentations as Hypertext Markup Language (HTML) to a website

Table 1-2: Minimum requirements for word processing, spreadsheet, and presentation software; adapted from Woods and Guliani (2005, p.155)

1.3 Benefits and challenges in open source

For software developers, guaranteed access to the source code is crucial. Source code together with free distribution, derived works, and other OSD criteria allow collaborative, community-based software development where new developments can always be built using the results of previous programming efforts. Major IT firms like IBM, HP, and Oracle, are participating and supporting open source development projects and using the results of the projects in their own product development. For small IT firms, open source solutions provide a low-cost entry to own product development and also opportunities in service business like training, consultancy, product support, and systems integration.

Instead of open source software development, the focus in this study is on the usage of open source solutions. Studies by West and Dedrick (2008), Ghosh (2006), and Glott and Ghosh (2005) show that for the user organizations of OSS, lower cost has been the most commonly cited benefit and one of the main reasons for adopting OSS. An obvious factor reducing the cost of open source solutions comes with the software licenses which may be available free of charge. Also the software itself can often be downloaded via the Internet without charge. However, this does not mean that the adoption and deployment of open source solutions is free of costs. The public procurement guidelines on open source software (Ghosh et al., 2008, p. 21) identify several cost factors, including associated hardware, support and maintenance, software customization and upgrades, training, and other services. In long-term cost evaluation the guidelines also consider exit costs, i.e. the cost incurred in moving to another IT system. In addition to licensing, cost reduction possibilities in open source solutions are also facilitated by increased possibilities for competition. Because access and modification of the source code is allowed, anyone with sufficient skills and other resources can provide support and other services. Open source solutions thus facilitate competitive software services markets not restricted by licenses and controls of particular software vendors. Ghosh et al. (2008, p. 32) conclude that in a call for tenders placed for the purchase of services related to an open source software system, any independent supplier can bid.

Freedom from vendor lock-in is another commonly cited advantage of open source solutions (Woods and Guliani, 2005; West and Dedrick, 2008). Vendor lock-in is caused by high switching costs which create a situation where the software vendor can tie the customer in the perpetual use and license pricing of their software solution. Access to source code and the resulting competitive software services market reduces the users' dependence from the original vendors of the software facilitating thus more sovereign IT governance. Woods and Guliani (ibid., p. 2) note that the freedom from vendor lock-in gains the customer's power in negotiations with software vendors.

Studies indicate that access to the source code is not among the main drivers to the user organizations. West and Dedrick (ibid.) go even further and argue that very few organizations have ever modified the source code even when they use open source software. Glott and Ghosh (2005, p. 22) suggest that one reason for the relatively low importance of access to the source code is that the exploitation of source code requires good programming skills and consumes a considerable amount of time. Without the necessary skills, many user organizations try to use open source solutions as much off-the-shelf software as possible. Due to the variation in the maturity levels of OSS solutions, Woods and Guliani (2005) emphasize the importance of systematic skill development in the user organizations so that, e.g., installation and configuration challenges can be met.

Considering challenges facing user organizations in the adoption of OSS, the FLOSSPOLS survey (Glott and Ghosh, 2005, p. 25) reported that difficulties in finding technical support for open source systems were considered to be a problem by 39% of the respondents. The survey also found (p. 25) that 39% of the respondents feared that migrating towards open source solutions would cause large investments in time and money in order to teach people how to use OSS solutions. The authors conclude (p. 25) that price and technical support seem to provide the crucial factors for a broad adoption of OSS in European local governments. The authors suggest (p. 66) to focus on increasing the awareness of open source solutions, their costs and benefits, to encourage pilot projects and experimentation, to build experience and to develop skills, and to facilitate the exchange of the best practices to reduce fears related to training costs and the availability of support services. The concern to increase the awareness of open source solutions was also expressed by Fitzgerald (2006) in his analysis of the OSS phenomenon. Fitzgerald (ibid.) expressed the need for an up-to-date catalog of high-quality open source products. The catalog could provide details on the functionality offered by various products, the types of support available, training needs, reference sites of deployment, and companies offering support.

The survey among Finnish municipalities (Välimäki et al., 2005) reported several factors which were considered problematic in the adoption of OSS. The Finnish organizations showed interest in open source solutions, but the lack of information concerning the availability of open source solutions and support was considered as

one of barriers in the adoption. Other problematic factors included lack of support from vendors and lack of co-operation among user organizations. Some of these concerns were addressed in 2009 when the recommendations concerning the use open source software in Finnish public administration (JHS, 2009) were published. The JHS-recommendations, approved by the Advisory Committee on Information Management in Public Administration (JUHTA), provide information management guidelines for public administration (both governmental and municipal). The open source recommendations provide methods to compare open source and proprietary software solutions. In addition, the recommendations also give guidelines to public administrations how to procure this type of software and how deal with software support issues.

1.4 Research objectives

Fitzgerald (2009) notes that there is a lack of research on OSS adoption in organizations. Fitzgerald (ibid.) also notes that the widespread media coverage of open source leads to high awareness of the concept, but there is still a lack of any tried and tested approach which could guarantee successful implementation of open source adoption. In Section 1.3, the overall need to increase the awareness of OSS solutions and the demand for practical OSS implementation and evaluation experiences in the organizational context was expressed.

This study addresses the need for research in organizational OSS adoption. The focus of the research is on studying the migration to an open source office suite in a large organization. The study seeks to provide rich understanding and insight based on a deep analysis in a single case context. As a longitudinal case study this research in depth discusses the adoption of OpenOffice.org open source office suite in a large Finnish public organization, the Ministry of Justice and its administrative sector. The process which finally lead to the adoption of the OSS office suite was started in 2003 when it became evident that major changes were necessary in the office suite software deployed in the study organization at that time. The end of product development of the IBM Lotus SmartSuite office productivity suite sparked the organization to study alternatives to replace the SmartSuite software. The longitudinal study covers a 7-year period 2003-2010 from the initial software evaluations to the actual implementation of the OpenOffice.org adoption which was started in 2007. The study addresses several practically important issues involved in the adoption of open source. These include the analysis of software functionality and interoperability, cost evaluations, installation and configuration issues, local language support issues, additional tools to support the migration, user training and support, technical support, and software usage measurements.

Given the lack of research on the organizational adoption of open source, there is a shortage of studies covering large-scale open source desktop adoptions as well. The

organizational migration context of this study represents the first large-scale transition in Finland to an open source office suite involving altogether more than 10 000 workstations. The publicly known open source office suite migrations in Finland have this far been in organizations involving at most a couple of hundred workstations. An in-depth study of a large real-life open source adoption thus has the potential to contributions both to practice and to research. The research questions in this study concern the topic of organizational adoption of OSS office suite software. Based on the implementation of the first large-scale OpenOffice.org adoption in Finland, the study seeks to provide answers to the following five questions:

Q1: Is the transition to an open source office suite feasible in a large-scale context?

Q2: Is the open source office suite a viable alternative to proprietary software?

Q3: Can the benefits, e.g., cost reductions of the OSS solution be realized?

Q4: What factors support or prevent the transition to an open source office suite?

Q5: What practical guidelines can be given to organizations considering the adoption of an open source office suite?

All questions Q1-Q5 address practical issues for large organizations considering the adoption of open source office suite. Considering research questions and IS science, Gregor (2006) provides a taxonomy of IS theories and addresses questions to which a certain theory type gives an answer. Gregor distinguishes between five interrelated types of theories: (1) theory for analyzing, (2) theory for explaining, (3) theory for predicting, (4) theory for explaining and predicting, and (5) theory for design and action. The theory for design and action says how to do something and gives explicit prescriptions (e.g., methods, techniques, principles) for constructing an artifact. The theory for design and action gives guidelines or principles that can be followed in practice. Gregor (ibid., p. 628) notes that associated research to the theory for design and action has been referred to as software engineering research, as a constructive type of research, as prototyping, as a systems development approach, and as design science. The research questions Q1, Q2, and Q3 involve issues of design science which stresses the utility of an innovation. The guideline aspect of design science also facilitates to address the research question Q5 by design science. The research question Q4 is an issue addressed in interpretive studies in IS.

Due to the practical origins of this study, the research view in the study is oriented towards the OSS implementation issues. The author of the study has been in a key position in the implementation process in the target organization of the study. The insider position of the researcher gives a unique opportunity to allow an in-depth insight into the implementation of the OSS adoption process. The practical origins of the study have also resulted to the research view where the European and especially

the local Finnish context has influenced the OSS implementation focus of the research.

The relevance of information systems research has been a longstanding issue in the IS academia. Over ten years ago Benbasat and Zmud (1999) argued that the lack of IS research relevance can be traced to the "ivory tower" nature of the IS research in general. Since then, the view has been supported by several other researchers (Hirschheim and Klein, 2003; Rosemann and Vessey, 2008; Ramiller and Pentland, 2009) who argue that there is a gap between IS research and IS practice with much IS research being of little relevance to the practice. This dilemma between "rigor or relevance" has been described by Schön (1991, p. 42) with the difference between high, hard ground where practitioners can make effective use of research-based theories and techniques and the swampy lowland where the problems of greatest practical concern actually exist but where the research-based theories and techniques are incapable to provide solutions. Due to the practical origins and the implementation focus of this research, the study has been conducted both in the high, hard ground of theories and in the swampy lowland of practice where all problems have to be solved one way or another. The study thus has the potential to contribute both to academic research and to relevant practices in the OSS adoption.

1.4.1 Research context

The research context of the study is the migration process where a proprietary office suite is replaced by the open source OpenOffice.org office suite. The context of the migration is the Finnish Ministry of Justice and its administrative sector which employs close to 10 000 persons. By Finnish standards, the organization represents a large public organization with the IT infrastructure including over 10 000 workstations. A short summary of the ministry and its IT services is given below.

> The Ministry of Justice[2] maintains and develops the legal order and legal safeguards and oversees the structures of democracy and the fundamental rights of citizens. The ministry is responsible for the drafting of the most important laws, the functioning of the judicial system, and the enforcement of sentences. The ministry has a Department of Judicial Administration, a Law Drafting Department, and a Criminal Policy Department.
>
> Close to 10 000 persons are employed in the administrative sector of the Ministry of Justice, about 250 of whom work at the ministry. The administrative sector has over 300 offices throughout the country including, e.g., offices for courts, prosecution, enforcement, State legal aid, public guardianship services, prison service, and probation service.
>
> The ministry and its administrative sector represent a typical large government organization in Finland. Drawing on the figures of the state

2 http://www.om.fi (cited 3 June 2010)

personnel balance sheet (Happonen and Nikkanen, 2006), the average age of persons employed by the State was 43.1 years in November 2005. Considering the level of education, 93% of State personnel had a vocational examination and 43% of all staff had an examination from an institute of higher education. The personnel of the ministry and its administrative sector was a bit older (47.3 years), but the educational structure of the staff was the same: 93% had a vocational examination and 43% had an examination from an institute of higher education.

The IT skills of the staff are modest. The majority of the staff completed their examinations in the 1970's and 1980's when, e.g., personal workstations and graphical user interfaces were not covered in the basic IT training. However, many employees have used several word processing packages over the years. The Finnish-made TEKO word processing software, WordPerfect, IBM WordPro, and Microsoft Word have all been used in text processing during the past 25 years.

The IT service function of the ministry employs 120 persons. In addition to the general IT governance of the ministry, the main roles of the in-house IT staff include requirements definition in systems development, application testing, application support, user support, and training. The actual systems implementation tasks (systems design and programming) and the tasks related to the operation of server computers are acquired from external IT service providers.

In 2008, the ministry and its administrative sector made up 1,7% of the annual Government expenditure of Finland and close to 8% of the total on-bugdet personnel of the State. The 39 M€ IT costs of the ministry represent 5% of the total 769 M€ expenditure of the ministry in 2008 (Ministry of Justice, 2009; Ministry of Finance, 2009b).

Following Yin (2003, pp. 40-42), the uniqueness of the situation is an appropriate rationale for a study in a single organization. The uniqueness also brings the potential for a study which Yin calls "revelatory" (in this research context a phenomenon previously inaccessible to scientific investigation in Finnish organizations). The adoption study presents a unique case involving the first large-scale transition in Finland to an open source office suite. The unique situation in this case is appropriate for a study in a single organization.

1.4.2 Personal motivation

My personal motivation for this research effort is based on the OpenOffice.org migration project in the Finnish Ministry of Justice. I am currently employed as a chief systems analyst in the Office of the CIO of the ministry, and I have been the key person in the migration since 2003. I was the author of the first public report

(Karjalainen, 2005a), where various office suite alternatives for the ministry were evaluated. Since then, I was the project leader in the OpenOffice.org pilot project during 2005-2006. I have been also the project leader in the actual OpenOffice.org migration project since the beginning of 2007.

When I started the evaluation of office software options for the ministry and its administrative sector in 2003, I quickly realized that there was a lack of public information concerning the adoption of open source office software. In Finland there were no adoption examples in large organizations, and adoption cases in other European countries were also rare. In addition to the lack of information, it was obvious that there was also considerable lack of knowledge within Finnish IT professionals concerning open source office software. For many organizations, the lack of information and the lack of knowledge create barriers for open source adoption considerations.

In this situation it was obvious that a scientific study could provide useful and important information to many stakeholders (public and private organizations, IT professionals and researchers) concerning migrations to open source office software. A scientific study applying relevant information from the knowledge base of IS research could also give additional support to the Ministry of Justice in the adoption of the OpenOffice.org software. A research project was thus justifiable from many perspectives. I also felt that I was personally ready and capable for the research project. I completed my Master's degree in computer science in 1974 and my Licentiate degree in 1980. I have more than 30 years of IT experience both in the universities and in the public administration. My professional tasks have been software-related: operating systems, programming languages and compilers, software architecture, design and implementation of IT applications.

1.5 Outline of the study

In Chapter 1 of the study we introduce the research domain, the research background, and the objectives and motivation for the research. In Chapter 2 we present other research which is related to the research domain of the study. The research approach applied in this study is described in Chapter 3.

The chosen research framework for the study follows a process model which closely defines the structure of the rest of the study. We present the analysis and findings of the study in chapters 4–9 which are arranged to closely follow the stages of the process model of the research. Each chapter has an introductory part describing the outline of the chapter. Each chapter also has a review section summarizing the findings of the chapter.

In Chapter 10 we draw together previous chapters and summarize the findings and contributions both to research and to practice. In Chapter 10 we also discuss the

limitations of the research and the reliability and validity issues concerning the research. In addition, suggestions for further studies are given Chapter 10.

The structure of the study where the results of each chapter are summarized in the review section of the chapter and then summarized (possibly again) in the final discussion of the study introduces some repetition of the results in the text of the study. However, this repetition was considered necessary so that individual chapters could easily be studied and evaluated also as separate entities.

2 Related research

In this chapter we discuss prior research which is related to the adoption of IT systems. We begin the chapter with a section presenting design research which forms the basis in the problem solving of IT systems adoption. Next, we present research results from the diffusion of innovations. This is followed with an overview of research on the organizational development and change. In the final section we discuss open source adoption studies.

2.1 Design research

In general, the adoption of IT systems can be seen as a problem-solving process where the facilities of information technology are utilized in order to serve the needs of the adopters. The problem-solving nature of IT adoption calls for design-oriented research which studies artificial as opposed to natural phenomena. The scientific basis for this type of research is grounded in Nobel Laureate Herbert Simon's classic work "*The Sciences of the Artificial*" (1996, first published in 1969) which links natural world, social world, and artificial world. Simon's work is related to Karl Popper's (1986) philosophical theory of reality which includes three interacting worlds, called World 1, World 2, and World 3. World 1 is the physical world of material things, World 2 is the world of mind or mental states, and World 3 is the body of human knowledge expressed in man-made entities. Simon's work together with the works of March and Smith (1995) and Hevner et al. (2004) form the roots of knowledge called *design science* which is concerned with the construction and evaluation of technological artifacts. Design science research is technology-oriented and applies knowledge of tasks or situations in order to create effective artifacts to serve human purposes. Design science is concerned with "*devising artifacts to attain goal*s" (Simon, 1996, p. 114). In Popper's three worlds, design science belongs to Wold 3, i.e. the world of man-made entities.

March and Smith (ibid.) presented a two dimensional framework for the design research in information technology.

- The first dimension is based on activities in design and natural science research: build, evaluate, theorize, and justify. *Build* refers to construction of the artifact for a specific purpose demonstrating the feasibility of the design. *Evaluate* refers to the development of criteria and the assessment of artifact performance against those criteria. The *theorize* activity explains the characteristics of the artifact and its interaction with the environment and attempts to unify the known data into a viable theory in order to explain how

and why the artifact performs as it does. The *justify* activity performs empirical and/or theoretical research to test the theory.

- The second dimension is based on outputs produced by design research: representational constructs, models, methods, and instantiations. *Constructs* or concepts form the vocabulary of a domain and they are used to describe problems within the domain and to specify their solutions. *Models* are sets of propositions or statements representing problems and solutions. *Methods* are sets of steps used to perform a task. An *instantiation* is the realization of an artifact in its environment.

Hevner et al. (2004) broadened the framework of March and Smith (1995) further. Their conceptual framework for IS research connects the problem space (the environment), IS research activities, and the knowledge base of the IS research. The assessment of relevance guides the application of research to the problems of the environment. IS research applies and updates the knowledge base. Research rigor is achieved by appropriately applying existing foundations and methodologies in the knowledge base.

Vaishnavi and Kuechler (2009) present on the portal page "*Design Research in Information Systems*" a general reasoning model for design research. This process model has the following five stages:

1. *Awareness of problem* (the beginning of design, resulting a proposal);
2. *Suggestion* (solution search from existing knowledge base, resulting a tentative design);
3. *Development* (an attempt to implement the artifact according to the suggested solution);
4. *Evaluation* (evaluation of the implementation according to the functional specification implicit or explicit in the suggestion);
5. *Conclusion* (the termination of design, results are available).

The stages development (3), evaluation (4), and further suggestion (2) are iteratively performed in the course of the research. Another general process model to carry out design science research was proposed by Peffers et al. (2007). Their model has the following six stages:

1. *Problem identification and motivation* (defining the specific research problem and justifying the value of a solution);
2. *Define the objectives for a solution* (inferring the objectives of a solution from the problem definition and knowledge of what is possible and feasible);
3. *Design and development* (creating the artifact);

4. *Demonstration* (demonstrating the use of the artifact to solve one or more instances of the problem);
5. *Evaluation* (observing and measuring how well the artifact supports a solution to the problem);
6. *Communication* (diffusing the resulting knowledge to researchers and other relevant audiences).

The model of Peffers et al. (2007) does not assume that researchers would always proceed in sequential order from activity 1 through activity 6. The model has several entry points supporting various research and problem contexts. The stages of the process may also be iterated depending on the findings during the activities. Similarities in the models of Vaishnavi and Kuechler (2009) and Peffers et al. (2007) are obvious. The model presented by Peffers et al. covers a bit broader spectrum of the research by including the demonstration of the design and the communication of the results in the model. These two process models are general and can be applied to any design research problem.

2.2 Innovation adoption

This study has a specific design domain which is concerned with the adoption of an open source office suite. The principles of innovation diffusion research as presented by Rogers (2003) provide a research model which can be used in the design effort in this study.

"*Diffusion of Innovations*" is the classic work of Everett M. Rogers. The book was originally published in 1962, and had reached its 5th edition in 2003. The diffusion theory was developed when Rogers studied the adoption of agricultural innovation by farmers in Iowa in the 1950's. The latest edition of Rogers' work provides a synthesis of more than 5000 previous studies in the adoption and diffusion of innovations. Rogers argues that diffusion of innovations is a general process which is not bound by the type of innovation studied. Rogers (ibid.) presents examples and studies where the theory has been applied to a wide variety of innovations, e.g., cigarette smoking regulations (p. 321 and pp. 415-416), automobile seat belts (p. 29 and pp. 234-235), family planning (pp. 68-72), kindergartens (pp. 63-64), aircraft hijackings (p. 335), terrorist attacks (pp. 79-81), Internet (p. 82 and pp. 346-348), and cellular telephones (p. 84 and pp. 259-265). The generality of the process suggests that it is a valid framework also for the diffusion of IT innovations, like the OpenOffice.org office suite.

Rogers (ibid., pp. 473-475) defines the *diffusion* to be a process by which an innovation is communicated through certain channels over time among the members of a social system. An *innovation* is an idea, practice, or object perceived as new by an individual or other unit of adoption. *Innovativeness* is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than

the other members of the system. Individuals can be classified into adopter categories on the basis when they first begin to use a new idea. Each adopter category consists of individuals with a similar degree of innovativeness.

In the classical diffusion model depicted in Figure 2-1, the cumulative number of adopters of an innovation tends to follow an S-shaped curve over time. At first the curve rises slowly when there are only a few earlier adopters. The curve "*takes off*" at about 10 to 20 percent of adoption and accelerates to a maximum until half of the individuals in the system have adopted. Then it increases at a gradually slower rate with later adopters. The S-shaped curve in the diffusion process is normal. Using the normal frequency distribution Rogers defines five adopter categories: (1) innovators (the first 2.5 % of adopters), (2) early adopters (the next 13.5 %), (3) early majority (the next 34 %), (4) late majority (the next 34 %), and (5) laggards (the last 16 % of adopters). The partitioning is based on the mean and on the standard deviation of the normal frequency distribution.

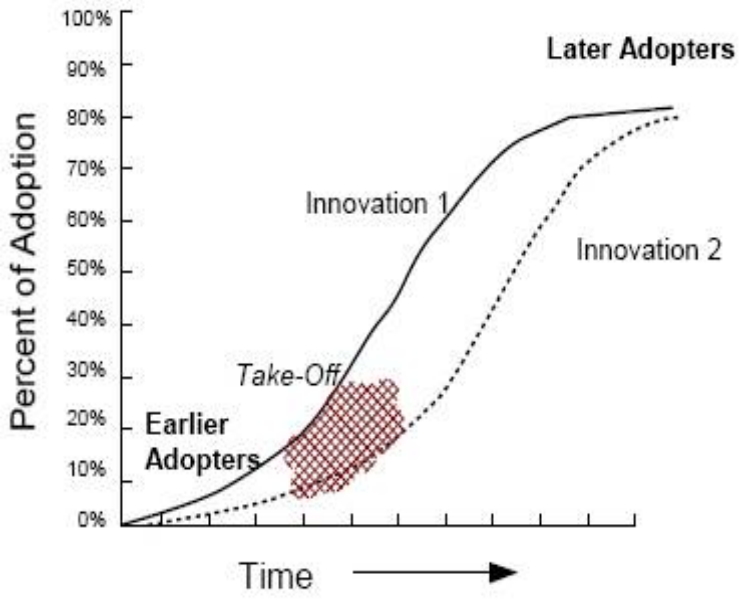

Figure 2-1. The diffusion process, adapted from Rogers (2003, p. 11)

Rogers presents two stage models for the innovation adoption process: (1) the general innovation-decision process (the classical or traditional diffusion) for the context where individual adopters make voluntary decisions to accept or reject an innovation and (2) innovation process in an organization (a model tailored for the organizational context). Due to the importance of these models for this study, the models are described in more detail in Section 3.2 in the discussion of the research approach of this study.

Figure 2-2, adapted from Rogers (2003) illustrates variables related to the organizational innovativeness. Innovativeness is related to such variables as (1)

individual (leader) characteristics, (2) internal organizational structure characteristics, and (3) external characteristics of the organization.

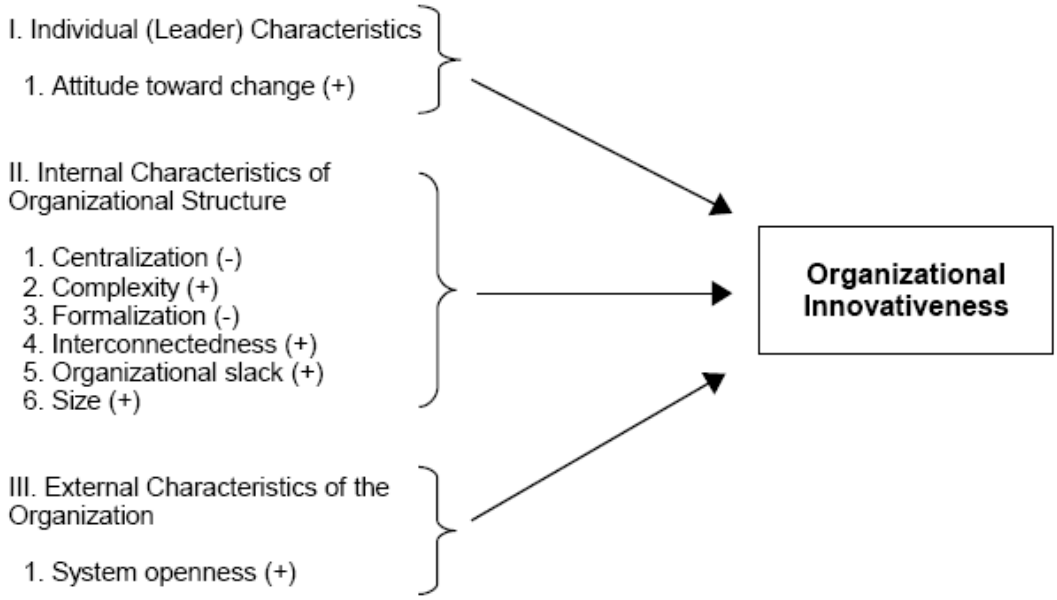

Figure 2-2. Organizational innovativeness, adapted from Rogers (2003, p. 411)

Following Rogers (2003, p. 412), the internal characteristics of the organizational structure are related to the innovativeness as follows.

- *Centralization* is the degree to which power and control in a system are concentrated in the hands of a relatively few individuals. Centralization has usually been found to be negatively associated with innovativeness. Centralization can encourage the implementation of innovations once a decision is made to adopt.
- *Complexity* is the degree to which an organization's members possess a relatively high level of knowledge and expertise, usually measured by the members' range of occupational specialties and their degree of professionalism (expressed by formal training). Complexity encourages organizational members to grasp the value of innovations, but it may make it difficult to achieve consensus about implementing them.
- *Formalization* is the degree to which an organization emphasizes its members' following rules and regulations. Formalization acts to inhibit the consideration of innovations, but encourages the implementation of innovations.
- *Interconnectedness* is the degree to which units in a social system are linked by interpersonal networks. Interconnectedness supports the flow of new ideas and is positively related to organizational innovativeness.

- *Organizational slack* is the degree to which uncommitted resources are available to an organization. This variable is is positively related to organizational innovativeness.
- *The size of an organization*, measured typically as the number of employees and the size of the budget, has constantly been found to be positively related to its innovativeness. Larger-size organizations have generally been found to be more innovative, just as are individuals with larger incomes and higher socioeconomic status. Size is variable that is easily measured, presumably with a relatively high degree of precision. Size is probably a surrogate measure of several dimensions that lead to innovation: total resources, slack resources, employees' technical expertise, organizational structure, and so on.

Rogers makes the generalization (2003, p. 413) that each of the organizational structure variables may be related to innovativeness in one direction during the initiation phases of the innovation process, and in the opposite direction in the implementation phases. Low centralization, high complexity, and low formalization facilitate initiation of the innovation process, but these structural characteristics make it difficult for an organization to implement an innovation.

In addition to the internal characteristics of the organizational structure, also external characteristics of the organization are related to the innovativeness. *The openness of the organization* (defined as the degree to which members of the system are linked to individuals external to the system) has been found to be positively related to the organizational innovativeness (Rogers, ibid., p. 408).

Also individual leader characteristics in an organization have been found to be related to the innovativeness. Rogers makes the generalization (ibid., p. 414) that the presence of an *innovation champion* contributes to the success of an innovation in an organization. He defines a champion as a charismatic individual who throws his or her weight behind an innovation, thus overcoming indifference or resistance that the new idea may provoke in an organization. Rogers gives examples which suggest that champions come in all ages, with various degrees of formal power, and with different kinds of abilities. The champion's role is to initiate the innovation process and guide the new idea to approval implementation. Schön (1963, p. 84) has stated the importance of a champion very clearly: "*The new idea either finds a champion or dies.*"

While Rogers (2003) developed general-purpose models for innovation, Fred Davis (1986, 1989) introduced the Technology Acceptance Model (TAM). TAM is an adaptation of Fishbein and Ajzen's Theory of Reasoned Action (TRA) specifically tailored for modeling user acceptance of information systems. TAM uses TRA as a theoretical basis for specifying the causal linkages between two key beliefs: perceived usefulness and perceived ease of use, and users' attitudes, intentions and actual computer adoption behavior. Later, Venkatesh and Davis (2000) developed the original TAM model further by introducing several new

concepts into the theory. They named this new and improved model TAM2. As a recent development, Venkatesh and Bala (2008) extended TAM2 further by introducing the Technology Acceptance Model 3 (TAM3).

The Technology Acceptance Model and Rogers' innovation-decision model (the classical diffusion) both apply to contexts where individual adopters make voluntary decisions to accept or reject an innovation. The original TAM and Rogers' innovation-decision model both identify the perceived attributes of an innovation as key predictors explaining adoption. However, there are also important differences between the models. Rogers' model identifies five perceived attributes of an innovation as influencing the adoption (relative advantage, complexity, compatibility, trialability, and observability). The TAM has two central attributes that influence adoption (perceived usefulness and perceived ease of use). These two attributes are respectively subsumed by the attributes relative advantage and complexity in the Rogers' model. The incorporation of these two models together is also possible: Zhou (2008) integrated the TAM and Rogers' classical diffusion model to explore empirically Chinese journalists' adoption of the Internet.

Fichman (1992) conducted a review of eighteen empirical studies of IT adoption and diffusion published during the period 1981-1991. Fichman argues (p. 204) that the outcomes of applying Rogers' classical diffusion model were strongest when researchers examined (1) individuals making autonomous adoption choices or (2) independent-use technologies that do not require specialized knowledge prior to adoption. In these instances the assumptions of the classical diffusion are most likely to hold. Results were less conclusive in studies of organizational adoption of complex multi-user technologies. Fichman argues that the classical diffusion model has limitations in the adoption of IT technology: the outcomes of applying innovation models are sensitive to the specific features of the adoption context and to the technology in question.

CLASS OF TECHNOLOGY	LOCUS OF INNOVATION ADOPTION: Individual	LOCUS OF INNOVATION ADOPTION: Organizational
Type 1: **Low knowledge burden and Low user interdependencies**	Cell 1 Traditional Adoption	Cell 2 Organizational Mandate
Type 2: **High knowledge burden or High user interdependencies**	Cell 3 Individual Mandate: Complex adoption	Cell 4 Organizational Mandate: Complex adoption

Table 2-1. IT diffusion classification matrix, adapted from Fichman (1992)

To address the sensitivity of the adoption context and the technology, Fichman proposes a framework to guide future research in IT diffusion. The framework maps two broad classes of technology (knowledge burden, user interdependency) against the locus of adoption (individual, organizational), resulting in four IT adoption contexts. The framework is shown in Table 2-1.

The horizontal dimension of Table 2-1 refers to the locus of adoption to be examined: individual or organizational adoption. The vertical dimension distinguishes between two classes of IT (Type 1 and Type 2). Type 1 technologies are characterized by a lack of user interdependencies and a lack of a substantial knowledge burden on would-be adopters. Type 2 technologies are characterized by high knowledge barriers or significant user interdependencies or both.

Fichman notes (p. 199) that typical Type 1 technologies include single-user hardware (like microcomputers and laptops) and software (like word processing and spreadsheet software). Type 2 technologies are characterized by high knowledge barriers (like in structured systems analysis and in stand-alone CAD systems) or significant user interdependencies (like in e-mail and in voice mail) or both (like in integrated CAD/CAM systems). Technologies with low knowledge barrier require typically only a few hours of training to reach a basic level of proficiency. Technologies with high knowledge barrier require several days of training, and it takes months to reach a basic level of proficiency. Users become interdependent when they are not adopting innovations just for their own independent use but instead as members of a larger community.

Fichman argues that the most assumptions of classical diffusion are likely to hold in cell 1 in Table 2-1, whereas cells 2, 3, and 4 represent situations where important assumptions are likely to be violated. In cells 2 and 4, the implementation gets complicated if co-operation of several decision makers is required. Fichman argues that Type 2 technologies in cells 3 and 4 bring several additional factors to the diffusion requiring thus modifications and extensions to the classical diffusion model. The additional factors include network externalities, critical mass, implementation characteristics and strategies, absorptive capacity, and institutions for lowering knowledge barriers.

- High user interdependencies in Type 2 technologies can emerge from network externalities (Katz and Shapiro, 1986; Markus, 1987). The concept of network externality was originally developed in the context of telephone networks. It means that the utility of the innovation to a user increases as the number of other users increases. E-mail is a good IT innovation example subject to the network externality effect. Markus (1987) argues that achieving critical mass among the would-be adopters becomes crucial when the technology is subject to network externalities. If critical mass is achieved, the innovation's further rate of adoption becomes self-sustaining.

- High user interdependencies can also be caused by the integration of the technology to the functions of the organization. For technologies that are integrated with organizational routines, the implementation characteristics of the technology can become important factors in successful adoption and diffusion (Leonard-Barton, 1988). Implementation characteristics include factors like the transferability (maturity and communicability), organizational complexity (number of people and functions affected), and divisibility (ability to divide implementation by stages or by sub-populations).
- Cohen and Levinthal (1990) suggest that the innovativeness of an organization is determined by its absorptive capacity which means the organization's ability to recognize the value of new information, assimilate it, and apply it to productive ends. Zahra and George (2002) conceptualize absorptive capacity further by building upon the dynamic capabilities of a firm and distinguish between a firm's potential and realized capacity. Potential capacity consists of knowledge acquisition and assimilation capabilities while realized capacity addresses knowledge transformation and exploitation. Cohen and Levinthal (ibid.) argue that absorptive capacity is developed over time through investments in learning and skill building. Absorptive capacity reduces knowledge barriers to adoption. Attewell (1992) has suggested that the development and availability of institutionalized innovation knowledge (service companies, consultants) also reduces knowledge barriers among would-be adopters and affects the rate and pattern of innovation adoption.

Some of these additional elements suggested by Fichman (1992) are discussed in the latest edition of Rogers' book (2003). Rogers suggests (ibid., p. 343) that the critical mass concept is often involved with the rate of adoption of interactive innovations such as e-mail, telephones, and fax. Rogers defines interactivity (p. 343) to be the degree to which participants in a communication process can exchange roles in, and have control over, their mutual discourse. The interactive quality of an innovation creates interdependence among the adopters in a system. With each additional adopter, the usefulness of an interactive innovation increases for all adopters. The benefits from each additional adoption of an interactive innovation increase not only for future adopters, but also for previous adopters. The concepts of critical mass and network externality are related. Rogers suggests (p. 350) that a lack of network externalities slows the rate of adoption of an interactive innovation. Rogers also suggests (p. 351) that the effects of network externalities on the rate of adoption often depend on compatibility standards. The absorptive capacity concept is not directly discussed by Rogers. The organizational innovativeness in Rogers' framework, depicted in Figure 2-2, has the complexity element which is related to absorptive capacity but is more limited in scope. Rogers defines complexity (p. 412) as the degree to which an organization's members possess a relatively high level of knowledge and expertise, usually measured by the members' range of occupational

specialties and their degree of professionalism. The complexity element is thus limited to the knowledge aspect while absorptive capacity is a dynamic capability covering knowledge acquisition, assimilation, exploitation, and the ability to recognize the potential of innovations.

Since Rogers presented the first process model for organizational innovation adoption and implementation, other process models have been introduced. The six-stage process model proposed by Cooper and Zmud (1990) is one of the best-known models for IT technology adoption and implementation. The stages in this model are shown below (Cooper and Zmud 1990, p. 124).

1. *Initiation* (finding a match between an innovation and its application in the organization).
2. *Adoption* (reaching a decision to invest resources to accommodate the implementation effort).
3. *Adaptation* (developing, installing, and maintaining the innovation). Procedures are developed and revised. Members are trained both in the new procedures and in the innovation.
4. *Acceptance* (inducing organizational members to commit to the innovation's usage).
5. *Routinization* (encouraging the usage of the technology application as a normal activity).
6. *Infusion* (obtaining increased organizational effectiveness by using the IT application in a more comprehensive and integrated manner to support higher level aspects of work).

The model of Cooper and Zmud was enhanced further by by Gallivan (2001) when he studied the implementation of client-server software development by IT professionals in four large organizations. Gallivan integrated the process model of Cooper and Zmud with constructs from other innovation research frameworks, including diffusion of innovations (Rogers, 2003), Technology Acceptance Model (Davis, 1986; Davis, 1989), and Theory of Planned Behavior (Ajzen, 1985). The integrated constructs are given as the following three factors (Gallivan 2001, p. 61):

- *Managerial interventions* describe the actions taken and resources made available by managers to support the implementation effort.
- *Subjective norms* describe adopter's beliefs about the expectations of other relevant persons (e.g., peers and coworkers) regarding the adoption behavior. The particular norms may vary for a given innovation and adoption context.
- *Facilitating conditions* is a broad category that describe factors of the environment affecting the implementation effort. These factors include specific

attributes of the innovation, the organizational context and culture, and the work task itself.

Gallivan (ibid., pp. 60-61) presents a theoretical two-stage (or multi-stage) innovation adoption framework where the primary adoption decision may occur at the corporate-, division-, or department-level in an organization. Primary adoption must occur to trigger secondary adoption (for contingent, authority innovation adoption). Gallivan's model is a hybrid framework that contains multiple adopter levels (individuals, workgroups, and the organization), as well as a combination of processes and factors that influence them. Feedback loops are provided in the model to reflect the complexities in the implementation of innovation adoption. The framework has a complex multi-level structure, and Gallivan notes (2001, p. 80) that while the framework is generalizable, it has not yet been generalized to other research settings (other innovations and organizations).

Fitzgerald (2009) studied the deployment of two OSS applications at the Hibernia Hospital, an Irish public sector organization. The research framework introduced by Fitzgerald is based on Gallivan's (2001) hybrid process/factor framework with some modifications. Instead of using the process model of Cooper and Zmud (1990), Fitzgerald adapted the IT assimilation stage model of Fichman and Kemerer (1997) to the research framework. Fitzgerald's framework has the following five levels:

- *Awareness/Interest* (key decision makers in organization are aware of OSS and actively committed to learning more);
- *Evaluation/Trial* (organization has acquired specific OSS products and has initiated evaluation or trial);
- *Limited Deployment* (organization has established a program of regular but limited use of OSS products);
- *General Deployment* (organization is using OSS products for at least one large and mission critical system);
- *Abandonment* (organization has discontinued live use of OSS products).

Considering variables to predict IT adoption, Jeyaraj et al. (2006) analyzed altogether 48 empirical studies on individual and 51 studies on organizational IT adoption published between 1992 and 2003. The authors report that the best predictors of individual IT adoption include Perceived Usefulness, Top Management Support, Computer Experience, Behavioral Intention, and User Support. The best predictors of IT adoption by organizations were Top Management Support, External Pressure, Professionalism of the IS Unit, and External Information Sources. At the level of independent variables, Top Management Support stands as the main linkage between individual and organizational IT adoption.

Jeyaraj et al. (ibid.) also found that there are known theoretical biases in IT adoption research. The biases include the pro-innovation bias (all adoption is good) and the rational bias (adopters make rational decisions). The authors also found that there are known methodological biases including recall bias (self reports are unreliable) and pro-adopter bias (non-adopters are understudied). To overcome self-reporting bias, the authors suggest to increase the study of Actual System Use as a dependent variable in both individual and organizational adoption research. The Actual System Use is an objective measure typically obtained from logs. The concerns with pro-innovation bias and pro-adopter bias have also been expressed by Rogers (2003). Following Rogers (ibid, p. 106), the pro-innovation bias is one of the most serious shortcomings of diffusion research with the assumed implication that an innovation should be diffused and adopted by all members of a social system, that it should be diffused more rapidly, and that the innovation should neither be re-invented nor rejected. Rogers (ibid., p. 111) also notes that we know too much about innovation successes and not enough about innovation failures. The later might be more valuable in an intellectual sense.

2.2.1 Process and variance research approaches

The research on the diffusion of innovations is divided by Rogers (2003, p. 196) into two basic types, variance research and process research:

- Data gathering and analysis in *variance research* consists of determining the covariances (or correlation) among a set of variables, but not their time order. Variance research is usually conducted using surveys and highly structured quantitative research methods which measure variables by assigning numerical values to behavior. Most diffusion research is variance-type investigation which is appropriate, e.g., for investigating variables related to innovativeness.
- Data gathering and analysis in *process research* seek to determine the sequence of a set of events and the mutual influences between events over time. Process research is less structured and is usually conducted using qualitative research methods. Statistical methods are seldom used in data analysis in process research.

Mohr (1982) explains the difference between variance theories and process theories in terms of the hypothesized relationships between logical antecedents and outcomes. In variance theories, the precursor (loosely, the “cause”) is posited as a necessary and sufficient condition for the outcome. In process theories, the precursor is assumed insufficient to “cause” the outcome, but is held to be merely necessary for it to occur. Variance studies look at the degree which one variable can predict changes in another variable while process studies look at the unfolding of events over time (Huber and Van de Ven, 1995).

Table 2-2, adapted from Markus and Robey (1988) characterizes variance and process theories.

	Variance theory	**Process theory**
Role of time	Static	Longitudinal
Definition	The cause is necessary and sufficient for the outcome	Causation consists of necessary conditions in sequencing; change and random events play a role
Assumptions	Outcome will invariably occur when necessary and sufficient conditions are present	Outcomes may not occur (even when the conditions are present)
Elements	Variables	Discrete outcomes
Logical form	if X, then Y; if more X, then more Y	if not X, then not Y; cannot be extended to "more X" or "more Y"

Table 2-2. Logical structure of variance and process theory, adapted from Markus and Robey (1988, p. 590)

In process theories outcomes are not conceived as variables that can take on a range of values, but rather as discrete or discontinuous phenomena that might be called "changes of state". Process theories accept a more limited definition of prediction where the analyst is able to say only that the outcome is likely (but not certain) under some conditions but unlikely under others. In spite of the more limited prediction, process theorists may be able to accumulate and consolidate findings about the relationship between information technology and organizational change.

Mohr (1982) suggests that variance and process models should not be combined within a single theoretical approach in an attempt to gain the advantages of both. He also describes stage models as incomplete process models, because they generally lack specification of the mechanism by which subsequent stages come about. This incompleteness applies also to the innovation stage models (innovation-decision model, organizational innovation model) by Rogers (2003). Rogers admits this (ibid., p. 195) by noting that definitive answer to the existence of the stages is impossible to provide. Rogers also notes that the in-depth approach of process research is needed to understand better the over-time aspect in the diffusion of innovations. The same view was shared by Fichman (1992) after he had reviewed empirical studies of information technology adoption and diffusion. Fichman suggests that when studying organizational innovation, researchers should consider examining fewer organizations but in greater depth.

Soh and Markus (1995) outline the application of process and variance research approaches in theory testing. The authors propose in their study a comprehensive process theory on how IT creates business value by synthesizing several previous studies on IT investment payoff. This process theory introduces three stages in the

process that IT creates business value in organizations: (1) IT conversion process (where organizations spend on IT and obtain IT assets), (2) IT use process (where quality IT assets, combined with appropriate IT use yield favorable IT impacts), (3) and competitive process (where favorable IT impacts lead to improved organizational performance). A number of factors influence successful completion of these stages. Soh and Markus (ibid.) suggest that variance type predictions can be made from process theories. It is possible to propose and test hypotheses about the conditions under which the outcome specified in a process theory is more or less likely to occur. The propositions represent variance theory implications of a process theory, testable by variance theory methods but not being a part of the process theory. The authors also suggest that process studies require in-depth case studies over time.

2.3 Organizational development and change

The implementation of new IT systems or changes to the existing IT systems causes changes also in the organization. Concerning the adoption of innovations, Rogers (2003, p. 425) makes a generalization that the implementation of a technological innovation in an organization results to a mutual adaptation of the innovation and the organization because the innovation almost never fits perfectly in the organization in which it is to become embedded.

Based on an extensive multidisciplinary literature review, Van de Ven and Poole (1995) present four basic theories to serve as building blocks for explaining processes of change in organizations: life cycle, teleology, dialectics, and evolution. The four theories represent different sequences of change events that are driven by different conceptual motors and operate at different organizational levels. In each theory, the process of development and change is viewed as unfolding in a fundamentally different progression of change events and is governed by a different motor (Van de Ven and Poole, ibid., pp. 520-521):

- A *life-cycle* model depicts the process of change in an entity as progressing through a necessary sequence of stages. An institutional, natural, or logical program prescribes the specific contents of these stages.
- A *teleological* model views development as a cycle of goal formulation, implementation, evaluation, and modification of goals based on what was learned by the entity. This sequence emerges through the purposeful social construction among individuals within the entity.
- In *dialectical* models of development, conflicts emerge between entities espousing opposing thesis and antithesis that collide to produce a synthesis, which in time becomes the thesis for the next cycle of a dialectical progression. Confrontation and conflict between opposing entities generate this dialectical cycle.

- An *evolutionary* model of development consists of a repetitive sequence of variation, selection, and retention events among entities in a designated population. Competition for scarce environmental resources between entities inhabiting a population generates this evolutionary cycle.

Figure 2-3 illustrates the theories using two analytical dimensions: the unit of change and the mode of change. Arrows are used to indicate likely sequences among events.

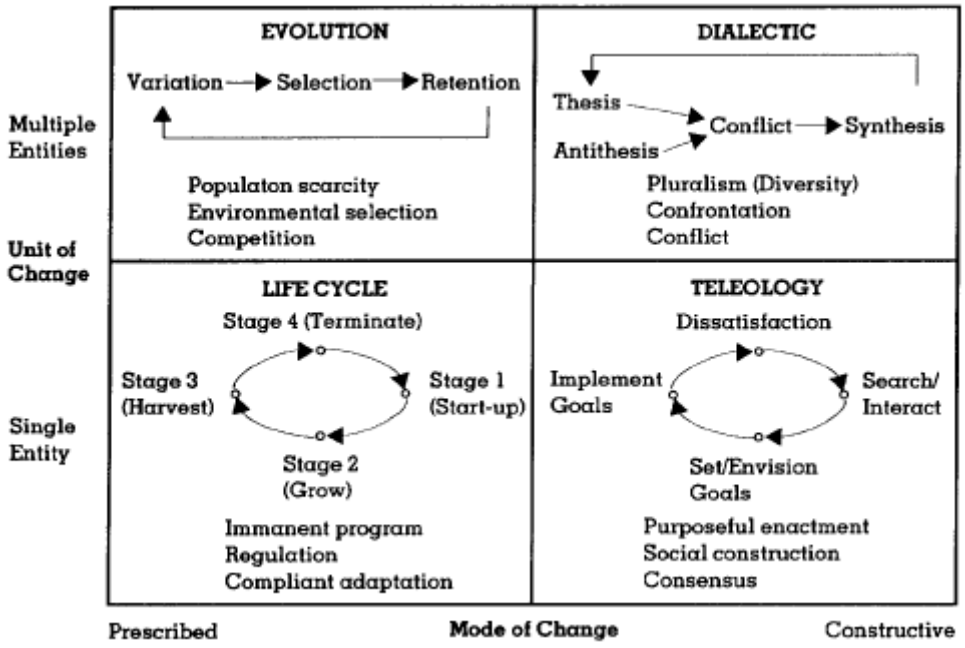

Figure 2-3. Process theories of organizational development and change, adapted from Van de Ven and Poole (1995, p. 520)

Evolutionary and dialectical theories operate on multiple entities while life-cycle and teleological theories operate on a single organizational entity. The mode of change divides the theories in two groups: life-cycle and evolutionary theories are based on a prescribed sequence of change events while in dialectical and teleological theories the progression is constructed as the change process unfolds. Each ideal type of theory describes a generative mechanism or motor of change. Van de Ven and Poole suggest (ibid., p. 527) that combinations of these motors are possible and that combinations create hybrid change theories.

Huy (2001) presents ideal types of generic change intervention theories to explain the change process in an organization. Each ideal type has distinct temporal and nontemporal assumptions, and each type is associated with altering a distinct organizational element. Based on four important organizational elements (formal

structures, work processes, belief systems, and social relations) Huy defines four ideal change intervention approaches:

- *Commanding intervention and change in formal structures*. The goal is to create an economically performing organization within a short time frame. Leadership of change belongs to one small group of people, typically located at the top of the formal hierarchy.
- *Engineering intervention and change in work processes*. The intention in engineering intervention is to improve the speed and quality of production. The main change agents are work process analysts and front-line employees. Engineering intervention is more likely to used when time pressure related to economic improvements is moderate.
- *Teaching intervention and change in beliefs*. The teaching intervention refers to analytical and guided learning approach in which change targets participate in their own re-education through the active involvement of change agents. A moderately long term time perspective is favored in teaching intervention.
- *Socializing intervention and change in social relationships*. The socializing intervention refers to change agents' actions to enhance the quality of social relationships among change targets to realize organizational tasks. It is assumed that changes in behavioral interactions among individuals will lead to changes in beliefs and organizational culture. A long term time perspective is favored in socializing intervention.

Intervention Ideal type	Potential Limitations
Commanding	Could create covert resentment and resistance. Seldom leads to lasting, deep change in beliefs and values.
Teaching	Cognitive change does not always lead to sustained behavioral change. Individualistic cognitive change seldom leads to corporate wide strategic realization.
Engineering	Reinforces autonomy and parochialism of business units at the expense of corporate wide integration and cooperation. Successful pilot site experiments rarely spread, for their very success generates defensiveness and rejection by other business units claiming that they are different.
Socializing	Too much socializing could create a splintered, anarchic organization. Groups work at cross-purposes and fight one another for scarce resources. Local expenditure of resources with little clear collective focus. Danger that informal groups indulging in experiential learning may narrow competence and creativity, limit the range of options considered, and tend toward inertia.

Table 2-3. Limitations of each intervention approach for realizing large-scale change, adapted from Huy (2001, p. 612)

Each of the four intervention approaches has its limitations when enacted in isolation. Table 2-3 summarizes limitations of each intervention ideal type.

Huy (ibid.) suggests that a large-scale change involves an alteration of multiple organizational elements and thus requires the application of multiple change intervention theories. Huy also suggests that by sequencing and combining the multiple intervention types, the duration of a large-scale change can be shortened and the pain and the costs involved in the change can be reduced. Huy (ibid., pp. 615-616) summarizes the use of multiple intervention types in a large-scale change process using the following three propositions:

- Starting large-scale change with commanding is likely to be effective in organizations that traditionally accept hierarchical authority, when the company has slack, and when change agents' power is concentrated. Commanding is likely to result in little resistance if it is done with benevolence, has a clear business logic that is acceptable to employees, and is done in a short time. Commanding has to be followed with other intervention approaches to repair the social fabric of the organization and improve work processes.
- In organizations with little slack, low receptivity to radical change, dispersed power structures, or low innovation, starting large-scale change with socializing, engineering, or teaching and ending with commanding is likely to constitute a more effective change sequence than starting with commanding.
- Combining seemingly opposite intervention approaches is likely to be accepted by recipients when change leaders apply a fair process and justify to recipients that these approaches are appropriate, and when leaders can complement and coordinate well with one another.

2.4 Open source adoption

Early studies on open source (Ljungberg, 2000; Lerner and Tirole, 2002) concentrate on the general aspects of open source movement. Ljungberg (2000) describes the background of open source by paying attention to the roots, free software, the origin of open source, ideology, and meeting places. Ljungberg identifies five key dimensions in the open source movement: (1) gift economy versus scientific knowledge sharing, (2) software process, (3) participatory user driven design, (4) virtual organizing, and (5) business model. Lerner and Tirole (2002) explore the economics of OSS where the behavior of individual programmers and commercial companies engaged in open source projects is initially startling to economists. The authors highlight the extent to which labor economics, especially the literature on "career concerns", and industrial organization theory can explain many of these projects' features.

The software development process in open source has been analyzed, e.g., in the study of von Hippel and von Krogh (2003). The phenomenon of OSS development shows that users program to solve their own as well as shared technical problems, and freely reveal their innovations without appropriating private returns from selling the software. The authors propose that open source software development is an exemplar of a compound "private-collective" model of innovation that contains elements of both the private investment and the collective action models and can offer society the "best of both worlds" under many conditions. In the "private-collective" innovation model, participants in OSS projects use their own resources to privately invest in creating novel software code. In principle, these innovators could then claim proprietary rights over their code, but instead they choose to freely reveal it as a public good. Clearly, the net result of this behavior appears to offer society the best of both worlds – new knowledge is created by private funding and then offered freely to all.

Iivari (2009) reports findings from an interpretive case study on user participation in the OSS development context. Iivari's research is based on the analysis of user discussion forum in one small but active OSS project. The findings reveal that different kinds of meanings have been attached to users and to their participation. Some user groups actively take part in OSS development, while others are merely represented in it. Iivari identifies four user categories of intermediaries representing the users in the OSS development. The classification is based on the abilities of users to read and/or write source code, and on the type of representation the users have in the OSS project:

- Novice users – in relation to the OSS in question;
- Non-technical users – the technologically illiterate;
- Typical users – in relation to the OSS in question;
- Human-computer-interaction specialists – user surrogates representing the users.

In the study of the open source software phenomenon Fitzgerald (2006) contends that the phenomenon has transformed into a mainstream and commercially viable form. The author notes that the emergence of OSS emphasizes the fundamental alteration of the basic ground rules in the software landscape, signifying the end of the proprietary-driven model that has prevailed for the past 20 years or so. Fitzgerald notes that in the traditional model of software development, users and developers were often located in separate departments, but open source changed the user–developer relationship with software developers being often also users of the products. The author discusses various licensing issues and characterizes the commercially viable form of open source software which he calls OSS 2.0. Fitzgerald suggests that OSS 2.0 can dramatically alter the economic dynamics of

the marketplace and both customers and developers need to perceive value for money in OSS 2.0. Free as in *zero cost* is replaced by a *value-for-money* concern, and OSS 2.0 customers are prepared to pay for a professional service.

In a recent study Fitzgerald (2009) notes that much of OSS research has focused inward on the phenomenon itself, studying the motivations of individual developers to contribute to OSS projects, or investigating the characteristics of specific OSS products and projects. According to Fitzgerald, far less has been done in looking outward at the process of OSS adoption and implementation in organizations.

One of the early studies on the adoption of an OSS office suite was reported by Fitzgerald and Kenny (2004). Beaumont Hospital, an Irish public sector organization, carried out a migration to an open source office suite during the period 2002-2003. Beaumont Hospital employs 3000 staff and has approximately 1000 desktop workstations. The Beaumont Hospital study was one of the first to include the evaluation of cost savings from the deployment of OSS. For desktop applications, the five-year cost of the OSS office suite was reported to be 34 700 € which yielded to 88 % savings when compared to the 288 500 € cost of the closed-source alternative. The study found that user acceptance and top management support were important issues in the implementation of the migration. As a result of migration resistance, 80 persons from the staff opted out of the migration due to fears being deskilled if they didn't have skills in popular proprietary software packages.

The EU-funded COSPA-project[3] has produced several studies on organizational open source adoption. The COSPA project (Consortium for Open Source Software in the Public Administration) lasted from January 2004 to June 2006 including altogether 15 European partners coordinated by the Free University of Bolzano-Bozen, Italy. The project aimed at analyzing the effects of the introduction of open data standards and OSS for personal productivity and document management in European public administrations. As part of the COSPA project, Rossi et al. (2005), Rossi et al. (2006), and Russo et al. (2005a) studied OpenOffice.org adoption in public administration. The study of Rossi et al. (2005) was a small-scale OpenOffice.org adoption study in an Italian public organization. The study compared productivity differences between OpenOffice.org and Microsoft Office in document processing. The results of the study indicated that the usage of OpenOffice.org did not reduce the number of documents handled daily and that the usage of OpenOffice.org did not increase the global effort to handle documents. Also the study of Rossi et al. (2006) reported a small-sale OpenOffice.org adoption analysis in one public organization. The results of the study suggested to prefer a phased migration approach with voluntary measures applied in the initial phases of the migration. The results also suggest that document conversion, training, and support are of key importance to overcome resistance to change in the implementation of the OpenOffice.org adoption. Instead of phased migration, also migration in one step ("big bang") has been applied in OpenOffice.org adoptions.

3 http://www.cospa-project.org/ (cited 9 June 2010)

The OpenOffice.org study by Ven et al. (2006) reports a big bang migration involving eight ministerial cabinets and 400 Windows XP workstations in the Brussels public administration. The migration was based on the authority decision issued by the Government of the Brussels-Capital Region. In the study of Russo et al. (2005a), a framework was developed to evaluate the transition to an open source software solution in terms of returns and losses in the context of public administrations. The goal of the framework is to identify costs that are not easy to trace or that are not usually collected like user acceptance.

The study on the economic impact of open source software on innovation and the competitiveness in the European Union (Ghosh, 2006) included an extensive report on the user-level productivity and relative costs of open source and proprietary software. Altogether six organizations in four countries were involved in the study which included the migration of over 6000 Windows desktops to OpenOffice.org. A comparative use of Microsoft Office and OpenOffice.org was performed in the study. In conclusion, the study reported that there were no extra costs due to lack of productivity arising from the use of the OpenOffice.org. Practical OSS office suite studies have been performed in several European countries by national organizations. The studies typically compare Microsoft Office with OpenOffice.org (or StarOffice) focusing, e.g., on compatibility, functionality, interoperability, or economics of the open source and proprietary office suite alternatives. Software studies from the following organizations have been used during this research:

- The Swedish Agency for Public Management (Statskonturet): compatibility and interoperability study (Vestin, 2003);
- The Danish Board of Technology: study on compatibility, functionality and economics (Poulsen et al. 2002);
- National Centre for IT in Public Administration, Italy: study on compatibility and functionality (CNIPA, 2004);
- Office of Government Commerce, United Kingdom: study on compatibility, functionality, and economics (OGC, 2004);
- The Danish Ministry of Science, Technology and Innovation: study on economics and productivity (Kristensen et al., 2005).

The study of Ven and Verelst (2006) focused on the adoption of open source server software in 5 Belgian organizations. The study found that the main drivers for OSS adoption were cost reduction combined with reliability. Potential barriers for OSS adoption were the standardization on the proprietary Microsoft Windows operating system in the organizations and the perceived lack of external support for the OSS solution. In his dissertation, Ven (2008) surveyed the use of OSS in 332 organizations in Flanders, Belgium. As part of his dissertation he researched the organizational adoption of seven well-known open source server applications such as

GNU/Linux, Sendmail, and Apache. Ven suggests that internal expertise is one of the most important drivers for organizations to adopt open source software. He found that often an employee within the organization recognizes the potential of open source and suggests it to the organization.

Fitzgerald (2009) studied the deployment of OSS applications at the Hibernia Hospital, an Irish public sector organization. Using a longitudinal case study, the author in depth discusses the deployment process for two OSS applications – the desktop application suite (StarOffice) whose deployment was unsuccessful ultimately, and the e-mail platform (Postfix mail transport agent, OpenLDAP directory access protocol service, SpamAssassin mail filter, and the SquirrelMail e-mail client) which was successfully deployed. According to the author, the study was the first in-depth study into successful and unsuccessful OSS implementation. In his study Fitzgerald concludes that the high knowledge burden in successfully deploying OSS supports the view that absorptive capacity is an important issue in OSS adoption. Also critical mass was found to be an important issue as the cohort of users who opted out of the move to StarOffice served to weaken the critical mass, whereas the increased number of users who received e-mail accounts worked in the opposite direction. Considering the OSS migration approaches ("big bang" in one step or phased migration approach), the findings of the study supported the "big bang" migration approach for each individual OSS application, primarily to avoid the situation where opting out of migration is seen as the preserve of those more privileged, thereby creating image and relative advantage problems subsequently. The findings also suggest that the zero cost trialability of OSS should not cause organizations to downplay the importance of implementation issues such as pilot tests, training, and support.

The EU-funded FLOSSPOLS-project[4] (Free/Libre/Open Source Software: Policy Support) focused on three study tracks: government policy towards open source; gender issues in open source; and the efficiency of open source as a system for collaborative problem-solving. The project lasted from March 2004 to February 2006 and was coordinated by MERIT, University of Maastricht in Netherlands. As part of the project, Glott and Ghosh (2005) reported the usage of OSS in European public sector organizations in an extensive survey involving 955 public sector organizations in 13 EU countries. The results of the survey have been summarized earlier in Section 1.2. Also the results of the OSS usage survey conducted by West and Dedrick (2008) were summarized earlier in Section 1.2.

In addition to scientific studies, also practical migration guidelines focusing on important implementation issues in organizational OSS adoption have been published. The IDA programme of the European Commission published in 2003 guidelines for open source migration (IDA, 2003a). In 2005, the migration guide written by the KBSt unit at the German Federal Ministry of the Interior was published (KBSt, 2005). Woods and Guliani (2005) provide a practical expert view

4 http://flosspols.org/ (cited 9 June 2010)

of the skills required to manage organizational issues in the adoption of OSS. A recent OSS guideline (Daffara, 2009) was published in 2009 by the EU-funded FLOSSMETRICS project. Typically, the guides provide advice on the planning of OSS implementation projects, evaluation of economics, and best practices to handle and avoid possible migration problems.

3 Research approach

In the research approach of this study we apply two main lenses, defined by design research and innovation adoption, to study the migration process to an open source office suite. In the discussion of related research in Chapter 2, both design research and innovation adoption in general have been introduced. In Section 3.1 we discuss the design research framework of this study. Next, in Section 3.2 we describe the two innovation adoption process models which set the conceptual grounding for this study. In Section 3.3 we summarize the research approach of the study.

3.1 Research framework

Yin's classic book on case study research (Yin 2003, first published in 1984), is one of the most often cited texts in IS research (Whitley and Galliers, 2007). Yin proposes several alternative research strategies based on three conditions: (a) the research question, (b) the control an investigator has over behavioral events, and (c) the focus on contemporary as opposed to historical phenomena (Table 3-1).

Strategy	Form of research question	Requires control of behavioral events?	Focuses on contemporary events?
Experiment	how, why	yes	yes
Survey	who, what, where, how many, how much	no	yes
Archival analysis	who, what, where, how many, how much	no	yes
History	how, why	no	no
Case study	how, why	no	yes

Table 3-1: Relevant situations for different research strategies, adapted from Yin (2003, p.5)

A case study is the preferred strategy when the study tries to answer "how" or "why" type of research questions. As depicted in Table 3-1, the case study is preferred in examining contemporary events, but when the relevant behaviors cannot be manipulated. The case study approach is not considered the ideal research strategy in cases where the investigator is an active participant and can manipulate the events.

When manipulation of events is possible, Yin (2003, p. 8) considers the study either an experiment or participant-observation type of study.

In this research the investigator has considerable control over the events. The investigator is the author of the initial office software evaluation and the author of several migration handbooks published during the migration. He is also the project leader of the open source office suite pilot project and the project leader in the actual implementation of the migration. The investigator is not a passive observer. Instead, he is the key actor and the designer of the migration.

The general research strategies shown in Table 3-1 apply to situations where the research investigates the truth value in the phenomenon to be studied. The strategies are not well suited to studies which apply technology to create artifacts to serve human purposes. In these studies, the assessment of relevance and utility guides the application of research to the problems of the environment. For these "value-laden" studies, design science provides a more suitable framework. The research approach of this study applies design research framework as defined by March and Smith (1995) and Hevner et al. (2004). Design research framework connects the problem space (the environment), IS research activities, and the knowledge base of the IS research. The assessment of relevance guides the application of research to the problems of the environment. IS research applies and updates the knowledge base. Research rigor is achieved by appropriately applying existing foundations and methodologies in the knowledge base. Figure 3-1 presents the key components of the framework.

Figure 3-1. Framework for IS research, adapted from Hevner et al. (2004, p. 80)

Hevner et al. (2004) established seven guidelines for the requirements for effective design science research. The guidelines are summarized in Table 3-2.

Guideline	Description
Guideline 1: Design as an artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.

Guideline	Description
Guideline 5: Research rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a search process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Table 3-2. Design science research guidelines, adapted from Hevner et al. (2004)

Design science is inherently a problem solving process to utilize new opportunities. Guideline 1 requires the creation of an innovative, purposeful artifact with Guideline 2 requiring the research to solve a relevant business problem. Because the utility of the artifact is important, thorough evaluation of the artifact is required (Guideline 3). The research contribution may come from the novelty or from the efficacy or efficiency of the artifact (Guideline 4). Guideline 5 requires that the artifact must be rigorously and consistently constructed and evaluated. The design uses a search process to find an effective solution (Guideline 6). The results of the research must be communicated both to technology-oriented and management-oriented audiences (Guideline 7).

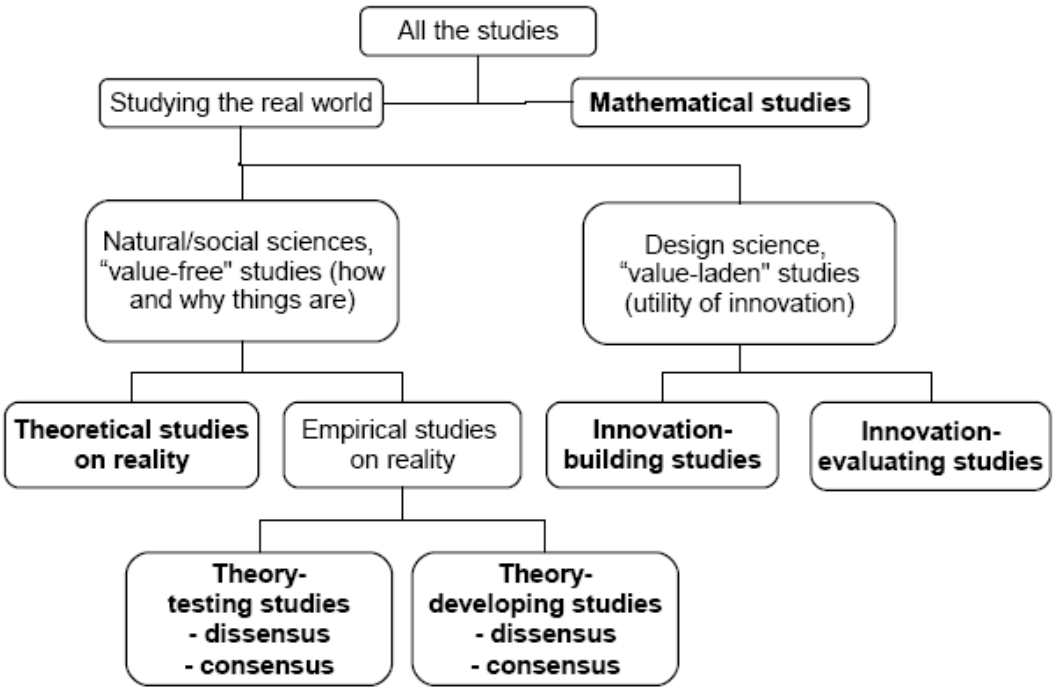

Figure 3-2. The taxonomy for scientific studies, adapted from Järvinen (2008, p. 34)

The design research framework defined by March and Smith (1995) and Hevner et al. (2004) has been developed further by Järvinen (2008). Järvinen introduced a tree-like structure for the taxonomy of scientific studies (Figure 3-2). The taxonomy is generalized to cover other disciplines in addition to IS. In this taxonomy Järvinen uses the term *innovation* instead of technical artifact in order to cover also social and informational innovations. The first dimension in the framework of March and Smith (ibid.) is represented by four leaves in the taxonomy tree: theory-developing studies (theorize), theory-testing studies (justify), innovation-building studies (build), and innovation-evaluating studies (evaluate). Järvinen (2007) also suggested the notion *goal function* as a measure to the utility of the artifact. Järvinen (2007) points out that in the evaluation of the design (Guideline 3 in Table 3-2), the quality aspect of the evaluation emphasizes business needs and managers' view on quality. Järvinen suggests other views also to be included (e.g., systems analysts' and customers' views).

In the taxonomy of scientific studies by Järvinen (2008), this research belongs to design science where the utility of the innovation plays an important role. The innovation (artifact) of the study is based on the open source OpenOffice.org software. The innovation-building part of the study creates an instantiation of the innovation which includes the installation and configuration of the OpenOffice.org platform, the development of supportive tools and documentation, and the development of integrations to support the migration. The innovation-evaluation part of the study includes the analysis of software functionality and interoperability, the evaluation of adoption costs, and software usage measurements. This study thus involves a combination of both innovation-building and innovation-evaluation activities.

3.2 Rogers' innovation adoption processes

This study has a specific design domain which is concerned with the adoption of an open source office suite. The principles of innovation diffusion research as presented by Rogers (2003) provide a research model which sets the conceptual grounding for this study. Rogers presents two stage models for the innovation adoption process:

- Chapter 5 in Rogers (ibid.) presents the general innovation-decision process (the classical or traditional diffusion) for the context where individual adopters make voluntary decisions to accept or reject an innovation;
- Chapter 10 presents the innovation process in an organization, a process model tailored for the organizational context.

The two process models are described in more detail in the following sub sections.

3.2.1 The innovation-decision process

Rogers (2003, p. 475) defines the *innovation-decision process* to be the process through which an individual or other decision-making unit passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision.

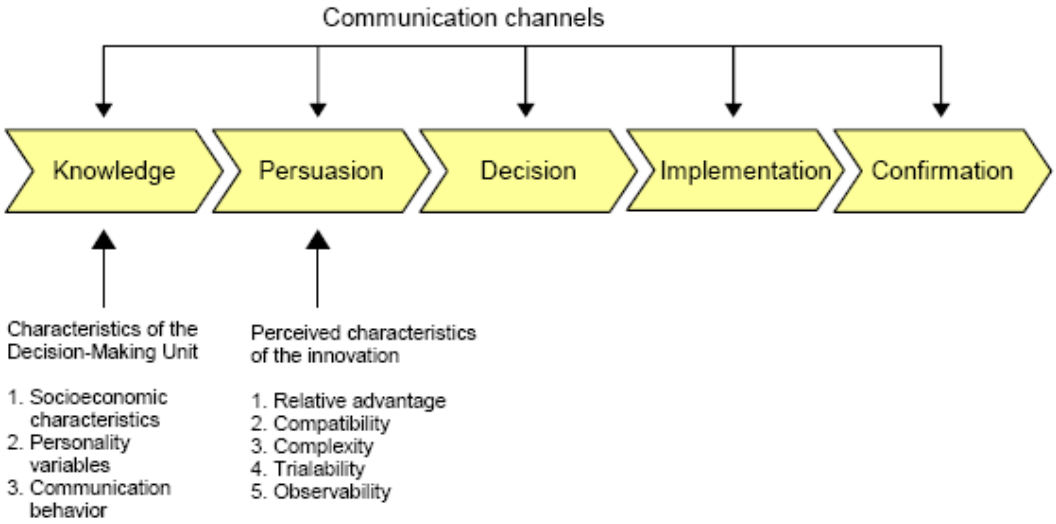

Figure 3-3. The innovation-decision process, adapted from Rogers (2003, p. 170)

Rogers presents the general innovation-decision process as a stage model consisting of five stages depicted in Figure 3-3. The stages are characterized as follows (ibid., p. 169):

1. *Knowledge* (exposing to the existence of the innovation and gaining an understanding of how it functions);
2. *Persuasion* (forming a favorable or unfavorable attitude towards the innovation);
3. *Decision* (activities to adopt or reject the innovation);
4. *Implementation* (putting the innovation into use);
5. *Confirmation* (reinforcement after making the innovation-decision).

Prior conditions preceding and affecting the innovation-decision process include felt needs or problems, innovativeness of the potential adopter, previous practice in the application domain of the innovation, and norms of the social system.

The model was originally developed in the context of agricultural innovations but Rogers suggests that the model applies to other types of innovations as well. Rogers also suggests that stages exist in the innovation-decision process. However, he also

admits (2003, p. 195) that definitive answer to the existence of the stages is impossible to provide. Stages may be a useful framework to simplify the complex reality involved in the introduction of innovations.

The innovation-decision process begins with the knowledge stage when the existence and the functionality of the innovation become known. Rogers (p. 174) characterizes the earlier knowers of innovations, when compared to later knowers, by several factors: they have more formal education, higher social status, greater exposure to mass media channels of communication, greater exposure to interpersonal channels of communication, greater change agent contact, greater social participation, and greater cosmopoliteness.

At the persuasion stage, a favorable or unfavorable attitude toward an innovation is formed. Rogers identifies in his model five main perceived innovation characteristics that influence the result of the adoption process:

- *Relative advantage* (the degree to which an innovation is perceived as being better than the idea it supersedes). Subdimensions of relative advantage include economic profitability, low initial cost, a decrease in discomfort, social prestige, savings in time and effort, and immediacy of reward. Relative advantage is found to be one of the strongest predictors of an innovation's rate of adoption.
- *Compatibility* (the degree to which an innovation is perceived as consistent with the existing values, past experiences, and the needs of potential adopters). An idea that is more compatible is less uncertain to the potential adopter and fits more closely the individual's situation.
- *Complexity* (the degree to which an innovation is perceived as relatively difficult to understand and use). High complexity is found to be negatively related to the adoption rate of an innovation.
- *Trialability* (the degree to which an innovation may be experimented with). New ideas that can be tried are generally adopted more rapidly than innovations that cannot be experimented with.
- *Observability* (the degree to which the results of an innovation are visible to others). If the results are easily observable, the innovation can be effectively communicated to others.

In addition to the five main perceived attributes of an innovation, also other variables affect an innovation's rate of adoption. These include (1) the type of innovation-decision, (2) the nature of communication channels in the innovation-decision process, (3) the nature of the social system in which the innovation is diffusing, and (4) the extent of change agent's promotion efforts diffusing the innovation. Innovations are generally adopted more rapidly when an individual makes an optional (voluntary) innovation-decision compared to the situation where

an innovation is adopted by an organization. The more persons are involved in making an innovation-decision, the slower the rate of adoption. Regarding communication channels, Rogers (2003, p. 205) generalizes that mass media channels are relatively more important at the knowledge stage, and interpersonal channels are more important at the persuasion stage.

The decision stage leads to a choice to adopt or reject an innovation. Small-scale trials of innovations are often used at this stage in order to cope with the uncertainty concerning the consequences and the usefulness of the innovation. Actually, each stage in the innovation-decision process is a potential rejection point.

After an adoption decision, the innovation is put into use. Operational problem solving concerning the use of the innovation is typical at this stage. Due to the number of individuals involved in the decision and implementation stages, problems during the implementation stage are usually more serious when the adopter is an organization rather than an individual (Rogers, ibid., p. 179). Some re-invention in the form of changes or modifications to the innovation can be expected during implementation when adopters attempt to adjust the innovation to fit their situation better. Conceptually Rogers (ibid., p. 180) defines re-invention as the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation. Rogers argues (ibid., p. 183) that innovations that are flexible and can be easily re-invented to solve a wide range of users' problems will be adopted at a faster rate.

According to Rogers (ibid., p. 189), empirical studies indicate that innovation-decision process does not end with the adoption or rejection activity. At the confirmation stage the individual or other decision-making unit seeks reinforcement for the innovation-decision already made, and may reverse the decision if exposed to conflicting messages about the innovation. Rogers suggests (ibid., p. 191) that later adopters are more likely to discontinue innovations than earlier adopters. Discontinuance is involved in the adoption of an innovation because adopting a new idea almost always means discontinuing a previous idea.

3.2.2 The innovation process in an organization

In the organizational context, Rogers (2003, p. 402) notes that innovation-process studies stress the implementation stage in putting an innovation into use. He defines an *organization* (ibid., p. 404) as a stable system of individuals who work together to achieve common goals through a hierarchy of ranks and a division of labor. Organizational structure is characterized by predetermined goals, prescribed roles, an authority structure, rules and regulations, and informal patterns.

The innovation-decision model discussed earlier in Sub section 3.2.1 was developed in the context of individual adopters making voluntary decisions to accept or reject an innovation. However, applying IT innovations in organizations is rarely voluntary. Especially the use of the computer hardware and software platforms is not

independent within the organization. Corporate-wide policies and decisions are made to coordinate and develop a uniform IT infrastructure shared by the whole organization.

Rogers argues (ibid., p. 407) that an innovation spreads among the companies in an industry in a fashion that is similar to the way that an innovation diffuses among the individuals in a community.

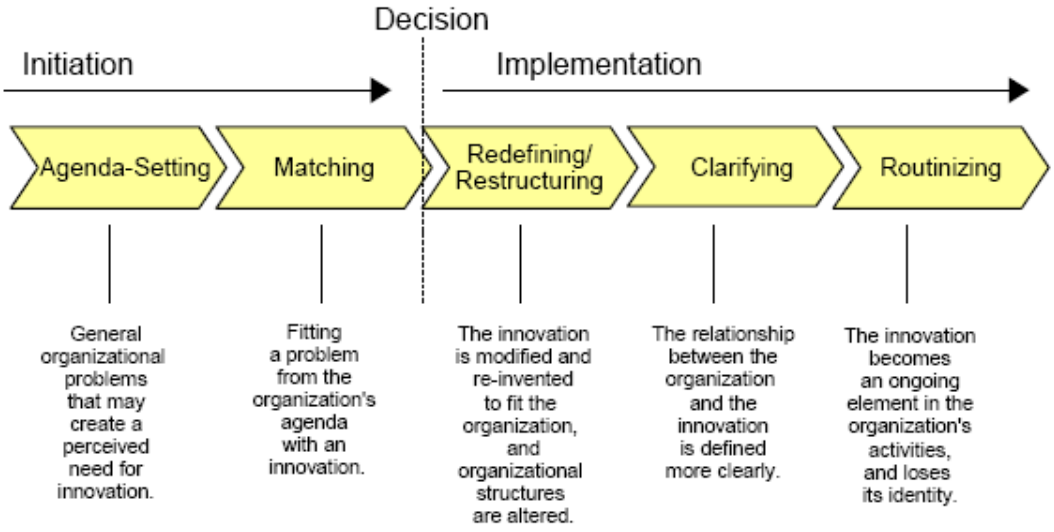

Figure 3-4. The innovation process in an organization, adapted from Rogers (2003, p. 421)

The innovation process is more complex in an organization than in the innovation process concerning an individual. The organizational process involves a number of people and often opposing opinions toward the innovation. Rogers (2003, p. 420) presents the innovation process in an organization consisting of five stages, two in the initiation subprocess and three in the implementation subprocess. Later stages in the innovation process cannot be undertaken until earlier stages have been completed, either explicitly or implicitly. The initiation subprocess leads to the decision to adopt and it consists of all of the information gathering, conceptualization, and planning for the adoption of an innovation. The implementation subprocess consists of all the events, actions, and decisions involved in putting the innovation into use. Figure 3-4 depicts the stages in the innovation process in an organization. The stages are characterized as follows:

- *Agenda-setting* occurs when a general organizational problem is defined that created a perceived need for an innovation. At the agenda-setting stage, one or more individuals in an organization identify an important problem and identify an innovation as one means of coping with the problem. Innovation in organizations can also be driven by solutions: organizations scan for

innovations and match a promising innovation with one of their relevant problems.

- *Matching* is defined as the stage in the innovation process at which a problem from the organization's agenda is fit with an innovation, and this match is planned and designed. At this stage, the organization's members attempt to determine the feasibility of the innovation in solving the organization's problem.
- *Redefining/restructuring* occurs when the innovation is re-invented so as to accommodate the organization's needs and structure more closely, and when the organization's structure is modified to fit with the innovation. This mutual adaptation occurs because the innovation almost never fits perfectly the organization in which it is to be embedded.
- *Clarifying* occurs as the innovation is put into more widespread use in an organization, so that the meaning of the new idea gradually becomes clearer to the organization's members. Too rapid implementation of an innovation at the clarifying stage can lead to disastrous results. The meaning of the innovation is constructed over time through a social process of human interaction. Innovation champions usually play an important role in this clarifying process.
- *Routinizing* occurs when an innovation has become incorporated into the regular activities of the organization and has lost its separate identity. At that point, the innovation process is completed. If the innovation-decision is an authority decision, with only one or a few powerful individuals involved, and these authorities happen to leave the organization, sustainability of the innovation is at risk. Sustainability is defined as the degree to which an innovation continues to be used after the initial efforts to secure adoption have been completed. Rogers (2003, p. 429) gives some factors that are positively related to sustainability: (1) participation of the members of the organization in the innovation process, (2) the degree of re-invention, and (3) the involvement of a local champion.

Rogers (2003, p. 418) suggests that the organizational context is a combination of individual innovation and organizational variables. The organizational variables act on innovation behavior in a manner over and above that of the aggregate of individual members of the organization. Rogers argues that organizational context adds an intellectual "supercharger" to the analysis.

Rogers (ibid., p. 30) defines contingent innovation-decisions as choices to adopt or reject that can be made only after a prior innovation-decision. In contingent innovation-decision, an individual member of a social system may be free to adopt or not to adopt a new idea only after (or until) his or her social system's innovation-decision. The distinctive aspect of contingent decision making is that two (or more) tandem decisions are required: either of the decisions have to be optional, collective

or authority. The contingent two-level innovation-decisions have been applied, e.g., in the innovation adoption framework defined by Gallivan (2001). In Gallivan's framework (pp. 60-61), the primary adoption decision may occur at the corporate-, division-, or department-level in an organization. Primary adoption must occur to trigger secondary adoption (for contingent, authority innovation adoption).

3.3 Summary of the research approach

In this section, we briefly summarize the research approach of this study. In Sub section 3.3.1 we give an overview of the use of research methods and complementary perspectives in the study. In Sub section 3.3.2 we position the researcher to the research context. An overview of the timeline of the study is presented in Sub section 3.3.3. In the final Sub section 3.3.4 we summarize the use of data gathering techniques in providing the research material of the study.

3.3.1 Use of research methods

In summary, the research approach of this study applies two main lenses, defined by design research and innovation adoption, to study the migration process to an open source office suite in the organizational context.

The taxonomy of scientific studies by Järvinen (2008) provides the first lens which classifies the study to design science where the utility of the innovation plays an important role. The innovation (artifact) of this study is based on the open source OpenOffice.org software. The innovation-building part of the study creates an instantiation of the innovation including, e.g., the installation and configuration of the OpenOffice.org platform, the development of supportive tools and documentation, and the development of integrations to support the migration. The innovation-evaluation part of the study includes the analysis of software functionality and interoperability, the evaluation of adoption costs, and measurements of software usage.

The second lens of the study is based on the specific research domain which is concerned with the organizational adoption of an open source office suite. The principles of innovation diffusion research as presented by Rogers (2003) provides the study with a widely accepted and applied framework to explore the adoption process. In spite of the fact that Rogers presented two process models for innovation adoption, the organizational model, although being the first process model for organizational innovation adoption, has this far received little attention among IS researchers. As discussed in Section 2.2, IS research has widely applied and discussed the (individual) innovation-decision model, even in the organizational context. While much of the IS innovation adoption occurs in organizations, the low attention given to Rogers' organizational innovation process calls for more IS

research applying the model. This study applies Rogers' organizational adoption process model in detail. At the same time, the research seeks to empirically test Rogers' organizational adoption process model with data collected during the open source office suite adoption in the target organization of the study.

Rogers suggests that the innovation process in an organization consists of five stages, two stages in the initiation subprocess (agenda-setting and matching) and three stages in the implementation subprocess (redefining and restructuring, clarifying, and routinizing). As suggested by Rogers (2003, p. 418), the innovation process in the organizational context is considered a combination of individual innovation and organizational variables. Due to this dual nature of innovation adoption, contingent innovation-decisions occur in the organizational context. Thus two (or more) tandem adoption decisions are required: the primary adoption decision occurring at the organization-level and the secondary adoption decision at the individual (employee) level. Thus in addition to the organizational process model, also the concepts defined in the (individual) innovation-decision process model are involved in the study.

A summary of the main process models discussed in Chapter 2 and in Chapter 3 is presented in Table 3-3. The table shows the main stages in five models: design research models both from Vaishnavi and Kuechler (2009) and Peffers et al. (2007), IT technology adoption and implementation model from Cooper and Zmud (1990, and the two innovation models from Rogers (2003). Rogers' innovation models which are used as the basis in the innovation adoption process in this study, are shown with thicker border lines. It should be noted that the side-by-side presentation of the process models in Table 3-3 is used just to present a compact summary of the models. The stages which are situated on the same row are not considered to be equal or directly comparable to each other.

Design research (Vaishnavi and Kuechler, 2009)	**Design research (Peffers et al., 2007)**	**IT technology imple-mentation (Cooper and Zmud, 1990)**	**Innovation-decision (Rogers, 2003)**	**Innovation in organizations (Rogers, 2003)**
Awareness	Identify problem	Initiation	Knowledge	Agenda-setting
Suggestion	Define objectives	Adoption	Persuasion	Matching
Development	Design & develop	Adaptation	Decision	(Decision)
	Demonstrate	Acceptance	Implementation	Redefining/ restructuring
Evaluation	Evaluate	Routinization	Confirmation	Clarifying
Conclusion	Communicate	Infusion		Routinizing

Table 3-3. Main stages of design research and innovation adoption process models

Considering the four theories presented by Van de Ven and Poole (1995) for the change processes in organizations, the research approach in this study is related to

two of these theories: design science with utility-oriented goals relates to a teleological theory while Rogers' innovation process models with predefined stages relate to life-cycle theories.

While Rogers' innovation framework defines a general stage model to explore the adoption process, it lacks situation-specific features and constructs which are needed in the realization and evaluation of the innovation. The research approach of this study is thus complemented with additional perspectives addressing OSS solutions and office suite software in the organizational context. These perspectives are taken from reference material available at the time of the study. The following summarizes essential complementary sources applied in this research:

- Woods and Guliani (2005) present OSS-specific concepts and frameworks which can be used by organizations considering the usage of OSS solutions;
- IDA (2003a) and KBSt (2005) give guidelines and recommendations for open source migrations in public sector organizations;
- Poulsen et al. (2002), Kristensen et al. (2005), OGC (2004), and Ghosh (2006) address the practical evaluation of OSS office suite migrations, including economic considerations in the migration;
- IDA (2003b) discusses issues related to the openness of document formats in office suite software.

In addition to writing up the results of the research, the complementary sources were also widely used in the actual innovation process in order to organize and support the practical work with factual information based on neutral literature sources. During the initial phases of the study, Rogers' model for the innovation process was not used in the practical work carried out by the researcher. The model was chosen rather late, during the actual implementation of the migration, to be used as the basic framework to analyze and organize the data of the study.

3.3.2 Positioning the researcher

The researcher in this study has a unique insider's view in the innovation process of the study organization.

The researcher is not a passive inside observer in this study. Instead, he is an active participant who is able to control the events in the innovation adoption process of the study. The researcher is a staff member of the study organization and the principal designer and the project leader in charge of the innovation adoption process in the organization.

This research provides thus a participative and implementation-oriented view to the innovation process. Complementary views focusing on end-user experiences in the same innovation process are underway in other research projects. The approaches

and methods of the parallel research efforts differ from those chosen in this doctoral thesis. The results of the parallel studies will be published in other forums.

3.3.3 Timeline of the study

Table 3-4 summarizes events and activities in the innovation process of the study. The timing of the events and activities during the years 2003-2010 are indicated in the table together with references to the corresponding stages in the underlying innovation process model of the study. Also references to the individual chapters discussing the events and activities in detail are shown.

Years	Events and activities	Process stages
2003-2004	– Defining an organizational problem that creates a perceived need for an innovation (2/2003) – Initial activities in the development of OpenOffice.org skills (3/2003) – Initial activities to evaluate the potential usefulness of an OSS solution (6/2003-2/2004)	Agenda-setting (Chapter 4)
2005-2006	– Building the business case (2/2004-3/2005) – OpenOffice.org pilot project (12/2005-9/2006) – Start of organization-wide desktop installations of OpenOffice.org version 2.0.2 (3/2006) – Authority decision to adopt OpenOffice.org (12/2006)	Matching (Chapter 5) Matching (Chapter 5), Redefining and restructuring (Chapter 7) Decision (Chapter 6)
2007-2008	– Start of the implementation project (1/2007) – Start of user training and document conversion activities in the first organizational units (1/2007)	Redefining and restructuring (Chapter 7) Clarifying (Chapter 8)
2009-2010	– Start of organization-wide upgrade to OpenOffice.org version 3.0.1 (2/2009) – Start of application integrations (1/2009) – OpenOffice.org usage measurements (3/2009) – OpenOffice.org migration and deployment cost update (6/2010)	Redefining and restructuring (Chapter 7) Clarifying (Chapter 8) Routinizing (Chapter 9)

Table 3-4. Overview of events and activities in the innovation process of the study

3.3.4 Research material

This research is restricted to an in-depth study in a single organization which leads to somewhat isolated use of information sources. Järvinen (2004) presents several data

gathering techniques to be used in studies, including interviews, observations, questionnaires, written material, video and voice recording, surveillance by a computer program, pilot tests, prototypes, and artifacts. Järvinen recommends to use triangulation, i.e. a combination of various data gathering techniques in the research.

For this study, the computer artifact is of crucial importance as research material. The instantiation of the OpenOffice.org artifact provides the technological base for the OpenOffice.org migration. Both the innovation-building and innovation-evaluation parts of the study rely on the instantiation of the artifact in the IT environment of the study organization.

Pilot experimentation provides important research material in the study. Piloting has been used to test and validate OpenOffice.org in the early stages of the innovation process. Piloting has also resulted to important documentation which has been extensively used in the study.

Concerning OpenOffice.org, the public website (www.openoffice.org) of the OpenOffice.org community is an important source in the research material. The website provides, e.g., installation files and advanced documentation addressing both engineering and end-user needs. The material from the website is essential in the innovation-building part of the study. In addition to the public OpenOffice.org website, other websites are of secondary importance as research material. However, the study has used information addressing several European case studies and evaluations on OpenOffice.org adoption, available from the public open source websites of organizations financed by the European Commission.

Throughout the study, the researcher has maintained documentation in a personal field note diary which is a form of participant observation in data gathering. The diary contains daily notes concerning meetings, training events, discussions, and telephone calls during the study. The diary is complemented with e-mail messages containing information on project activities, training, and user support issues.

The research project has created an intranet site where detailed data concerning the migration has been kept and updated. The intranet contains, e.g., frequently asked questions, handbooks, training materials, discussion pages, administrative project documentation, migration progress wiki as well as OpenOffice.org product news and information pages.

The study has been able to use internal written material in the form systems documentation showing details of the applications deployed in the study organization and also official contracts between the study organization and external vendors. Internal written material in the form of progress reports and minutes of meetings of the project and the steering group has also been available. Written material used in the study also includes information available from public diaries of organizations. The study has produced extensive migration documentation which forms an important reference material in the study. The documentation is publicly available from the website of the study organization, and it has also been available from the website of the Finnish OpenOffice.org community.

Direct surveillance by a computer program has not been used as research material. However, computer log files have been used in the innovation-evaluation part of the study. Also computer records from the help desk service application of the study organization have been used in the innovation-evaluation part of the study.

The data gathering techniques of this study do not contain video or voice recordings, interviews, or questionnaires. The insider view of the research and the fact that the researcher was acting as a project leader diminishes the possible value of interviews and video or voice recordings as research material. Questionnaires are mostly used as a data gathering technique in survey studies which is not the approach followed in this study.

4 Agenda-setting

In this chapter we present the agenda-setting stage of this innovation adoption study. At this stage, an organizational problem is defined that creates a perceived need for an innovation (Rogers 2003, p. 422). The agenda-setting stage can also be driven by solutions: organizations may scan for innovations and match a promising innovation with one of their relevant problems.

Rogers suggests that the agenda-setting stage may require an extended period of time, often several years. Rogers makes a generalization (ibid., p. 422) that a shock to the organization often triggers the agenda-setting stage. Also a performance gap can trigger the agenda-setting stage. The agenda-setting consists of (1) identifying and prioritizing needs and problems and (2) searching for innovations of potential usefulness to meet these organizational problems.

In the evaluation of the potential usefulness of the innovation candidates, we complement Rogers' framework with concepts from Woods and Guliani (2005) in order to evaluate the required expertise to exploit the innovation candidate based on an OSS solution. The evaluation of potential usefulness also includes information on practical OSS case studies and evaluations as well as OSS-related guidelines for European public organizations. IDA (2003a), IDA (2003b), and Poulsen et al. (2002) constitute the main sources to complement Rogers' framework in presenting OSS case studies, evaluations and guidelines.

The agenda-setting stage is structured as follows. In Section 4.1 we define the problem creating the perceived need for an innovation. In Section 4.2 we introduce innovation candidates and give an initial evaluation of their potential usefulness. We summarize the chapter in Section 4.3 giving a review of the results of the agenda-setting stage.

4.1 The problem

The agenda-setting stage in this study was caused by a problem which needed a solution. In February 2003 (research diary: meeting with IBM representatives on 18 February 2003), the information concerning the end of IBM Lotus SmartSuite[5] product development sparked the Ministry of Justice to explore alternatives to the SmartSuite software. The proprietary SmartSuite package contains the typical components in an office application suite, including software for word processing (WordPro), spreadsheets (1-2-3), and presentation graphics (Freelance Graphics). The Ministry of Justice had previously acquired more than 7 000 SmartSuite 97

5 http://www-01.ibm.com/software/lotus/products/smartsuite/ (cited 7 June 2010)
http://en.wikipedia.org/wiki/SmartSuite (cited 7 June 2010)

licenses, and thousands of employees were using these programs. A shock is perhaps too strong expression to describe the situation but anyways it was unpleasant news to the Ministry of Justice. The migration to the SmartSuite software was completed just about 5 years ago, and the end of product development gave reason to expect the need to migrate to another office application suite in a couple of years.

Because the problem required organization-wide attention, the handling of the problem was within the responsibility of the Office of the CIO in the ministry. The problem can simply be defined as follows.

- to find and evaluate office software products to replace the SmartSuite package;
- to suggest a migration path to the new office software.

Within of the Office of the CIO, the problem was assigned to the author of this study. At this stage, no project was established. The author started to work on the problem as a regular line of work. The progress of the work was reported to the IT governance co-operation board of the ministry.

The problem was not given high-priority attention at this stage. Several other large multi-year application development projects were to be completed at the same time and these were given higher priority in work assignments. There was no pressure to start an immediate migration in order to replace the SmartSuite software.

The ministry and its administrative sector had over 10 000 Windows NT 4 workstations, and the SmartSuite release 97 software was being deployed on the Windows NT 4 platform. The last release of the software (SmartSuite Millennium 9.8, released in October 2002) was supported both on Windows NT 4 and Windows XP platforms. One of the ongoing other projects was the evaluation of platforms (Windows XP and Linux) to replace the aging Windows NT 4. The availability of the Windows XP version of the SmartSuite software was an important benefit to consider because it gave the possibility to avoid a sudden stop in the deployment of the SmartSuite software when the platform change was to be implemented.

4.2 Innovations of potential usefulness

In the following sub sections we evaluate possible alternatives as solutions to the problem defined in Section 4.1. In Sub section 4.2.1 we introduce Microsoft Office and the open source OpenOffice.org suite as alternative replacements to the SmartSuite software. The emphasis in the following sections is on the OpenOffice.org suite which is perceived as a new possibility in solving the problem. In Sub section 4.2.2 we analyze the study organization's expertise end experience regarding the deployment of open source software. Rogers (2003) has found communication channels to play an important role in the diffusion of innovations.

The main communication channels established during the agenda-setting stage are described in Sub section 4.2.3. The potential usefulness of OpenOffice.org is evaluated Sub section 4.2.4. The evaluation of usefulness covers early migration case studies in Europe, compatibility evaluations, implementation guidelines, and a preliminary evaluation of the software in one application area in the target organization of the study.

4.2.1 Microsoft Office and OpenOffice.org

An obvious alternative to the SmartSuite software was the proprietary Microsoft Office[6] suite which already had a fairly large user base within the ministry and its administrative sector. Microsoft Word (word processing), Excel (spreadsheets), and PowerPoint (presentations) are the key components of the Microsoft Office suite.

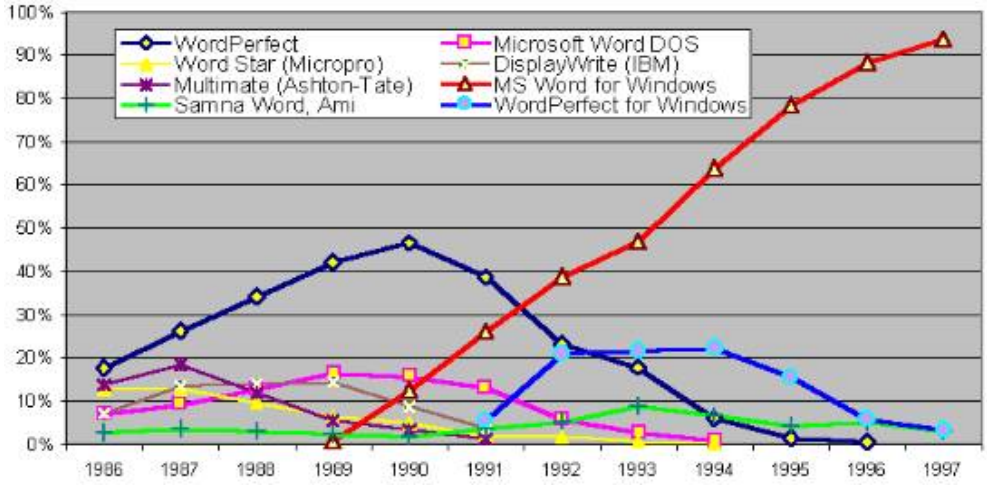

Figure 4-1. Word processor market shares (Liebowitz and Margolis, 1999)

Microsoft Office is one of the most widely-used and commercially successful software applications ever produced. The market analysis (IDA, 2003b) published by the IDA[7] programme of the European Commission suggests that Microsoft Office was the dominant suite having approximately 95% of the worldwide office suite market in 2002. Both IBM SmartSuite and Corel WordPerfect Suite had approximately 2% share each. The analysis was based on estimated 250 million desktop computers worldwide. As a byproduct of the dominant market position of Microsoft Office, also the proprietary file formats of Word, Excel, and PowerPoint

6 http://office.microsoft.com/en-us/default.aspx (cited 7 June 2010)
http://en.wikipedia.org/wiki/Microsoft_Office (cited 7 June 2010)

7 http://europa.eu/legislation_summaries/information_society/l24147a_en.htm (cited 7 June 2010)
IDA (Interchange of Data between Administrations) it is a community programme managed by the European Commission. It aims to promote data interchange between Member State administrations and/or the Community institutions.

(doc, xls, and ppt) had gained a dominant position as the document exchange formats between organizations and citizens. The first version of Microsoft Office was released in 1989 for Apple Macintosh with a Windows version following next year. The extraordinary growth of Microsoft Office market position can be illustrated tracking the market share history of word processing software. Figure 4-1 from Liebowitz and Margolis (1999) shows the changes of revenue market shares between leading word processors during the period 1986-1997. Due to acquisitions, product names have changed over the years justifying, e.g., to regard Samna Word and Ami the same as WordPro in Figure 4-1.

In spite of the dominant position of Microsoft Office, also other possibilities to replace the IBM SmartSuite software were considered. An interesting new office suite candidate had emerged when the OpenOffice.org[8] office suite version 1.0 was released in May 2002[9]. OpenOffice.org is both a community-based project and a cross-platform open source office suite. OpenOffice.org is available for several operating systems including Microsoft Windows, Linux, Solaris, and Mac OS X. The software is based on StarOffice, an office suite originally developed by the German software company StarDivision and acquired by Sun Microsystems in August 1999. The source code of the suite was released as an open source project in July 2000. The suite includes the key desktop applications, e.g., word processor (Writer), spreadsheet (Calc), and presentation manager (Impress). OpenOffice.org supports a variety of file formats, including those of Microsoft Office. OpenOffice.org is free software, with the source code available under the GNU Lesser General Public License (LGPL). The software is available for download on the OpenOffice.org website. The reaction to the release of OpenOffice.org was positive: the market analysis (IDA, 2003b) indicated that by the end of 2003 OpenOffice.org had almost 19 million downloads from its official websites. OpenOffice.org is available also bundled with other (proprietary) software components, e.g., Sun Microsystems' StarOffice product includes OpenOffice.org.

In the beginning of the agenda-setting stage, the OpenOffice.org version 1.0 was available also as a Finnish-language version. Version 1.1 was released in October 2003, and the Finnish-language version 1.1 was released in November 2003.

4.2.2 Expertise and experience

The Ministry of Justice (the author included) had no prior experience of OpenOffice.org in the beginning of the agenda-setting stage. On the other hand, the Microsoft Office suite already had a fairly large user base within the ministry and its administrative sector. The development of basic OpenOffice.org skills was necessary in the ministry in order to properly evaluate the new open source office suite as a

8 http://www.openoffice.org/ (cited 7 June 2010)
http://en.wikipedia.org/wiki/OpenOffice (cited 7 June 2010)

9 http://wiki.services.openoffice.org/wiki/Product_Release (cited 7 June 2010)

possible adoption platform. At this point the expertise concerning the use open source products in the organization was low. Linux was being deployed as a server operating system platform in some applications, but desktop open source products were not being used. Even the internal expertise with the Linux server platform was low due to the fact that the services related to the development of server applications and to the operation of the server platform were acquired from external IT service providers. Applying the concept of absorptive capacity from Cohen and Levinthal (1990), investments in learning and skill building were necessary in the Ministry of Justice to recognize the value of OpenOffice.org as an innovation and to put the innovation into practice in case a positive adoption decision would be reached.

Woods and Guliani (2005, p. 50) introduce the following four skill levels to define expertise required in the deployment of open source products: (1) beginner, (2) intermediate, (3) advanced, and (4) expert.

The beginner level defines the minimum amount of skills needed to use the most mature open source products. Beginners understand at a superficial level the packaging and development tools involved in downloading and unpacking the binary versions appropriate for an existing operating system. Beginners are able to perform the basic configuration of the open source program. Regarding programming languages, no skills are required at the beginner level. Beginners will be able to use only the most mature open source products. Users at the intermediate level are able to perform advanced configuration of the open source program and are also familiar with the basic use of programing languages needed in the configuration of the open source program. Users at the intermediate level are able to use less mature open source programs and are capable to adapt open source projects that are relevant to the needs of the organization. Using this skill classification, the Ministry of Justice was at the beginner level in the beginning of the agenda-setting stage in February 2003.

In spite of the modest skill level concerning open source products on desktop computers, the Ministry of Justice had acquired a fairly extensive experience with desktop software migrations:

- The Finnish TEKO word processor on the DOS platform was not developed further to support a graphical user interface. A migration from TEKO to WordPerfect was performed in 1990's.
- The deployment of the DOS desktop operating system was discontinued. Some organizational units migrated IBM OS2, and some units migrated to Microsoft Windows. At that time the IT organization of the ministry was decentralized and organization-wide platform policies did not exist.
- The deployment of the IBM OS2 operating system was discontinued. A migration to Microsoft Windows was performed.

- The deployment of WordPerfect word processor was discontinued. Some organizational units migrated to IBM WordPro and some units migrated to Microsoft Word.

The average age of the staff being over 45 years (Happonen and Nikkanen, 2006), many users had thus already experienced several software migrations on the desktop. The IT staff had acquired practical knowledge and skills concerning the implementation of desktop migrations. In addition to desktops, there had also been several software migrations on the server side over the years.

The development of required OpenOffice.org skills started in March 2003. The author with 4 other persons from the IT staff attended an OpenOffice.org course (research diary: course attendance 17-18 March 2003). The course covered the installation and basic use of OpenOffice.org. In May 2003, a basic Linux course was also attended (research diary: course attendance 12-13 May 2003).

4.2.3 Communication channels

Rogers (2003, p. 205) defines communication channels as means by which messages are transmitted in the innovation-decision process. The active use of various communication channels was an important factor in acquiring OpenOffice.org knowledge and skills. The main communication channels were established during agenda-setting phase, and they were thereafter used throughout the innovation study. Rogers classifies communication channels to mass media channels and to interpersonal channels. Mass media channels are means of transmitting messages involving a mass medium, e.g., television, newspapers, and Internet. Interpersonal channels involve face-to-face message exchange between individuals.

Mass media coverage of OpenOffice.org in Finland was thin, basically some general articles in professional magazines like Tietokone[10]. General articles and news were obtained from international professional magazines, like InfoWorld[11], PC Pro[12], and eWeek[13]. Information from the OpenOffice.org documentation website[14] was abundant, detailed, and extremely useful. The Open Source Observatory hosted by the IDA programme of the European Commission was an important clearinghouse of news and case studies related to OSS in the public sector. The IDA programme expired in 2004, and a follow-up IDABC[15] programme was established. The public

10 http://www.tietokone.fi/ (cited 7 June 2010)

11 http://www.infoworld.com/index.html (cited 7 June 2010)

12 http://www.pcpro.co.uk/ (cited 7 June 2010)

13 http://www.eweek.com/ (cited 7 June 2010)

14 http://documentation.openoffice.org/ (cited 7 June 2010)

15 http://ec.europa.eu/idabc/en/home (cited 21 July 2010)
IDABC is a Community programme managed by the European Commission's Directorate-General for Informatics. IDABC stands for Interoperable Delivery of European eGovernment Services to public Administrations, Business and Citizens.

on-line services of the IDABC Open Source Observatory[16] were extensively used in this study. The services provided, e.g., documentation on interoperability recommendations and information on practical case studies involving open source products in the public sector. Later on, the OSOR.EU[17] website (Open Source Observatory and Repository for European public administrations) was established to replace the IDABC Open Source Observatory. OSOR.EU provides the same services and in addition a repository with OSS and documentation for public administrations. A further administrative follow-up occurred when the IDABC programme expired in December 2009, and the ISA[18] programme was established for the period 2010-2015.

Also several interpersonal channels were established during the agenda-setting stage. A former colleague of the author from the University of Tampere was one of the early adopters of OpenOffice.org, and his positive remarks of the software were encouraging. In the general innovation-decision model of Rogers (2003, p. 175), the information from near peers is typical in forming a positive attitude toward the innovation during the persuasion stage of innovation-decision. An important Finnish peer contact network was created when the Open Source Office Systems (OSOS) project was established. It included members from the Ministry of Finance, Ministry of the Interior, Ministry of Justice, Finnish Customs, and Finnish Meteorological Institute. The Meteorological Institute can be described as a public expert organization, the others being typical public government organizations. The OSOS project was established in February 2004, and it lasted till June 2005. All members of the project had expressed interest in open source and were ready to co-operate. The main tasks of the OSOS project were as follows:

- exchange of information and experiences concerning open source office systems and open document formats;
- participating the IDABC programme of the European Commission;
- finding and presenting case studies;
- gathering information of open source office systems.

The OSOS project arranged an open source study visit to Berlin, a workshop, and two open source seminars which were also attended by experts from Great Britain, Denmark, and France. The project also prepared a report of open source office software. As a byproduct of the OSOS project, several additional interpersonal channels to peers in European public administrations were established. The author of this study started active participation in the OSOS project in February 2004 which

16 http://ec.europa.eu/idabc/en/chapter/452 (cited 7 June 2010)

17 http://www.osor.eu/ (cited 7 June 2010)

18 http://ec.europa.eu/isa/ (cited 7 June 2010)
The ISA programme is managed by the European Commission in close cooperation with the EU Member States. ISA stands for Interoperability Solutions for European Public Administrations.

also marked the commencement of more detailed planning activities involved in the matching stage of the organizational innovation process in this study.

4.2.4 Potential usefulness of OpenOffice.org

The communication channels were used to acquire information on the potential usefulness of the OpenOffice.org innovation during the agenda-setting stage. The first version of the software was released in 2002, and some publicly available information on case studies and migrations was already available.

The most well-known early open source and OpenOffice.org case in Finland is the city of Turku[19]. The city is one of the largest in Finland having over 170 000 inhabitants and a staff of more than 13 000 employees. The IT infrastructure of the city consists of approximately 11 000 workstations. In 2001, the IT department of the city evaluated and tested the suitability of the OpenOffice.org office suite and the Linux operating system as the new workstation standard of the city of Turku. The evaluation report (Onnela, 2001) suggested that a migration to OpenOffice.org and Linux would be implemented:

- First a migration to OpenOffice.org would be carried out by the end of 2003. OpenOffice.org would replace Microsoft Office 97.
- In the second phase, a migration to the Linux operating system would be carried out. Linux would replace Microsoft Windows NT 4.

It should be noted that in 2001 there was no official release of OpenOffice.org. The evaluation used a release candidate (version 633) of the software. There was no OpenOffice.org documentation in Finnish available at that time, and, e.g., Finnish spelling and hyphenation was not yet available. The IT department considered the reported product maturity shortcomings temporary and marginal from the average user's viewpoint. In the conclusions of the report, the Microsoft platform was considered good and feature-rich but too expensive for the municipality. The IT management of the city clearly supported the suggested open source platform. However, the open source issue got politicized, and it took almost four years before the city was ready to make the final decision. During that time, pressure on the IT department staff was high resulting to several changes in the IT management (ITviikko, 2003b; Turun Sanomat, 2004; Turun Sanomat, 2005a). The City Board decided on November 7 in 2005 to continue with the Microsoft platform with Office 2003 as the office suite and Windows XP as the workstation operating system (Turun Sanomat, 2005b).

The first publicly reported successful OpenOffice.org migration in a Finnish organization was completed in 2003 in the Finnish Union of Practical Nurses[20]

19 http://www.turku.fi/ (cited 7 June 2010)

20 http://www.superliitto.fi/ (cited 7 June 2010)

(SuPer). SuPer is Finland's largest union of professionals with a secondary-level education and diploma in social welfare and healthcare. SuPer has 70 000 members organized into more than 200 local unions. The staff employed by SuPer and the local unions have close to 400 workstations, and 300 of the workstations were migrated into an open source platform with Linux as the operating system and OpenOffice.org as the office suite (ITviikko, 2003a). The Microsoft Windows and Office platform was kept in 80 workstations. SuPer is not an IT expert organization, and consulting services were used in the implementation of the migration including workstation installations, user training, and support. Cost savings and data security were important considerations in the migration to the open source platform. ITviikko (2003a) reported that some doubts were initially raised regarding the migration to the open source platform, but training, management support, and clearly communicated messages to employees helped in the motivation of the staff. Ms Tuulia Laitalainen from the top management of SuPer was the driving force and local champion in the migration.

Public information on OpenOffice.org migrations on the European level also started to be available during 2003-2004. The market analysis published by the IDA programme of the European Commission reported the migration in the French Ministry of Interior where 15 000 desktop computers were migrated to OpenOffice.org in 2003 (IDA, 2003b, p. 58). The extensive migration plan of the city of Munich drew international public attention (IDA, 2003b, p. 59; IDABC, 2004). The migration in Munich involves 14 000 desktop workstations which will be migrated to an open source platform with OpenOffice.org as the office suite. During the period 2002-2003 an Irish public sector organization, Beaumont Hospital, carried out a migration to an open source office suite (Fitzgerald and Kenny, 2004). The Beaumont Hospital migration is also reported in OSOR case studies (OSOR, 2008a). Beaumont Hospital employs 3000 staff and has approximately 1000 desktop workstations to support. The implementation of open source was largely driven by the necessity to reduce costs. The IS infrastructure of the hospital consists of a mixture of open source and proprietary software. In addition to desktop applications, the open source components of the IS infrastructure include, e.g., the Linux operating system, Java/J2EE application server (JBoss), e-mail (Skyrix), content management system (Zope), and digital x-ray imaging system. The proprietary desktop office software had a mixture of components including several versions of Microsoft Word and WordPerfect. The migration to an open source office suite started in spring 2002 with the introduction of StarOffice. The initial version (5.2) proved to be problematic, and in September 2002 the transition to StarOffice 6 (equivalent to OpenOffice.org version 1) was implemented. The Beaumont Hospital study was one of the first to include the evaluation of cost savings from the deployment of open source software. Comparative costs of both open source and closed-source solutions were evaluated. Software purchases as well as maintenance and upgrade costs were included in the cost calculations. The overall savings from

the first phase of the open source migration viewed over a five-year period were reported to be an impressive 8,2 M€ with the x-ray imaging system accounting for most of the savings. For desktop applications the five-year cost of StarOffice was reported to be 34 700 € which yielded to 88 % savings when compared to the 288 500 € cost of the closed-source alternative. While reporting overall satisfaction with the open source implementation, the hospital also experienced problems. The initial implementation with StarOffice was based on a thin client strategy where the applications were downloaded from the network. Server overloading and network connection failures proved the strategy erroneous, and the software had to be reinstalled on desktop workstations. Migration resistance was also experienced with 80 persons from the staff opting out of the migration to StarOffice. Some of the staff feared being deskilled if they didn't have skills in popular proprietary software packages. The study concludes that support from top management is critical when highly visible desktop open source applications are introduced. Top management support is also critical regarding OSS maintenance arrangements. Online bulletin boards and mailing lists may be the main source of software support when standard maintenance contracts are not an option. Within Beaumont Hospital, the IT project manager Tony Kenny has been the initiator and driving force in the adoption of open source solutions.

With the introduction of OpenOffice.org, the compatibility of the software with the dominant Microsoft Office suite received attention. The compatibility has several aspects, like the functionality and user interface of the two products, and especially the level of interoperability. High interoperability would support problem-free exchange of documents enabling documents to be opened and edited with different products without loss in document contents, structure, or layout. The early compatibility evaluations (Poulsen et al., 2002; Vestin, 2003) were published in 2002-2003 shortly after the public release of OpenOffice.org.

The Danish Board of Technology, an independent body established by the Danish Parliament, published in 2002 the results of a detailed investigation into the economics and usability of open source software in public administration (Poulsen et al., 2002). The analysis concludes that OSS is a viable technical and economical alternative to the proprietary software. The report also presents the results of the compatibility test of StarOffice version 6 (equivalent to OpenOffice.org version 1) and Microsoft Office 97. The compatibility test was targeted to the exchange of documents in Microsoft's doc and other file formats. The report concludes that the degree of compatibility between Microsoft Word and StarOffice Writer is very high. It is possible for most documents in doc format to be opened in StarOffice Writer, edited, saved and returned to the original doc format without difficulties. The tests show that there are few problems in converting documents between file formats. The problems that arose in conversion are mostly concerned with layout, which in turn is predominantly based on anchoring of graphics. As a long term solution to the file format issue the report recommends that an open standard document format would be

developed for problem-free exchange of documents and for the integration of systems in e-government.

The Swedish Agency for Public Management (Statskonturet) performed in 2003 interoperability tests between Sun StarOffice Writer 6 (equivalent to OpenOffice.org Writer 1) and Microsoft Office Word 2003 beta 2. The resulting report (Vestin, 2003) concludes that the graphical user interface of StarOffice Writer closely resembles that of Microsoft Word. The symbols and icons in StarOffice Writer are in most cases similar to those found in Word. The functionality of StarOffice Writer proved to be adequate although it is not fully compatible with Microsoft's doc-format. The report also evaluates the XML file formats of the programs. For interoperability purposes between the two programs the report recommends to use the Microsoft doc-format, even if the tests showed that the preservation of the full function, structure and layout of documents cannot be guaranteed.

The IDA programme of the European Commission published in 2003 guidelines for open source migration (IDA, 2003a). The report, written in co-operation with the consulting company Netproject Ltd, was designed to help public organizations evaluate open source migration issues. The guidelines are based on practical experience and they also describe technical issues involved in the implementation of the migration. The guidelines define a reference architecture which is based on functional groups. The office functions define facilities for the creation, modification, and printing of files containing letters, reports, spreadsheets, and presentations. OpenOffice.org is the chosen software for the office functions in the reference architecture. The justifications for the preference of OpenOffice.org are based on good interoperability with the Microsoft Office file formats and on the fact that OpenOffice.org can also be run on the Windows platform. For the agenda-setting stage of this study, the inclusion of OpenOffice.org as the preferred office software in the reference architecture was a positive and encouraging signal considering the potential usefulness of the software. The general recommendations of the guidelines also emphasize building up expertise with OSS. In addition, the recommendations point out that the existence of a champion for change in the organization is important. The importance of an innovation champion is also emphasized by Rogers (2003, p. 414).

During the agenda-setting stage, a preliminary evaluation of OpenOffice.org as a replacement for Microsoft Office in one application area of the Ministry of Justice was performed. A large new application, the Prisoner Information System, was being developed, and it used Microsoft Word and Excel for document print-outs. The application was based on Visual Basic programming and Microsoft COM (Component Object Model) and ActiveX technologies in the integration of Word and Excel document templates to the data base of the application. Two Finnish IT consulting companies were involved in the OpenOffice.org evaluation. A small company which had OpenOffice.org expertise, prepared 15 OpenOffice.org test templates and provided integration information for the templates. The large company

(the developer of the application) tested the templates and prepared preliminary cost evaluations to replace Word and Excel with OpenOffice.org. The evaluation confirmed the feasibility of OpenOffice.org in the print-out interface. Also the cost factors were favorable. However, the print-out interface of the application was not modified because the development of the Prisoner Information System was already seriously delayed, and it was decided not to add any extra work to the project. This evaluation was carried out during June-November in 2003 (research diary: the first meeting with the representatives of consulting companies on 16 June 2003; the last test template completed in an e-mail on 11 November 2003).

4.3 Review

The agenda-setting stage started in February 2003 when the problem and the need for an innovation was experienced. Activities during the agenda-setting stage included preliminary matching of OpenOffice.org as an innovation, the evaluation of the potential usefulness of the software, and initial actions to build expertise with the software. Participation in the OSOS co-operation project started detailed planning activities to fit the innovation to the needs of the organization in February 2004. The time period for the agenda-setting stage was thus fairly long, approximately a year.

The following list summarizes the main results and findings of the agenda-setting stage.

- The problem which created the perceived need for an innovation was defined.
- Several suggestions by Rogers (2003) were confirmed: (1) a shock to the organization caused the problem, (2) the agenda-setting stage took a long time to complete, and (3) the importance of communication channels in the process, both mass media and interpersonal, was evident.
- The open source innovation candidate OpenOffice.org was identified and initially matched to the problem.
- During the agenda-setting stage, a combination of innovation-decision activities could be noticed: extensive use of communication channels, knowledge acquisition, and persuasion in the attitude-formation towards the innovation. Innovation-decision activities were related to the matching of the innovation and the organization's problem.
- In the evaluation of the potential usefulness of the innovation candidates, Rogers' innovation framework was complemented with perspectives addressing OSS solutions and office suite software. Additional perspectives to Rogers' framework were provided from practical OSS case studies and evaluations as well as from OSS-related guidelines for European public organizations. Some early migration case studies, both successful and unsuccessful, were presented.

The migration of the Finnish city of Turku proved to be unsuccessful while the migration in 2003 by the Finnish Union of Practical Nurses (SuPer) was the first publicly reported successful OpenOffice.org migration in a Finnish organization. The migration implemented during 2002-2003 by the Irish public sector organization, Beaumont Hospital, was one of the first migrations which publicly reported the evaluation of cost savings from the deployment of OSS. The importance of top management support in the migration was emphasized in the early case studies. Case studies, international compatibility evaluations (Poulsen et al., 2002; Vestin, 2003), and implementation guidelines (IDA, 2003a) gave preliminary support for the feasibility and viability of the innovation. The initial technology evaluation in one application area of the Ministry of Justice, the Prisoner Information System, confirmed the feasibility of the innovation in systems integration.

- Also the skill evaluation suggested by Woods and Guliani (2005) provided an additional complementary perspective to Rogers' innovation framework. The skill evaluation indicates the expertise required to exploit various OSS solutions. The study organization was found to be at the beginner skill level which suggests to use only the most mature open source products. Open source skill building from beginner level was initiated during the agenda-setting stage in order to be able to properly evaluate OpenOffice.org as a possible adoption platform.
- The experiences from the additional OSS-related perspectives to Rogers' innovation framework, including skill evaluation, case studies, compatibility evaluations, and guidelines to public administrations, suggest that the additional perspectives can be useful in addressing the uncertainty regarding the possible adoption of the innovation.

5 Matching

In this chapter we present the matching stage of this innovation adoption study. At this stage, a problem from the organization's agenda is fit with an innovation, and this match is planned and designed (Rogers 2003, p. 423). During this stage, the organization's members attempt to determine the feasibility of the innovation in solving the organization's problem and to evaluate the benefits and problems that the innovation will encounter.

The author of this study started active participation in the OSOS co-operation project (see Sub section 4.2.3) in February 2004 (research diary: the first OSOS project meeting in Helsinki on 25 February 2004). Participation in the project triggered the matching stage with the detailed planning activities to fit the innovation to the problem presented in the agenda-setting stage in Section 4.1.

In the detailed contents of the matching stage, we complement Rogers' innovation framework by applying the open source migration guidelines of the IDA programme (IDA, 2003a). The guidelines were published in 2003 and they were available as research material before the start of the matching stage. The guidelines present both management and technical recommendations for the evaluation of open source migration issues. The guidelines assume a complete change to OSS, but for the purposes of this study we apply the guidelines for a heterogeneous environment where both open source and closed source software would be used side-by-side. Among other things, recommended activities applicable to the matching stage include the following:

- *Building the business case for the migration*. The business case is a management level report based on detailed analysis of the problem area and alternative problem solutions. The report should present, e.g., the cost of the existing environment over a reasonable length of time, the cost of alternative environments, and the cost of the migration. The business case also analyzes the strengths and weaknesses of the current environment and the various alternatives.
- *Pilot projects*. Assuming the business case has been made, small-scale pilot projects are recommended, preferably in a self contained environment with a small number of users. Pilot projects represent reality testing and validation of the business case and the suggested problem solution.

In determining the feasibility of the innovation and in the evaluation of the benefits and possible problems we also draw on complementary resources using practical European OSS case studies and OSS evaluations. From the use of research

methods presented in Sub section 3.3.1, Poulsen et al. (2002), OGC (2004), KBSt (2005), and IDA (2003b) provide complementary OSS perspectives applied in the matching stage.

First hand information concerning the migration guidelines of the IDA programme became available when Eddie Bleasdale, one of the authors of the guidelines report (IDA, 2003a), attended an OSOS project meeting (research diary: project meeting in Helsinki on 29 March 2004). Later during the matching stage, in March 2005, the migration guide written by the KBSt unit at the German Federal Ministry of the Interior was published (KBSt, 2005). The KBSt guide covers many practical migration problems, server and desktop migrations, project planning, legal aspects, evaluation of economics, efficiency, and critical success factors in detail. The special targets of the KBSt guide are so called *replacing migrations* where Microsoft software products are to be replaced with open source alternatives. The guide also discusses *continuing migrations* where organizations migrate to newer versions of Microsoft products. The migration recommendations of the KBSt guide (KBSt 2005, pp. 427-428) stress the development of overall IT and open source strategies, economic efficiency, open standards, and the use of the open source Linux operating system as the basis of the IT platform in replacing migrations. The development of the business case for the open source migration is defined in the KBST guide using the framework of the economic efficiency assessment based on the administrative regulation of the Federal Budget Code (pp. 376-377). The KBSt guide does not stress the importance of pilot projects, although the identification of costs includes pilot projects in the migration phase model (pp. 379-381).

The matching stage is structured as follows. The chapter begins with Section 5.1 discussing the attributes of the innovation. Following the OSS migration guidelines, the matching stage includes the building of the business case of the OpenOffice.org migration which is presented next in Section 5.2. In Section 5.3 we discuss some reflections which were generated by the business case report. The business case is based on the office software evaluation report written by the author during the course of this study and released in March 2005 (Karjalainen, 2005a). In Section 5.4 we present the OpenOffice.org pilot project which was carried out during 2005-2006 in order to validate the results of the business case report and to also to test several practical migration issues, e.g., OpenOffice.org functionality, interoperability, training, and support. The results of the pilot project were reported by the author in 2006 (Karjalainen, 2006b). The chapter ends with a section giving a review of the results of the matching stage.

5.1 Attributes of the innovation

Rogers (2003, p. 424) considers the matching of the innovation and the organization's problem being one particular type of compatibility of the innovation.

Compatibility is one of Rogers' five key perceived innovation attributes presented in Sub section 3.2.1:

- Relative advantage: the degree to which an innovation is perceived as being better than the idea it supersedes.
- Compatibility: the degree to which an innovation is perceived as consistent with the existing values, past experiences, and the needs of potential adopters.
- Complexity: the degree to which an innovation is perceived as relatively difficult to understand and use.
- Trialability: the degree to which an innovation may be experimented with.
- Observability: the degree to which the results of an innovation are visible to others.

In discussing innovation attributes, Rogers (ibid.) does not discuss the effect of different versions in innovations based on computer software. However, the perceived attributes of software innovations are version dependent because software evolves and the new features introduced in new software versions may affect several of the five perceived innovation attributes. In the following, the attributes of the office suite software products are related to the versions available during the matching stage (OpenOffice.org version 2, Lotus SmartSuite Millennium, and Microsoft Office 2003).

Several of the above five innovation attributes are obvious in the context of OpenOffice.org and open source software in general. Easy trialability is built-in the software being available as a zero-cost downloadable installation package from the website of the OpenOffice.org community. The easy trialability is sometimes even emphasized by the saying "*test drive and keep the car*". Low initial cost and economic profitability belong to the subdimensions of relative advantage: low initial cost is obvious due to the zero-cost license, but economic profitability is a more complicated issue because in addition to license costs there are several other cost factors, e.g., training, support, and conversion costs affecting the economic profitability of the innovation. The economic profitability is discussed in more detail in the context of the business case in Section 5.2.

Considering relative advantage, compatibility and complexity, OpenOffice.org has been designed to facilitate possible adoption by replicating many of the familiar features and functions in the user interface of the Word, Excel, and PowerPoint programs which are included in the proprietary Microsoft Office software package. The same attributes are also apparent in the document format support where the familiar file formats of Word, Excel, and PowerPoint (doc, xls, ppt) are supported by OpenOffice.org and can even be used as the default file formats of the program. The file format support of OpenOffice.org also includes the built-in functionality to create pdf (Portable Document Format) files which was not available in the alternative

proprietary software packages. However, in case of the Ministry of Justice and the Lotus SmartSuite software, the benefits of all these attributes are not so obvious. There are more differences when compared to the user interface and functionalities of the SmartSuite programs (WordPro, 1-2-3, Freelance Graphics), and also the default file formats (lwp, 123, prz) differ. The compatibility and functionality of OpenOffice.org is discussed further in the context of the OpenOffice.org pilot project in Section 5.4. Also additional aspects related to the compatibility and complexity, like software localization and user manuals are discussed further in Section 5.4.

The observability of OpenOffice.org is twofold depending on the comparison situation. When compared to Lotus SmartSuite, the observability is fairly obvious because the visible differences in the user interface to WordPro, 1-2-3, and Freelance Graphics can immediately be noticed. However, the observability of OpenOffice.org is less obvious when compared to Word, Excel, and PowerPoint. This is due to the design strategy of OpenOffice.org to replicate the functionality in these Microsoft Office programs.

Rogers (2003, p. 226) suggests that the main attributes for most innovations can be described by the above five key perceived attributes of the innovation-decision model. However, he also notes (2003, p. 223) that the distinction between relative advantage and compatibility is not always very clear cut and that there are indications suggesting that the status-conferring aspect of an innovation may be considered as a sixth attribute. The latter, status-conferral, is considered as a subdimension of the relative advantage attribute in Rogers' model. Status-conferral (social prestige, image) is considered as the degree to which the use of an innovation is perceived to enhance the image or status of possible adopters. The innovation studies of Moore and Benbasat (1991) and Tornatzky and Klein (1982) suggest that image is a separate attribute and not a subdimension of the relative advantage in the Rogers' model. From the perspective of a possible adopter, OpenOffice.org and open source software in general can be be seen as a positive image factor which frees the adopter from the constraints and possible vendor lock-in situation of proprietary software. However, the image factor may also be felt negatively by possible adopters. In the open source migration guidelines (IDA, 2003a, p. 21) this is characterized as the *CV dilution effect*. Adopters may feel that not using the industry standard proprietary software will impair their ability to develop their career. Fitzgerald and Kenny (2004) reported the negative image factor in the migration to an open source office suite in the Beaumont Hospital where some of the staff feared being deskilled by losing experience with the commercial office software package.

5.2 The business case of the OpenOffice.org migration

The author started to work on the preparation of the business case for the OpenOffice.org migration as a regular line of work among other duties in February

2004 simultaneously with the participation in the open source OSOS co-operation project. At this stage, no internal project within the Ministry of Justice was established and no specific deadline for the results was defined. The progress of the work was being reported to the IT governance co-operation board of the ministry.

Activities in the OSOS project turned out to be a useful information source in the preparation of the business case. In May 2004 the OSOS project arranged an open source office software seminar in Helsinki (research diary: seminar attendance on 11 May 2004). One of the speakers of the seminar was Thomas Kristensen from the Danish Ministry of Science, Technology and Innovation. He was one of the contributors to the Danish report (Poulsen et al., 2002) investigating the economics and usability of OSS in public administration. In addition to the results of the Danish investigation, he was able to provide information on several OpenOffice.org migration pilot projects in Danish public organizations (e.g., municipality of Naestved and Aarhus county hospital). The OSOS project financed a preliminary evaluation of open source office software featuring OpenOffice.org, StarOffice, and LBA Office. The evaluation report (Toivanen and Öfversten, 2004) was presented in the seminar.

The OSOS project also organized a study visit to Berlin in May 2004 in order to become familiar with the open source activities in Germany (research diary: OSOS project visit to Berlin 25-27 May 2004). According to the analysis published by the IDA programme of the European Commission (IDA 2003b, p. 59), the German government had activities to standardize on Linux and an open-source IT model at the federal, state, and communal levels. Discussions with experts from the Ministry of Interior (research diary: meeting on 27 May 2004) and other public administrations (research diary: discussion in Parliament House on 26 May 2004) confirmed that migration plans were not based just on economic and technical evaluations. Strategic goals were also being considered, especially to facilitate more sovereign IT governance and to avoid vendor lock-in, the common attribute of proprietary software. The open source migration of the city of Munich is the most widely known German example of these considerations (research diary: Munich case presentation during study visit on 25 May 2004). Public information covering the Munich case has been available since the early phases of the migration, e.g., (IDA, 2003b) and (IDABC, 2004). Detailed case studies are available on the OSOR website (OSOR, 2008b; OSOR, 2008c). Munich also maintains a public website[21] for the project. The Munich case and its background is also covered in the article by Grassmuck (2005). Until 2004, the IT workstation infrastructure of the city of Munich consisted of 14 000 desktop computers which were all running Windows NT 4 operating system and Microsoft Office 97/2000 office software. The end of support for the operating system caused the city to study several alternatives during 2001-2004, both proprietary and open source, to replace the aging Windows platform. In terms of Rogers' model, the end-of-support problem started an agenda-

21 http://www.muenchen.de/Rathaus/dir/limux/english/147197/index.html (cited 11 June 2010)

setting phase in the city in 2001. The preparation of the business case to evaluate alternative solutions included several studies commissioned by the city council of Munich and conducted by consulting companies. In June 2004, the city council decided to migrate to open source software on the desktop computers. The migration decision was not based just on the economic evaluation of the alternative solutions. In fact, the pure proprietary alternative (migrating to Microsoft Windows XP operating system and Microsoft Office XP office software) offered a slight advantage on a cost basis when initial and operational costs during the first four years were considered. Critical arguments in favor of OSS were greater vendor independence, leading to more competition in the software market; open protocols, interfaces, and data formats offered by the open source alternatives; and improved security through greater transparency of OSS. The city council decided on a phased migration over five years starting in late 2004. Munich chose a pure open source desktop strategy. The client operating system is based on Debian GNU/Linux, but modified by the city to suit its needs, hence the name LiMux (Linux for Munich). Other desktop software components include OpenOffice.org office suite, Firefox browser, Thunderbird e-mail client, and Gimp image editor. A "soft" migration model was chosen where OpenOffice.org, Firefox, Thunderbird, and Gimp are first deployed on the Windows platform and then migrated to the Linux desktop. Before the actual migration, three pilot projects were conducted in three departments to iron out possible problems. The migration in Munich has enjoyed strong top management support starting with Munich Mayor Christian Ude. The head of the central IT service provider for the city of Munich, Wilhelm Hoegner, has been the driving force and local champion behind the migration (Grassmuck, 2005).

The business case of this study was prepared by the author during the second half of 2004. The 35 page report (in Finnish) was published in March 2005 (Karjalainen, 2005a). The key findings and recommendations of the report are given in the following sub sections. The contents of the business case follows the structure suggested in the open source migration guidelines (IDA, 2003a). In determining the feasibility of the innovation and in the evaluation of the benefits and possible problems we also draw on practical European OSS case studies and OSS evaluations. The research material of the business case is partly based on internal written material of the study organization in the form systems documentation showing details of the applications deployed in the organization and also on official contracts between the study organization and external vendors. In Sub section 5.2.1 we present the results of data gathering where the existing office software environment was analyzed. In Sub section 5.2.2 we discuss the issue of document formats which is an important viewpoint for public organizations which need to be able to interact and exchange documents with other organizations and private citizens. Thereafter we present the migration alternatives and cost evaluations of the alternatives in Sub sections 5.2.3 and 5.2.4. In Sub section 5.2.5 we review available information on OpenOffice.org migrations and deployment. A summary of the

strengths and weaknesses of the migration alternatives is given in Sub section 5.2.6. The last sub section presents the recommendations given in the business case report.

5.2.1 Analysis of the office software environment

At the time of the analysis, in late 2004 and in the beginning of 2005, the IT workstation infrastructure of the Ministry of Justice and its administrative sector consisted of over 10 000 desktop computers. The size of the staff deploying the desktops was close 10 000 employees. All desktops were running the Windows NT 4 operating system. Due to the decentralized IT organization in the past, several office software products were being used in the organization. Table 5-1, based on the license acquisition and license contract information of the study organization, summarizes word processing, spreadsheet, and presentation software products used within the ministry and its administrative sector in 2005.

Office software	Version(s)	Licenses
Lotus SmartSuite (WordPro, 1-2-3, Freelance Graphics)	SmartSuite 97, SmartSuite Millennium	7200
Microsoft Office (Word, Excel, PowerPoint)	Office 97, Office 2000, Office XP, Office 2003	2900
WordPerfect	5.1	< 300

Table 5-1. Office software products in 2005

The mixed environment of several office suite products shown in Table 5-1 caused numerous problems. Altogether seven office products, including the various office software packages and their different versions, were being deployed. Old program versions created interoperability problems both internally and externally with other organizations and citizens.

Also various license purchase options had been used during the past years. A large number of the software licenses were bought without subsequent license maintenance and support contracts. The yearly cost 297 000 € paid for office software maintenance and support thus covered only part of the licenses listed in Table 5-1.

Various application integrations to office software had been developed during the years. With these back-office integrations, office software was intertwined with organizational routines in a larger context. The most important integrations analyzed in the office software evaluation report (Karjalainen, 2005a) were the following:

- Several court information systems had built-in integration to the SmartSuite WordPro word processor. These applications were based on the IBM Lotus Notes/Domino platform and they had modules written in the LotusScript language for the integration of Lotus Notes to WordPro templates.
- The civil case management system in district courts used WordPro for document processing. The application was deployed on the Linux server platform, had BEA Tuxedo/Jolt middleware and used Java modules, XML technology, and WordPro macros in the integration of document processing and the application data base.
- The Prisoner Information System used Microsoft Word and Excel for document print-outs. The application was deployed on the Windows Server platform. It was based on Visual Basic programming and Microsoft COM (Component Object Model) and ActiveX technologies in the integration of Word and Excel document templates to the application data base.
- All ministries in Finland share common applications of the Finnish Government. These applications are used to prepare documents for the cabinet and also for the activities in the administration of the European Union. These applications were based on Microsoft technology using VBA macros and binary Word and Excel file formats.

5.2.2 Open document formats

Considering document formats in the analysis of the office software environment in Sub section 5.2.1, the situation was typical to organizations in 2004 and 2005. Documents were produced and saved using the proprietary document formats defined by the software vendors for use with their own particular products, e.g., the lwp format in SmartSuite WordPro and the doc format in Microsoft Word. Depending on the vendor's discretion, public documentation for the proprietary file formats could be available in some detail or not released at all. Lacking or unavailable documentation causes several problems. Document exchange with other organizations and citizens faces interoperability problems when software vendors are not able to implement adequate capabilities in their products to process the file formats of other vendors. With the accumulation of documents in the proprietary format, the ability of the user to migrate to alternative products in the markets diminishes due to substantial switching costs. The presence of high switching costs creates a situation called vendor lock-in where the software supplier can tie the customer in the perpetual use and license pricing of their proprietary software.

The problems related to the proprietary document formats could be noticed in the office software situation in the Ministry of Justice and its administrative sector. Detailed public documentation covering the file formats used by the Lotus SmartSuite and Microsoft Office products was not available. Interoperability

problems were apparent especially with the aging Lotus SmartSuite product, but to some extent also with the Microsoft Office product.

The need for open document formats is not restricted just to the situation encountered in this study. It is a general concern in public administrations which need to be able to interact with other organizations and private citizens. Public administrations need to provide equal access to information. Adopting proprietary document formats in an organization may cause the requirement for citizens and other organizations to support, and possibly to acquire a particular software adopted by the public organization.

The IDA programme of the European Commission released in 2003 a report assessing the openness of document formats (IDA, 2003b). The report, written in co-operation with the consulting company Valoris, received wide attention and became known as the Valoris report. The purpose of the report was to evaluate market trends and assess existing or emerging open document formats as a step towards recommendations on their use for office documents exchanges between EU member states' administrations. Altogether 24 document formats were analyzed in the report. Both technical and non-technical criteria were used in the analysis. The following criteria were used in the report to define an "ideal" office document format:

- *Open* (the document format to be completely described in publicly accessible documents which are freely distributed and that the document format may be implemented in programs royalty-free without restrictions);
- *Non-binary* (the preferred format having the textual component of the saved document in plain text format compared to a binary stream);
- *Modifiabl*e (separating modifiable formats from document formats intended only to distribute information);
- *Cross-platform interoperability* (implying that the format can be exploited with full preservation of its semantics on various hardware and software platforms);
- *Preserve format fidelity* (ability to preserve the original layout or visual emphasis of the document regardless on which platform or computer the document is opened);
- *Support current word processor features* (ability to represent common features found in currently available word processor applications);
- *Support emerging requirements* (e.g., digital signatures, version control, and user-defined XML schemas);
- *Widely adopted* (sufficient user and tool supplier momentum to sustain the format’s existence and exploitability).

According to the report, no single format met all of the above criteria. The report concludes by choosing two document formats that qualify for further evaluation, namely the default document format of OpenOffice.org (ODF) and the MS XML reference schemas of Microsoft Office 2003. Both of these formats are based on XML[22] technology. XML (eXtensible Markup Language) was developed by an XML Working Group formed under the auspices of the World Wide Web Consortium (W3C). Version 1.0 of XML became a W3C Recommendation in 1998. XML is an application profile or restricted form of the ISO standard 8879:1986 SGML (the Standard Generalized Markup Language). XML has several technical advantages supporting the above "ideal" document format:

- Using the angle-bracket XML mark-up language, XML describes in plain text format office documents as a class of XML documents.
- The emphasis in XML is on descriptive rather than procedural mark-up. The mark-up codes define the contents of the elements in the document rather than the processing logic. The structure of the document and the type of elements can be specified using the XML document type concept. The structure defines what elements are allowed in a document instance, how the elements can be ordered, and how many times the elements can occur.
- The basic design goals of XML support cross-platform interoperability ensuring that documents encoded in XML can be moved from one hardware and software environment to another without loss of information.

The MS XML reference schemas (WordprocessingML for word processing and SpreadSheetML for spreadsheets) were introduced in Microsoft Office 2003. The schemas describe how information is stored when documents are saved as XML. The schemas were published and made available in 2003. ODF is the default document format used in OpenOffice.org. It is an XML-based format which is fully documented and freely available from the OpenOffice.org open source community. International standardization activities around the ODF format started in 2002 via OASIS[23] (Organization for the Advancement of Structured Information Standards) with the goal to create an open, XML-based file format specification for office applications. The consensus committee draft was published in early 2004 in the process to finalize the file format as an OASIS standard.

Based on the results of the Valoris report and on the feedback of major software companies, the Telematics between Administrations Committee (TAC) of the IDA programme endorsed several recommendations on open document formats in May 2004. The recommendations (IDA, 2004a) recognized the need for open document formats and the responsibility of the European public sector to ensure the accessibility of its information. In order to facilitate equal access to information, the

22 http://www.w3.org/TR/REC-xml/ (cited 9 June 2010)

23 http://www.oasis-open.org/ (cited 9 June 2010)

European public sector was recommended to provide its information through several formats. The recommendations prefer standardized open formats and encourage the OASIS Technical Committee to consider submitting the emerging OASIS ODF standard also to an official standardization organization such as ISO. Also Microsoft was encouraged to consider the merits of submitting its XML formats to an international standards body.

The recommendations on the European level were also targeted to the Finnish public administration. In Finland, the Ministry of Finance had published in 2003 the recommendations concerning the openness of the code and interfaces of State information systems (Ministry of Finance, 2003). The recommendations were prepared as the result of a study made into the use of open source methods in the development of tailored applications for State administration. In general, government organizations are recommended to gain the possession of the source code and the rights to modify the code. The recommendations favor open interfaces and standards. Organizations should be wary not to become dependent on software suppliers due to closed interfaces. Following open interfaces and standards it should be possible, if needed, to replace system components and entire systems. Considering open source software, the recommendations emphasize the viability of established open-source operating systems, middleware and utility products as platform solutions.

In conclusion, support for open document formats in office productivity software was favored in the European level recommendations targeting public sector organizations. The technological platform for open document formats was clearly based on XML technology in the European recommendations. National Finnish recommendations favored open interfaces and standards and considered also open source solutions as viable platform alternatives.

5.2.3 Migration alternatives

The problem presented in Section 4.1 was to find and evaluate office software products to replace the Lotus SmartSuite package. However, for comparison purposes, the alternative to continue the deployment of the SmartSuite package was one of the options considered. An obvious replacement candidate for the SmartSuite software was the dominant Microsoft Office suite which already had a fairly large number of users (close to 3000) within the ministry and its administrative sector. Some old document forms from the past were based on the proprietary WordPerfect software but WordPerfect was not considered a practical migration alternative. The third alternative used in the evaluation was to consider the introduction of the open source OpenOffice.org office suite in the organization.

The migration from the current Windows NT 4 platform to Windows XP was an underlying assumption in all alternatives. The deployment of the new office software was assumed to commence simultaneously with the introduction of the new version of the operating system.

The migration alternatives of the business case are summarized in Table 5-2.

Lotus SmartSuite alternative	Microsoft Office alternative	OpenOffice.org alternative
Migration to SmartSuite Millennium on 7000 work-stations and to Microsoft Office 2003 on 3000 workstations	Full migration to Microsoft Office 2003 on 10 000 workstations	Migration to OpenOffice.org on 8500 workstations and to Microsoft Office 2003 on 1500 workstations

Table 5-2. Migration alternatives

The Lotus SmartSuite alternative represents the current software solution and can be characterized as a "do as little as possible" or "business as usual" option. When compared to the analysis of the current office software environment in Sub section 5.2.1, new software versions would be introduced, but other changes to the software infrastructure would be minimal. The requirements for user training, document conversions, and modifications to application integration would be minimal in this alternative. The risks involved with the future of Lotus SmartSuite would remain high in this option. The product was not being developed actively any more which suggested evident interoperability problems for the coming years.

The Microsoft Office alternative involves a complete migration to Microsoft Office 2003, including all current 7000 users of the Lotus SmartSuite software. Several Microsoft Office versions (from Office 97 to Office 2003) were being used in the organization. The same software version (Office 2003) would be introduced for all users. This option requires user training, document conversions, and modifications to application integrations. The risks involved with the Lotus SmartSuite software would be eliminated. Only minor compatibility problems would be expected when using the market leader of office suite software.

A partial migration to OpenOffice.org would be introduced in the third alternative. The Lotus SmartSuite office suite would be completely replaced by OpenOffice.org. Also half of the of Microsoft Office licenses would be replaced by OpenOffice.org. A complete migration to OpenOffice.org including all 10 000 users was not considered a practical alternative, e.g., due to the Microsoft technology based integrations in the document handling applications mandated by the Finnish Government. The OpenOffice.org alternative involves the highest requirements for user training, document conversions, and modifications to application integrations. The generous licensing terms of OpenOffice.org would be an obvious cost benefit in this alternative. The default document format of OpenOffice.org is based on an open XML specification which would be a benefit offered by the OpenOffice.org alternative.

5.2.4 Evaluation of alternative costs

For the purposes of the cost evaluation of the migration alternatives, a 6-year period 2006-2011 was chosen. The migration from the Windows NT 4 platform to Windows XP was planned for the year 2006. At the time of the analysis, the year 2011 was the last year for the extended support of the Windows XP operating system. The period 2006-2011 represented thus the planned deployment time of the new Windows operating system platform.

Table 5-3 gives a summary of the costs of the migration alternatives for the years 2006-2011. The cost evaluation is based on internal documentation of the study organization involving information on license acquisitions, license contracts, IT applications, and training and support expenses. The costs in Table 5-3 represent costs where differences between the alternatives could be noticed. Thus costs being neutral between the alternatives are excluded. The cost evaluation includes the following cost factors:

- license purchases;
- software maintenance;
- training and support;
- systems development, document conversions, and application integrations.

	Lotus SmartSuite alternative	Microsoft Office alternative	OpenOffice.org alternative
License purchases	423 000 €	3 315 500 €	349 000 €
Software maintenance	1 874 000 €	5 186 000 €	2 004 500 €
Training and support	500 000 €	880 000 €	1 155 000 €
Systems development, conversions, and integrations	75 000 €	445 000 €	685 000 €
Costs total	**2 872 000 €**	**9 826 500 €**	**4 193 500 €**

Table 5-3. The costs of the migration alternatives 2006-2011 (Karjalainen, 2005a)

The 6-year costs in the Microsoft Office alternative would amount to a total of 9.8 M€, in the OpenOffice.org alternative to 4.2 M€ and in the Lotus SmartSuite alternative to 2.9 M€. Approximately 44 % of the costs in the OpenOffice.org alternative would be caused by training and support as well as conversion of documents and applications.

Microsoft Office license purchase and software maintenance costs are in some extent included in all alternatives in Table 5-3: the Lotus SmartSuite alternative includes 3000 Microsoft Office licenses and the OpenOffice.org alternative includes

1500 Microsoft Office licenses. The migration from Lotus SmartSuite to either Microsoft Office or OpenOffice.org was not considered practical without Lotus SmartSuite being available on the Windows XP platform during the transition period to the new office software. The SmartSuite software was still needed to open old documents because the proprietary file format (lwp) of the SmartSuite word processor could not be opened by the other alternatives. Thus all alternatives include the license costs of the Lotus SmartSuite software on the Windows XP platform. In addition, the licensing bundle of Lotus SmartSuite and Lotus Notes software created a situation where also Lotus Notes client software maintenance costs are included in all alternatives.

An explanation to the rather low licensing costs of the Lotus SmartSuite alternative came from the fact that in this alternative no changes in the current software maintenance contracts would be introduced. Both in the Microsoft Office and in the OpenOffice.org alternatives all Microsoft Office licenses would be covered by maintenance contracts.

In the OpenOffice.org alternative, the OpenOffice.org software itself does not carry any licensing costs. All licensing costs in this alternative were caused by the licenses of Microsoft Office and Lotus SmartSuite software.

The costs of training in Table 5-3 were calculated assuming that third-party training services would be used in all alternatives. One-day basic training was considered adequate when introducing a new office software package, like Microsoft Office or OpenOffice.org, to the users of the SmartSuite software. For support costs, the costs of a separate support contract with an third-party service provider was considered necessary in the OpenOffice.org alternative while the basic license maintenance contract with the software provider was considered sufficient in the commercial alternatives to cover the support costs.

Considering the application integrations presented in Sub section 5.2.1, modifications to the Prisoner Information System (Word and Excel integration) and modifications to the court information systems (WordPro integration) were included in the evaluations of costs in all migration alternatives. Integration modifications to the civil case management system were excluded from the cost evaluation because one of the recommendations of the business case report was to replace the document processing functionality in that application with a technology which would not be based on integration with a separate word processing software. Integration changes to the document handling applications mandated by the Finnish Government were not necessary because all migration alternatives included enough Microsoft Word and Excel licenses to keep that integration unmodified. Document conversion costs were included in all migration alternatives. The conversion of old WordPerfect document forms was necessary in all alternatives. Depending on the migration alternative, the number of SmartSuite or Microsoft Office document templates to be converted varied between 1500 and 2500 templates. Old SmartSuite documents needed no

conversion because the SmartSuite package was still available on the Windows XP platform in all alternatives.

The evaluation of costs in this study does not follow a full TCO (Total Cost of Ownership) approach as discussed, e.g., by Russo et al. (2005a). TCO analysis for IT measures was popularized by the Gartner Group[24] in the 1980's and has been developed further with various supportive software tools. In TCO analysis all costs that can be directly or indirectly quantified in monetary terms are assigned to the evaluation of costs. Typical causes of IT costs include software acquisition, hardware acquisition, maintenance, training, and support. The methodology of economic efficiency evaluation as presented in the migration guide of the KBSt unit at the German Federal Ministry of the Interior (KBSt, 2005) is an example of the adoption of the TCO approach following the German regulations.

Instead of a TCO approach, the evaluation of costs in this study concentrates on the parts of the cost structure where differences between the migration alternatives can be found. This approach was also used in the economic analysis of open source migrations which were presented in the study of the Danish Board of Technology (Poulsen et al., 2002). Poulsen et al. (pp. 38-39) drew up a theoretical model for assessing the economics in open source and proprietary software. The cost factors of the model do not quite overlap the factors of this study. For example, the model includes the costs of hardware requirements and several software related cost factors (user-friendliness, operational stability, compatibility, and interoperability) which are not directly itemized in the cost evaluation of this study. On the other hand, Poulsen et al. exclude application integrations costs which are included in the cost evaluation of this study.

Both Russo et al. (2005a) and Poulsen et al. (2002) note that the actual categories structuring a cost evaluation are strongly driven by the context. The starting situation of the specific installation is decisive in the assessment of economics. For example, the assumption of Windows XP as the desktop operating system platform in all three alternatives in Table 5-3 reduces the differences in costs considerably: the cost of the Windows platform and, e.g., the client access licenses (CAL) are the same in all alternatives. In addition, the same tools for maintenance and support can be used in all alternatives. The hardware requirements of all alternative software packages on the Windows platform were met by the current desktop computers in the organization. Thus no new hardware acquisitions specific to the software packages were necessary in any of the alternatives. This justified to exclude the desktop hardware costs from the evaluation in this study. In addition to large savings in license costs, Poulsen et al. (ibid.) noted also savings in the replacement of hardware in case the alternative is frequent upgrading of the Microsoft Office suite. Considering the costs related to the compatibility and interoperability in their model, Poulsen et al. did not include extra costs to the open source alternatives in the example migration cases in Danish organizations. The compatibility and

24 http://www.gartner.com (cited 9 June 2010)

interoperability of the open source alternatives were considered acceptable by the Danish organizations in the field tests which were carried out in the study.

The old Lotus SmartSuite software in the starting situation brought some special considerations in this study. These include the licensing bundle with the Lotus Notes software, several application integrations, and the approach to document conversions. Also the training costs were affected by the SmartSuite background: if the old software would have been Microsoft Office in the starting situation, the requirements for training in other alternatives would have been lower.

It should be noted that the cost evaluation period 2006-2011 in Table 5-3 reflected the office software deployment time on the Windows XP platform rather than the exact migration time. Because the actual migration time is shorter than the deployment time, the evaluation of costs includes also regular support and maintenance costs in addition to the costs caused by the migration to the new office software. The total costs in Table 5-3 reflect the sum of cost factors where cost differences were noticed in the study. In a TCO evaluation the total costs would have been higher in all migration alternatives, but the differences in total costs between the alternatives would still have remained the same.

5.2.5 Case studies and open source evaluations

The business case report (Karjalainen, 2005a) presented results and experiences from several migration case studies and evaluations both from Finland and from other European countries. The case studies and evaluations were included in order to provide information concerning the viability of the open source OpenOffice.org migration alternative. Several of these case studies have already been discussed in previous sections. The large-scale open source migration plans of the city of Turku in Finland (Onnela, 2001) were discussed in Sub section 4.2.4. As it turned out, the implementation of the plans was not successful (ITviikko, 2003b). The first successful Finnish small-scale OpenOffice.org migration was completed in 2003 (ITviikko, 2003a) by the Finnish Union of Practical Nurses as discussed in Sub section 4.2.4. In the same sub section, also the open source migration in the Beaumont Hospital in Ireland was discussed. The Beaumont Hospital migration in 2002-2003 was one of the first European publicly reported migration cases where the office suite migration involved a fairly large number of desktop workstations (around 1000) and where the comparative costs of both open source and closed-source solutions were evaluated. The extensive open source migration plans of the city of Munich in Germany were discussed earlier in this chapter. The migration in Munich involves 14 000 desktop workstations which will be migrated to the Linux platform with OpenOffice.org as the office suite (Grassmuck, 2005).

In addition to Munich, also the extensive open source adoption in the Spanish region of Extremadura is internationally widely known. The Extremadura LinEx

website[25] gives information on the progress and achievements of the project. Information on the Extremadura case has also been maintained on the OSOR (formerly IDA) website since 2003, see e.g. (OSOR, 2008d). Also the article by Ghosh (2005) gives a review of the Extremadura LinEx project. The Spanish Region of Extremadura, having approximately one million inhabitants, is the country's poorest region. In fear that the region would miss out the information revolution, the President of the Region Juan Carlos Rodriguez Ibarra launched in 1997 the regional strategy regarding information society. The strategy presented two formal objectives (1) accessibility of Internet as a public service for every citizen and (2) stimulation of technological literacy. The LinEx project (Linux for Extremadura), is derived from this strategy. Its objective is to give universal access of information society tools to all citizens by creating a functional platform based on open source software. In order to provide access to all citizens and not, e.g., just to government officials, inexpensive open source software was seen as the only possibility. The LinEx project concentrated on specific translation and customization of the GNU/Linux platform and supporting software and on the distribution of the resulting tools. The first version of the free gnuLinEx distribution was released in 2002. The release was a success which was also noted internationally as being an indicator of future big changes in ICT. The creation of gnuLinEx received the Computerworld 2003 award of the year. Since the introduction, the open source platform and applications have been adopted on an extensive scale by the entire public sector of the region. According to Ghosh (2005), gnuLinEx was used by over 100 000 desktop computers in schools and in public administration. The government of the region provides installation discs to everyone who is interested. OpenOffice.org is included as the office software suite in the gnuLinEx distribution. Ghosh (2005) reports that 300 000 € has been spent on gnuLinEx (software development, manuals, distribution CD's). Savings, when compared to the deployment of a comparative proprietary software platform in the same extent, are in the order of magnitude of several million Euros. In April 2004, the outstanding achievements of the LinEx project were recognized by the European Union’s Regional Innovation Award in the Information Society category.

The OpenOffice.org migration of the Dutch city of Haarlem was announced in November 2004 (Straat et al., 2004; IDA, 2004c). Further details of the migration can be found, e.g., from the OpenOffice.org roundtable discussion[26]. Close to 2000 Windows workstations were involved in the migration. The city decided to investigate alternatives to Microsoft Office 97 and Office 2000 software when faced with a 500 000 € upgrade cost in software licenses and hardware. With external consultants the city evaluated the functionality of OpenOffice.org version 1.1 in comparison with Microsoft Office 2000. OpenOffice.org compared well with Microsoft Office, and the functionality was adequate to the needs of the City's

25 http://www.linex.org (cited 9 June 2010)

26 http://www.openoffice.org/editorial/roundtable_haarlem.html (cited 9 June 2010)

employees. The main shortcoming of OpenOffice.org regarded its incompatibility with Microsoft VBA macros and the integration with third party software used by the City. After reaching a political agreement with the City Council the migration project was started. The City had previously developed an in-house document generator ("*huisstijl*", meaning "house style") based on Microsoft Office. The migration involved modifications to the document generator to support OpenOffice.org. The investment to the document generator was 50 000 €, and another 50 000 € cost was needed for training. The city of Haarlem runs a mixture of OpenOffice.org and Microsoft Office. A relatively small number of users who depend on specific features continue using Microsoft Office. Expertise within the IT staff of the City facilitated the migration allowing, e.g., parts of the software solution to be developed in-house by the own IT staff. Mr. Jan van de Straat from the IT management of the City has been the initiator and the driving force in the migration.

The first publicly reported OpenOffice.org migration within the Finnish public administration was completed in spring 2004 by the small municipality of Lemi (ITviikko, 2005). The web page maintained by the municipality[27] gives details describing the migration. In the starting situation, the municipality had around 50 Windows workstations, two Windows servers, and Corel WordPerfect Suite 8 as the office software. The Windows servers were replaced by three new Linux servers and some of the Windows workstations were changed to Linux terminals using the LTSP thin client architecture. Migration to OpenOffice.org version 1.1 on all workstations involved user training and conversion of documents. Outside consultants were hired for training and software installations. The original 60 000 € budget for the modernization of the software and hardware was based on the Windows platform and Microsoft Office software. The actual cost of the implementation using open source software was less than 35 000 €. Chief Accountant Pentti Pitkänen from the municipality administration has been the key figure and local champion in the migration.

Some early compatibility and interoperability evaluations were discussed earlier in Sub section 4.2.4. In general, the evaluations concentrated on the interoperability of document exchange between the dominant Microsoft Office suite and the open source alternatives (OpenOffice.org, StarOffice). Because OpenOffice.org and StarOffice share the same program code base, the results obtained using the StarOffice suite are also equally valid for the OpenOffice.org suite. The evaluation released in 2002 by the Danish Board of Technology (Poulsen et al., 2002) concludes that the document format interoperability between StarOffice/OpenOffice and Microsoft Office is high. The interoperability was accepted by the organizations participating the field tests of the Danish study. The study also concludes (p. 77) that open source software represents a serious technical and economic alternative to proprietary software even where there are proprietary industry standards. The field tests of the study were performed using the proprietary doc format of Microsoft

27 http://www.lemi.fi/ (cited 9 June 2010)

Office as the file format for the exchange of word processing documents. As a long term solution to the file format issue the report discusses the development of an XML-based open standard document format for problem-free exchange of documents. Considering the software versions used in the field tests, Microsoft Office 97 and StarOffice 6 (equivalent to OpenOffice.org version 1), XML technology was supported by StarOffice/OpenOffice but not by Microsoft Office 97. The XML evaluation report released by the Swedish Agency for Public Management (Vestin, 2003) was based on the newer version of Microsoft Office (beta version of Word 2003) which had support for XML document format. The tests showed that the implementation of XML support in the programs had differences which prevented the use of XML documents to be exchanged between the programs while maintaining the structure and layout of the documents. For interoperability purposes the report (Vestin, 2003) recommended to still use the proprietary doc format.

The office software study (CNIPA, 2004) released by Italy's National Centre for IT in Public Administration (CNIPA) in September 2004 was based on the latest program versions, Microsoft Office 2003, StarOffice 7, and OpenOffice.org 1.1. The main goal of the study was to identify the advantages and disadvantages for a public administration in the migration from Microsoft Office to an office productivity suite based on open standards. In addition to technical documentation, the results of the study were obtained using field tests and analysis of case studies and best practices collected within the Italian public administration. Overall, the study found all three office productivity suites equally adapted to the usual needs of civil servants. The study highlighted the importance of adequate technical support in order to avoid problems and to prevent negative reception in the migration to the new software. Considering document formats and interoperability, the study concludes that the interoperability of Microsoft Office with other office suites will remain compromised as long as the XML schemas of Microsoft Office are not completely open. Microsoft Office was found in the study to be the best choice for certain categories of users, e.g., for those civil servants who exchange data and complex documents with external organizations.

In United Kingdom, the Office of Government Commerce (OGC) which is an independent office of the United Kingdom's economics and finance ministry, had been coordinating "Proof of Concept" trials on open source software in government during 2003-2004. The final report of the trials (OGC, 2004) was released in October 2004. The objective of the trials was to obtain information from case study situations on the viability of open source software as an alternative to proprietary software. Further issues included the evaluation of costs and benefits and the evaluation of possible obstacles to the implementation of OSS. The functional scope of the trials included the deployment of OSS as a server platform, as a desktop platform, as an office suite on Windows platform, and open source as a replacement to proprietary business applications. Altogether six UK sites participated the trials, and additional five UK sites were contacted by OGC in the preparation of the study.

Considering desktop deployment, the key conclusions of the study are summarized below (OGC, 2004, p. 2).

- Open source software is a viable and credible alternative to proprietary software for infrastructure implementations, and for meeting the requirements of the majority of desktop users.
- The main obstacles to the widespread implementation of OSS for desktop applications are the current lack of complex functionality which can affect ease of migration and interoperability for some organizations.
- The adoption of OSS can reduce the licensing costs and hardware refresh requirements for desktop implementation.
- Adoption of open source, particularly for the desktop, requires investment in planning, training of users, development of skills for implementation and support, and detailed consideration of migration and interoperability issues.

The OGC report concludes that generally open source office suite software is adequate for so called transaction users, whose work is largely procedural and routine, and who constituted typically around 85-90% of the desktop users in the trial sites. OGC recommended that public sector bodies should consider the potential costs and benefits of migration to an open source desktop for transaction users. The interoperability obstacles with complex documents noted by OGC were also reported in the study within Italian public organizations (CNIPA, 2004). According to the OGC report, most trial sites expected to continue to run a "mixed economy" of Microsoft Office and StarOffice/OpenOffice. The Microsoft Office suite would still be supported for tasks which required access to complex facilities not available in the open source alternatives and for tasks where interoperability with Microsoft Office was required due to integrations with external organizations or back-office applications. However, interoperability was not seen as a major issue for most business purposes. Word processing documents could be exchanged in the doc format and also in the pdf format which were both natively supported by StarOffice and OpenOffice.org.

5.2.6 Strengths and weaknesses of the alternatives

The three migration alternatives of the business case were introduced in Sub section 5.2.3 and their costs evaluated in Sub section 5.2.4. Table 5-4, adapted from Karjalainen (2005a, pp. 27-28), summarizes the strengths (+) and weaknesses (-) of the migration alternatives. It should be noted that the evaluation in Table 5-4 is based on the program versions which were available in 2005.

The Lotus SmartSuite column in Table 5-4 depicts the situation where the current office software platform is being deployed as long as possible. Lotus SmartSuite was available on the Windows XP platform but the lack of development of the software

gave reason to expect degrading interoperability with other office suite alternatives. Past experience had shown that security risks related to the SmartSuite software had been low. Due to the version upgrade of SmartSuite, only minor changes were needed in the IT environment which suggested trouble-free migration and low user resistance in the Lotus SmartSuite alternative.

	Lotus SmartSuite	Microsoft Office	OpenOffice.org
Costs 2006-2011	+ Lowest costs	- Highest costs	+ Low costs
Momentum	- No development	+ Active development	+ Active development
Popularity	- Weak market share	+ Dominant market share	- Weak market share
Interoperability	- Degrading interoperability	+ Highest Microsoft Office interoperability	+ High Microsoft Office interoperability
User resistance	+ Low user resistance	+ Low user resistance	- Risk to user resistance
Security	+ Low security risk	- High security risk	+ Low security risk
File format	- Closed proprietary file format	- Partly open proprietary file format	+ Open file format
XML support	- No XML support	+ Strong XML support	+ Strong XML support
Standards compliance	- No support to document standards	- No support to document standards	+ Support to OASIS document standard
Migration considerations	+ Easiest migration, only minor changes in IT environment	- Conversions and integrations needed	- Conversions and integrations needed

Table 5-4. Strengths and weaknesses of the migration alternatives

The various versions of Microsoft Office held over 90% share of the worldwide office suite market (IDA, 2003b). The dominance meant "de facto" interoperability based on the vast majority of users using the same software package. Also strong development effort and XML support were characteristics of the Microsoft Office alternative summarized in Table 5-4. The file format specification of the office suite was not completely publicly available (IDA, 2003b), and there were no activities to support the emerging OASIS open file file format standard discussed in Sub section 5.2.2. Over the years, Microsoft Office had been the target of security attacks, and this situation was not expected to change. The evaluation of costs in Sub section 5.2.4 showed that the Microsoft Office migration alternative had clearly the highest costs during the evaluation period 2006-2011.

The mixed deployment of OpenOffice.org and Microsoft Office in the OpenOffice.org alternative formed a cost effective alternative as shown in the evaluation of costs in Sub section 5.2.4. The interoperability between OpenOffice.org and Microsoft Office had been demonstrated by several international case studies as discussed in Sub section 5.2.5. The specification of the XML file format of OpenOffice.org is publicly available and was the base of international

standardization activities by OASIS. Security vulnerabilities in OpenOffice.org had been rare, and no viruses were known to be "in the wild". For example CERT-FI[28], the Finnish national Computer Emergency Response Team at FICORA (the Finnish Communications Regulatory Authority), issued no vulnerability reports regarding OpenOffice.org during 2004. No vulnerabilities were either reported regarding Lotus SmartSuite, while five vulnerability reports related to Microsoft Office were issued by CERT-FI during 2004. Regarding the weaknesses of the OpenOffice.org alternative in Table 5-4, recent studies (Fitzgerald and Kenny, 2004; CNIPA, 2004) indicated that resistance to change may be expected during the migration. As discussed in Sub section 5.2.1, document conversions and changes to application integrations would be needed both in the OpenOffice.org and Microsoft Office alternatives which suggested more complicated migration when compared to the Lotus SmartSuite alternative.

5.2.7 Recommendations of the business case

The business case report (Karjalainen, 2005a) presented several recommendations, e.g., an extensive migration to OpenOffice.org and the adoption of the XML-based Open Document Format for office documents. The key recommendations of the business case report are summarized in Table 5-5.

Considering the timing of the migration, the recommendations took advantage of the planned migration from the Windows NT 4 platform to Windows XP. The Windows migration involved a complete re-installation of all desktop computers. This gave the opportunity to have OpenOffice.org installed at the same time with all other software installations without causing notable costs related to the OpenOffice.org installation on Windows XP.

– The Ministry of Justice and its administrative sector migrate to the open source OpenOffice.org office suite for 8500 desktop users and to Microsoft Office 2003 for 1500 users.
– The XML-based ODF format is adopted as the office document file format.
– OpenOffice.org is installed on all Windows XP workstations.
– The migration is scheduled to commence from the beginning of 2007 when the migration from Windows NT 4 platform to Windows XP platform has been completed.
– The final migration decision should be reached by October 2005.

Table 5-5. The recommendations of the business case

One of the background assumptions in the recommendations was that the applications based on the Notes/Domino platform would still be deployed during 2006-2011. The evaluation of costs in Sub section 5.2.4 did not assume any major technology changes in the Notes/Domino platform.

28 http://www.cert.fi/index.html (cited 9 June 2010)

The recommendations took the stand that the XM-based ODF file format would be adopted. In the beginning this would mean that the file format is used mostly internally. Other formats supported by OpenOffice.org, like doc and pdf, would most often be used in document exchange with external organizations and citizens. The benefits of the open file format, like ensuring the accessibility of information over long periods of time and avoiding software vendor lock-in, were considered to be of special importance to a public organization like the Ministry of Justice.

It can be noted from the recommendations that a fairly long period of time (over a year) was reserved from the release of the business case report to the suggested start of the migration. This left enough time for the administration of the ministry to properly consider the recommendations. Time was also reserved for the IT organization of the ministry to prepare the migration. Time was needed for pilot project(s) in order to test and validate the recommendations and to prepare software installations, document conversions, and training.

5.3 Reflections of the business case

The business case report (Karjalainen, 2005a) was released as a publicly available report on the website of the Ministry of Justice. The report caught extensive interest being also covered in the IT media (e.g., Tietoviikko, 2005; IDABC, 2005b). The Ministry of Justice was the first large Finnish government organization to seriously and publicly consider adopting an open source office suite. Consequently, the author of this study gave several presentations on the subject in both public and private events (research diary: presentation in a private event on 16 March 2005 organized by the Ministry of Interior and on 8 April 2005 in an event organized by Tietoviikko Magazine and the Finnish Information Society Development Centre TIEKE). In June 2005 the Finnish open source co-operation project OSOS (see Sub section 4.2.3) arranged a public open source office software seminar where the results of the business case were presented (Karjalainen, 2005b). The results were also presented in the Linux and open source seminar in Helsinki in November 2005 (Karjalainen, 2005c).

The migration plans were also discussed with major IT vendors. The migration alternatives involved software supported by IBM, Microsoft Corporation, and Sun Microsystems. Software support and licensing issues were discussed with all these major vendors (research diary: meeting with IBM representatives on 5 April 2005, with Sun representatives on 6 April 2005, and with Microsoft representatives on 4 May 2005). As an additional topic Microsoft expressed interest to have a new evaluation of the Microsoft Office alternative, and the company was willing to cover the expenses of the evaluation. Initial project arrangements between Microsoft and the Office of the CIO of the Ministry were worked out in May and in June 2005, but the project was rejected by the Office of the CIO due to discrepancies regarding the

terms of the project. Later on, Microsoft directly approached the highest ranking permanent officer in the ministry, the Permanent Secretary. A meeting was arranged on 11 October 2005. The meeting was attended by the CEO of Microsoft Finland, Microsoft Sales Director for Finnish public sector, the CFO of the Ministry, and the Permanent Secretary of the Ministry. The Permanent Secretary asked the Office of the CIO also to attend, and so the CIO of the Ministry and the author of this study learned about the meeting and were allowed to attend. The representatives of Microsoft proposed again a productivity analysis project focusing on the Microsoft Office System to be carried out with Microsoft covering the expenses of the project. The business case report of the ministry was criticized by Microsoft, and a response report was being prepared by the company. After the meeting, on 19 October 2005, the Permanent Secretary of the Ministry received a letter from Microsoft. The letter included the Microsoft Office System productivity project plan and a 28 page report criticizing the contents and conclusions of the business case report of the Ministry of Justice. The Permanent Secretary and the CFO of the Ministry responded with a letter on 3 November 2005. The productivity project was declined, and a 11 page response memorandum to the critique was enclosed with the letter. The correspondence, the productivity project plan, and the response reports are available for anyone interested from the public diary of the Ministry of Justice (the diary reference number is OM 46/042/2005).

The presentations and discussions with other organizations and professionals had the positive effect of generating new connections. OpenOffice.org training was a necessity in the pilot project, and an excellent trainer from a local private company was found as the result of the discussions (research diary: first contact with the trainer in the meeting on 8 April 2005). Also services for the open source Moodle e-learning software platform were found through the same contact.

5.4 OpenOffice.org pilot project

Within the administration of the ministry, the recommendations of the business case were initially presented in February and March 2005. The recommendations were first reported by the author of this study to the IT governance co-operation board of the ministry in February 2005 (research diary: presentation in board meeting on 22 February 2005) and to the board of Department Heads of the ministry in March 2005 (research diary: presentation in board meeting on 8 March 2005). More than half a year passed before the administrative organs reached decisions in October and November (research diary: meeting of the IT governance co-operation board on 25 October 2005 and meeting of the board of Department Heads on 1 November 2005). At that point, decisions were made to carry out the OpenOffice.org pilot project and to install OpenOffice.org on all Windows XP desktops. The actual migration decision was postponed until the results of the pilot project would be available. The

administrative organs were cautious not yet to decide on actions which would cause any considerable expenses to the coming years. The top management also wanted to buy more time in order to see if any other large government organization would decide to adopt OpenOffice.org.

Luckily, the delay in the decision-making process actually benefited the migration plans. Version 2 of OpenOffice.org was to be released in May 2005, and the original plan within the IT organization was to start piloting in summer 2005 using the new version. However, OpenOffice.org version 2 did not become available until October 2005. The pilot project based on version 2 of the software could thus be launched just after the decisions of the administration.

Considering the contents of the pilot project, Rogers (2003, p. 423) calls the matching stage as reality testing where the organization's members attempt to determine the feasibility of the innovation in solving the organization's problem and to evaluate the benefits and problems that the innovation will encounter. The open source migration guidelines (IDA, 2003a) which are used here to complement Rogers' framework suggest carrying out pilot project(s) which represent reality testing in a self contained small-scale environment to validate the business and the suggested problem solution. In order to perform reality testing, we considered the following to be the essential contents in the pilot project of the study:

- First of all, the actual use of the innovation requires that the innovation has to be installed in the IT environment of the study organization. Thus the evaluation of software installation and configuration is needed.
- In order to migrate from the current office suite software to the new software solution, the new alternative has be provide the functionalities currently already used. This requires the evaluation of the functionality of the new solution.
- The suggested mixed deployment of OpenOffice.org and Microsoft Office in the OpenOffice.org alternative suggests compatibility evaluation addressing Microsoft and also Lotus SmartSuite which would remain available during the transition period.
- The deployment of the new solution involves user training which suggests the evaluation of training requirements. The deployment also requires user support services which suggests the evaluation of support requirements.

The initial arrangements for the pilot project were started in spring and summer 2005. The first course on OpenOffice.org was given in June by the author of this study (research diary: the first training event on 15 June 2005). The attendees of the course were members from the IT staff of the organization. The course included the basic functionality of OpenOffice.org (Writer, Calc, and Impress) and the installation of the software. The training was based on version 1.1 of the software because

version 2 was not yet available. However, initial familiarity to the software and to the installation details were introduced.

The actual design and arrangements of the pilot project were completed in November and early December 2005. Version 2 of OpenOffice.org had been released, and there were several issues to be addressed concerning the Finnish language support of the software. For example, there was no user guide in the Finnish language for version 2, and also Finnish spelling and hyphenation functionality was not yet available in version 2. Consequently, the pilot project financed the Regional Institute of Northern Satakunta to prepare the first Finnish OpenOffice.org version 2 user guide (the institute had previously prepared a user guide for version 1). The user guide (Ruohomäki, 2005) was released in the beginning of December 2005 and made freely available for anyone interested from the website of the Finnish OpenOffice.org community. The pilot project also contacted a small Finnish software firm to address the spelling and hyphenation issue (research diary: discussion with the CEO of the firm on 10 November 2005). As the result, the Finnish language spelling and hyphenation package ("Soikko") was adjusted to support version 2 of OpenOffice.org. The adjusted Soikko component was released in November and made available as a free add-on to OpenOffice.org from the website of the Finnish OpenOffice.org community.

The preparations for user training were completed in November. The training contact established earlier (see Section 5.3) was used in the design and in the actual implementation of the training. The training design included establishing the Moodle e-learning platform services which became available from the beginning of December in 2005.

The OpenOffice.org installation CD's and instructions for the installation and configuration of the software for the pilot project were prepared by the author of this study in November.

The key persons of the pilot project team were selected from members of the IT staff having experience with word processing, document templates, software installations, and desktop configurations. The author of this study acted as the project leader. The progress of the project was reported to the IT governance co-operation board of the ministry.

The piloting lasted ten months starting from 1 December 2005 to 30 September 2006. Piloting was originally planned to end in June 2006 but delays in the migration to Windows XP extended the timetable by three months till September 2006. The participants included over 150 staff members from four offices from the administrative sector of the ministry. The four pilot offices were the District Court, the District Prosecutor's Office, Legal Register Centre, and ICT Service Centre. Geographically the offices were situated in the Hämeenlinna region in Southern Finland. All participants of the pilot project had previous experience in the use of office suite software, either Microsoft Office or Lotus SmartSuite or both. The offices

represent large user groups in the usage of office software within the administrative sector. The pilot offices also have document exchange with external organizations.

The technical environment of the pilot was the ordinary Windows NT 4 and Windows XP workstation platform of the four offices. Piloting used version 2 of OpenOffice.org. The OASIS ODF standard (OASIS, 2005) had been released in May 2005, and OpenOffice.org supported the ODF format as its default file format. In addition to OpenOffice.org, also Lotus SmartSuite Millennium and Microsoft Office 2003 software packages were used in the pilot project.

The detailed description of the pilot project and its results (Karjalainen, 2006b) was published in October 2006 just after the project was completed in September. The key findings of the pilot project report (Karjalainen, 2006b) are given in the following sub sections. The results of the functionality and compatibility evaluation of OpenOffice.org are presented in Sub sections 5.4.1 and 5.4.2. The results of the evaluation of training and support services are summarized in Sub sections 5.4.3 and 5.4.4. Both user support and technical support services are discussed. In Sub section 5.4.5 we summarize software installation and configuration issues where the pilot project was connected to the simultaneous migration project from Windows NT 4 to Windows XP. In Sub section 5.4.6 we present experiences regarding additional issues like security and resistance to change. Finally, the resources and the cost of the pilot project are summarized in Sub section 5.4.7.

5.4.1 Functionality

The results regarding two important tasks of the piloting, the functionality and compatibility of OpenOffice.org, were published in a separate report (Karjalainen, 2006a). The report analyzes the functionality and compatibility in the form of 87 questions and answers. The questions represent one-to-one all user contacts regarding the use of OpenOffice.org during the course of the pilot project and during the training sessions. The questions were collected from all user contacts to the help desk service and to the IT support personnel. Also discussions during training events were an important source of questions. The report of questions and answers was released in May 2006 and made freely available for anyone interested. It turned out that there was demand for this type of Finnish-language OpenOffice.org handbook both from other organizations and private citizens. Later on the handbook was expanded to cover more questions and it became the most extensive Finnish-language handbook covering OpenOffice.org version 2. The 87 questions of the report (Karjalainen, 2006a) are listed in Appendix. They can be categorized as follows:

- general topics (18 questions);
- text processing (31 questions);
- spreadsheets (23 questions);

- slide presentations (15 questions).

Questions are on different levels of complexity. On the one hand, there are questions on small details like how to make a hanging indent as specified the official Finnish document standard. On the other hand, some questions cover wide topics and require more comprehensive explanations like the management of spelling and hyphenation in foreign languages.

Considering functionality, the questions and answers comprehensively explored the topics of document production in the administrative sector of the Ministry of Justice. Overall, the analysis concluded that the functionality of OpenOffice.org was adequate and covered the needs of the administrative sector in document processing starting from basic document processing functions to more advanced and automated functions (like paragraph and page styles, document templates, and abbreviation handling). Also the requirements in multilanguage document production were met by OpenOffice.org (user interfaces in several languages, spelling and hyphenation in several languages). The support of different file formats was, as a whole, one of the strengths of OpenOffice.org. The software opened and saved file formats used by a large number of programs. A good example was the ease of producing pdf files.

The analysis of the functionality of OpenOffice.org confirmed the results obtained from earlier evaluations (CNIPA, 2004; OGC, 2004; Straat et al., 2004; Kristensen et al., 2005) which concluded that the functionality was adequate for the usual needs in public administration. The earlier evaluations were based on OpenOffice.org version 1 while the evaluation in the pilot project of the Ministry of Justice was based on version 2. The new version had additional functionality which made only logical that a confirmation with earlier evaluations was obtained. The same conclusions were also drawn in simultaneous evaluations using version 2 at Birmingham City Council (iMPOWER, 2006) and Bristol City Council (Beckett, 2005; Beckett and Muller, 2005).

In order to further support the functionality in file format management, the OpenOffice.org piloting platform was installed and configured with *MultiSave* which is a free add-on module to OpenOffice.org. The author of this study knew about MultiSave as the result of an earlier contact to the OpenOffice.org migration project carried out in the French Customs. On 2 June 2005, Department Head Denis Martinez from the IT services of the French Customs gave a presentation in Helsinki in the open source office software seminar organized by the OSOS co-operation project. The presentation (Martinez, 2005) addressed the OpenOffice.org migration of the French Customs, and the open source MultiSave component was introduced in the presentation. MultiSave was developed further in the pilot project in co-operation with the same Finnish software firm which had in November 2005 adjusted the Finnish spelling and hyphenation package Soikko to OpenOffice.org version 2 (research diary: meeting firm representatives on 16 December 2005). Improvements to the original French version of MultiSave included facilities to support multiple

languages and the localization to Finnish. The firm did the actual programming of the improvements with the pilot project testing the new version and financing the development. The adjusted MultiSave was released in January 2006 and made available as a free add-on to OpenOffice.org through the website of the Finnish OpenOffice.org community. With MultiSave, a document can be saved in altogether three formats in different files in one save operation. The formats supported by MultiSave are the three most common formats: ODF, Word/Excel/PowerPoint, and pdf.

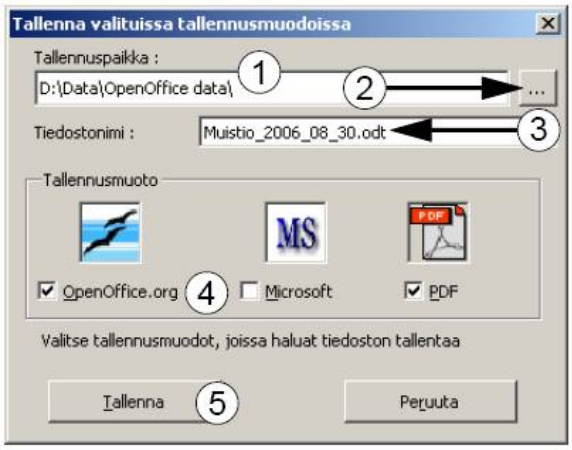

Figure 5-1. MultiSave

Figure 5-1 shows the general idea of multiple saves in the Finnish language version of MultiSave. When the MultiSave icon is activated, the user either types the folder (1) or browses the folder (2) and gives the name for the file to be saved (3). Up to three file formats can be selected for the save operation (4): ODF format (OpenOffice.org), Word/Excel/PowerPoint format (Microsoft), and pdf format (PDF). The save operation is accepted by pressing the save button (5). The example save operation in Figure 5-1 would create two files: one in ODF format and one in pdf format.

Another example of the additional functionality available in OpenOffice.org is *OpenOffice.org Portable*[29]. It provides a complete OpenOffice.org installation on a USB memory stick or any portable storage device. OpenOffice.org Portable can be used in any Windows computer supporting the USB interface. With OpenOffice.org Portable, the functionality of OpenOffice.org can be provided in a Windows desktop without installing OpenOffice.org on the computer. OpenOffice.org Portable is a useful tool for mobile users and for persons wanting to try out OpenOffice.org. Also user support and software support can benefit from OpenOffice.org Portable because many versions of the software can be installed on the USB memory stick and thus a mobile test and support environment with several OpenOffice.org versions can easily

29 http://portableapps.com/apps/office/openoffice_portable (cited 9 June 2010)

be provided. OpenOffice.org Portable is part of the *PortableApps.com* open source platform which is available free of charge from the PortableApps.com website[30]. OpenOffice.org Portable was first used in the pilot project by the project team. Later on USB memory sticks with a ready-made OpenOffice.org Portable installation were also used in targeted marketing by distributing them to key persons in the staff and also to external organizations.

Overall, the results of the functionality analysis of OpenOffice.org in the pilot project can be summarized as follows.

The functionality of OpenOffice.org covered the needs of the administrative sector of the Ministry of Justice. In ordinary tasks, only a small part of the features of the software was utilized. The results confirmed the results from several functionality evaluations based on OpenOffice.org versions 1 and 2.

The pilot project enhanced the functionality of OpenOffice.org by developing further the open source MultiSave add-on module.

Using the question and answer handbook format in the analysis of the functionality and compatibility, the pilot project produced as an offspring a user handbook which became the basis of the most extensive Finnish-language handbook covering OpenOffice.org version 2.

5.4.2 Compatibility

The results regarding the compatibility analysis of OpenOffice.org were published in the same report covering also the analysis of the functionality of the software (Karjalainen, 2006a). In general, the compatibility analysis is more complicated than pure functionality analysis because in addition to the functionality evaluation, the compatibility also addresses user interface issues and the interoperability of documents produced using the programs. A large portion of the OpenOffice.org handbook (Karjalainen, 2006a) is devoted to compatibility issues.

OpenOffice.org version 2 natively supports the ODF file format which was first published as an OASIS standard in May 2005 (OASIS, 2005) and thereafter also as an international ISO standard ISO/IEC 26300:2006 in November 2006 (ISO, 2006). Both Lotus SmartSuite Millennium and Microsoft Office 2003 were based on proprietary file formats. The handbook (Karjalainen, 2006a) gives detailed guidelines for the management of the proprietary file formats used by Lotus SmartSuite and Microsoft Office:

- file formats which OpenOffice.org reads and writes;
- compatibility of OpenOffice.org Writer with Lotus SmartSuite WordPro;
- compatibility of OpenOffice.org Writer with Microsoft Word;

30 http://portableapps.com/ (cited 9 June 2010)

- compatibility of OpenOffice.org Calc with Lotus SmartSuite 1-2-3;
- compatibility of OpenOffice.org Calc with Microsoft Excel;
- compatibility of OpenOffice.org Impress with Lotus SmartSuite Freelance Graphics;
- compatibility of OpenOffice.org Impress with Microsoft PowerPoint.

Overall, the analysis concluded that the compatibility of OpenOffice.org version 2 with different Microsoft Office versions, including Office 2003, was high. OpenOffice.org was able to open and save Word, Excel, and PowerPoint files automatically. During the pilot project, all Word, Excel, and PowerPoint files could be opened and processed with OpenOffice.org. However, documents containing VBA macros were not fully compatible requiring a separate conversion. In ordinary documents VBA macros were rare. With some documents, minor fidelity issues with text and graphics layout could also be noticed. Where necessary, OpenOffice.org could be specified as the default application to open Word, Excel, and PowerPoint files. For migration purposes, OpenOffice.org included a wizard function (*Document Converter*) for the automatic (batch) conversion of Word, Excel, and PowerPoint files to the ODF format. The MultiSave add-on module enabled saving a document simultaneously both in Microsoft Office format and in the ODF format.

The analysis of the interoperability between OpenOffice.org and Microsoft Office confirmed the results obtained from earlier evaluations (Poulsen et al., 2002; Vestin, 2003; Straat et al., 2004; CNIPA, 2004; OGC, 2004) where the interoperability was considered to be adequate for the usual needs in public administration. The earlier evaluations had also found VBA macros and complex documents as main causes of incompatibility in document exchange between OpenOffice.org and Microsoft Office. The new version 2 of OpenOffice.org used in the pilot project did not change the overall interoperability conclusions drawn in the earlier evaluations which were based on OpenOffice.org version 1. The same conclusions on interoperability were also drawn in a simultaneous evaluation using version 2 at Birmingham City Council (iMPOWER, 2006).

The support for the new XML formats introduced by OpenOffice.org and Microsoft Office was too weak to be used as the interoperability solution: neither software package was able to process the XML file format of the other suite. Considering interoperability and document formats, the practical choice was to use the binary formats of the Microsoft Office package in document exchange between OpenOffice.org and Microsoft Office.

The compatibility of the user interface between OpenOffice.org and Microsoft Office was high. This is due to the design strategy of OpenOffice.org to replicate the functionality in the Microsoft Office programs. The symbols and icons in the OpenOffice.org user interface are in many cases similar to those found in Microsoft Office programs. This was already reported by Vestin (2003) in the analysis of the

word processing facilities of the two office suite packages. As noted by Ven et al. (2006), the compatibility improved further with version 2 of OpenOffice.org. Especially the user interface of the Impress presentation program was redesigned to resemble the features of Microsoft PowerPoint. As the result, all three major components of OpenOffice.org, Writer, Calc, and Impress, closely resembled the look and feel of the corresponding programs in Microsoft Office. In spite of high compatibility, there are some tasks which should be performed slightly differently in OpenOffice.org than in Microsoft Office. For example, the formatting of page layout (like page size and orientation, page numbering, headers, and footers) is controlled using page styles in OpenOffice.org. The page style concept does not exist in Microsoft Office. Users have to slightly alter their way of working when formatting a document which often results to requirements for user training and support services.

The interoperability of OpenOffice.org with Lotus SmartSuite was not as high as with Microsoft Office. Lotus 1-2-3 spreadsheet files could be opened directly but word processing files (WordPro) and slide presentations (Freelance Graphics) had to be saved or converted separately to a file format supported by OpenOffice.org. WordPro files could be saved in Microsoft Word doc format and Freelance Graphics files in PowerPoint ppt format which could then be opened by OpenOffice.org. Both WordPro and Freelance Graphics documents thus required manual operations and file format knowledge from the user in order to be able to open and process the documents in OpenOffice.org.

Also the compatibility of the user interface between OpenOffice.org and Lotus SmartSuite was not as high as with Microsoft Office. Clear visible differences in the user interface between Writer and WordPro, Calc and 1-2-3, and Impress and Freelance Graphics can immediately be noticed. The lower level of compatibility both in the interoperability and in the user interface of Lotus SmartSuite places higher requirements to user training in the migration scenario from Lotus SmartSuite to OpenOffice.org when compared to a migration scenario from Microsoft Office to OpenOffice.org.

Differences in the internal compatibility within the alternative office suite packages were noticed in the pilot project. OpenOffice.org was found to have a uniform and consistent functionality throughout the programs included in the package. High internal compatibility reduces learning effort and also training requirements. The high internal compatibility of OpenOffice.org originates from the fact that the software has been developed from the beginning as a complete package. Both Microsoft Office and Lotus SmartSuite originate from separately developed programs which have then been combined into an office suite package. Weaknesses in the internal compatibility could especially be noted in the Lotus SmartSuite package.

Overall, the results of the compatibility analysis of OpenOffice.org in the pilot project can be summarized as follows.

The compatibility of OpenOffice.org with the different Microsoft Office versions, including Office 2003, was high. OpenOffice.org was able to open and save Word, Excel, and PowerPoint files automatically. Where necessary, OpenOffice.org could also be specified as the default application to open Word, Excel, and PowerPoint files. The results confirmed the results from other compatibility evaluations based on OpenOffice.org versions 1 and 2. In spite of high compatibility of the user interface, there were some tasks which should be performed slightly differently in OpenOffice.org than in Microsoft Office.

The compatibility between OpenOffice.org and Lotus SmartSuite was only partly automatic. The interoperability required that users knew which file formats were supported by the software packages and that users were able to perform document save and open operations accordingly.

5.4.3 Training

In general, the importance of training has been recognized in the traditional IS literature, e.g., by Nelson and Cheney (1987) whenever introducing a new software application to end-users. Also previous case studies on OpenOffice.org (Rossi et al., 2005; Ven et al., 2006) have emphasized the importance of user training. In their assessment of information technology and organizational learning Robey et al. (2000) conclude that learning is accomplished through both formal training and participation in practice. In addition of training to increase the proficiency of end-users with the software, OpenOffice.org studies (Rossi et al., 2006; Ven et al., 2006) have emphasized the importance of training also in increasing user acceptance of the software. Ven et al. (2006) also noted that training had effects on user support: users who reported not having attended training sessions also reported more problems in using OpenOffice.org.

In the pilot project of the Ministry of Justice, altogether 18 OpenOffice.org training sessions were arranged for a total of 164 participants. The first training sessions were given in the beginning of the pilot project in December 2005 (research diary: the first training event on 9 December 2005). Each session lasted one day for a maximum group size of 15 persons. The majority of the sessions (16) was targeted on basic functionalities of OpenOffice.org, especially on the facilities in word processing. In two training sessions the focus was on document templates and forms. One-day training proved to be sufficient in the pilot project to acquire basic skills in the use of OpenOffice.org. Teachers from outside training service providers were used for most of the sessions. Also in-house training given by the author of this study was arranged. The participation to all training sessions was voluntary.

OpenOffice.org training day - goals

- Understanding overall functionality of OpenOffice.org
- Basic skills in the use of OpenOffice.org

Prior knowledge

- Experience in the use of some office suite software

General topics

- Network learning environment for OpenOffice.org (Moodle)
- What is OpenOffice.org?
- File formats: ODF, XML, pdf, doc/xls/ppt
- Installation procedure of OpenOffice.org
    - Path settings for own documents and templates

Word processing - Writer

- Writer interface: Title bar, Menu bar, Standard toolbar, Formatting toolbar, Status bar
- File management: open/save, ODF, pdf, doc-files, lwp-files, MultiSave
- Inserting and modifying text, copy/paste, copy/paste special
- Practicing
- Styles and formatting, paragraph styles: Default, Body text
- Heading styles: Heading 1, Heading 2, Heading 3
- Page styles: Default, First page
- Spelling and hyphenation
- Document templates
- Tab stops, indents, bullets and numbering, inserting tables and pictures
- Practicing

Spreadsheets - Calc

- Calc interface: Title bar, Menu bar, Standard toolbar, Formatting toolbar, Formula bar, Status bar
- File management: open/save, ODF, pdf, xls-files, 123-files, MultiSave
- Cell references, series, AutoFill
- Functions and formulas, SUM function
- Inserting a chart
- Page and cell area formatting
- Borders, background, print scale adjustment
- Practicing

Slide presentations - Impress

- Impress interface: Title bar, Menu bar, Standard toolbar, Line and Filling toolbar, Drawing toolbar, Status bar
- File management: open/save, ODF, pdf, ppt-files, MultiSave
- Adding and modifying slides, using slide designs
- Master slides
- Slide transition effects
- Practicing

Questions and answers

Table 5-6. Basic OpenOffice.org training day

The framework shown in Table 5-6 was designed in the pilot project for the contents and structure of a basic OpenOffice.org training day. As noted in the framework, the participants are assumed to already have prior experience in the use

of an office suite package (in practice, either Microsoft Office or Lotus SmartSuite). In addition to the main functions in word processing, spreadsheets, and slide presentations, the emphasis of the training is in file management and compatibility issues.

Previous OpenOffice.org studies (Zuliani and Succi, 2004; Ven et al., 2006) suggest that training should be followed by practical work with the software as soon as possible. In order to achieve this goal in the pilot project, a general practice was that the students completed the OpenOffice.org installation on their regular workstations by themselves after the training sessions. The installation procedure was one of the subjects of the training session, and the author of this study had prepared instructions and an installation CD-ROM which were handed out to the students. The installation was supported by an expert who was present during the installation to solve possible problems. The arrangements made it possible to activate the first OpenOffice.org session on the workstation immediately after the installation and to have a short discussion with the user. Practical experience in the installation was also considered helpful in order to encourage persons to do installations on their home computers. These start-up arrangements were facilitated by the limited number of participants in the pilot project and the rather long time period reserved for the piloting. The training practice discussed by Ven et al. (2006) also included installation CD-ROM's handed out to the participants after the training sessions. The practice to include installation media in training materials is a concrete way to demonstrate participants the benefits of OSS.

In order to further support training and user support, a browser-based OpenOffice.org e-learning platform was established in the pilot project. The platform was based on the open source Moodle software. It contained, e.g., frequently asked questions, handbooks, training materials as well as discussion pages. The e-learning platform was used and maintained also after the pilot project during the actual migration. In October 2008, the e-learning platform contained 280 subject titles and 480 document files. An example screen of the migration intranet is shown in Figure 5-2. The screen shows main headings for discussions, frequently asked questions (FAQ), training, and Finnish-language support materials. The material in the e-learning platform is categorized under the following main headings:

- Discussions;
- Frequently Asked Questions;
- Training materials;
- Migration support materials (Finnish and Swedish);
- Migration support materials (English);
- Migration project (administration, migration wiki, news);
- OpenOffice.org (product information, product news).

Figure 5-2. An example screen of the OpenOffice.org e-learning platform

The OpenOffice.org study by Ven et al. (2006) reported shortcomings in the user documentation of OpenOffice.org concerning the Dutch language community. Shortcomings concerning the user documentation in Finnish were also experienced in the pilot project of the Ministry of Justice. The pilot project started with the new version 2 of OpenOffice.org which initially had no user guide in Finnish. As already noted in Section 5.4, the pilot project financed the Regional Institute of Northern Satakunta to prepare the first Finnish user guide on OpenOffice.org version 2. The user guide (Ruohomäki, 2005) was released in the beginning of December and made freely available for anyone interested.

The pilot project also financed another Finnish user guide which targeted on advanced topics such as the design of document templates in OpenOffice.org Writer. This type of user guide was considered necessary for advanced users who prepare base document templates to be used by end-users in the offices. Document templates which were designed from the beginning using pure OpenOffice.org functionalities were considered the preferred method when compared to automatic conversion from old Microsoft Word or SmartSuite WordPro templates. Conversions result in documents which internally still may contain hidden structures from original source documents which in turn may produce unwanted behavior to end-users. The template

design guide (Grönroos, 2006) was released in April 2006 and made freely available through the Finnish OpenOffice.org website. Later on during the actual migration project, the template design guide was developed further to cover topics like form design and the implementation of templates complying with the Finnish document standard SFS 2487. Also the new guide (Grönroos, 2007) was made freely available through the Finnish OpenOffice.org website.

As noted earlier in Sub section 5.4.1, the results concerning the analysis of the functionality and compatibility of OpenOffice.org were published in the report of questions and answers (Karjalainen, 2006a). During the pilot project the report was developed further to serve as a Finnish OpenOffice.org handbook for end-users in the possible migration of the Ministry of Justice. The new handbook (Karjalainen and Karjalainen, 2006) was released in October 2006 and made freely available through the Finnish OpenOffice.org website. Later on during the actual migration project, the handbook was again developed further to serve as a general-purpose Finnish OpenOffice.org handbook. The new handbook (Karjalainen and Karjalainen, 2007) became the most extensive Finnish-language handbook covering OpenOffice.org version 2. It was released in August 2007 and made freely available through the Finnish OpenOffice.org website.

The website of the OpenOffice.org documentation project[31] had plenty of excellent English user documentation which was also used extensively during the pilot project. The English handbooks were not useful for regular end-users due to language barriers but more advanced users were able use them as detailed reference guides. Overall, the following user documentation was used during the pilot project:

- OpenOffice.org Express Guide by Ruohomäki (2005), in Finnish;
- OpenOffice.org Template Guide by Grönroos (2006), in Finnish;
- OpenOffice.org Handbook of Questions and Answers by Karjalainen (2006a), in Finnish;
- Getting Started Guide, general introductory guide produced by the OpenOffice.org documentation project, in English;
- Writer Guide, text processing guide produced by the OpenOffice.org documentation project, in English;
- Migration Guide, introductory user guide featuring Microsoft Office migrations, produced by the OpenOffice.org documentation project, in English.

Overall, the results of the OpenOffice.org training in the pilot project can be summarized as follows.

31 http://documentation.openoffice.org/ (cited 9 June 2010)

The framework for the contents of the basic OpenOffice.org training day was designed and tested in practice during the pilot project. One-day training proved to be sufficient to acquire basic skills in the use of OpenOffice.org when the participants already had previous experience in the use of an office suite package. As part of the training, the participants were guided to install OpenOffice.org on their workstations. This procedure facilitated practical work with the software immediately after the training. Together with installation media and instructions which were handed out to participants, the procedure also supported possible installations on home computers. The pilot project initiated the Finnish user documentation of OpenOffice.org version 2. Several handbooks, both basic and advanced, were produced as the result of the pilot project. The user documentation was made freely available for all interested parties.

5.4.4 Support services

One of the tasks of the piloting was the evaluation of requirements to support services. In addition to user support services, also the need for technical support services was evaluated in the pilot project.

As noted by Ven et al. (2006) in the OpenOffice.org migration in the Brussels public administration, training had effects on the requirements for user support: users who attended OpenOffice.org training sessions had less problems in using OpenOffice.org than users who did not attend. Also the availability of handbooks and various additional tools supporting the training influenced the need for user support. The arrangements affecting user support during the pilot project are summarized in Table 5-7.

– Basic one-day OpenOffice.org training for each person
– Additional training day on document templates for selected persons
– Handbooks (both in Finnish and in English)
– Browser-based OpenOffice.org e-learning environment
– Document templates complying with the Finnish document standard SFS 2487
– User support service agreement with a third-party service provider

Table 5-7. User support arrangements in the pilot project

The IT service function of the Ministry of Justice employs 120 persons including, e.g., technical support and a centralized help desk service. To strengthen the OpenOffice.org user support during the piloting, a support service contract with a third-party service provider was made.

Past experience with office suite software had shown that almost all user support tasks could be solved by the own IT staff of the Ministry of Justice. The Lotus SmartSuite and Microsoft Office software packages had been in use for almost ten years, and the number of problem contacts to IBM and Microsoft software support had been very rare. The same was experienced during the ten months of the pilot project: there were only two problem contacts to the third-party service provider (and even these two could have been solved by the own IT staff). The detailed list of all user questions presented during the pilot project is given in Appendix. The questions represent one-to-one all user contacts regarding the use of OpenOffice.org. The questions were collected from user contacts to the help desk service and to the IT support personnel during the course of the pilot project and during the training sessions. As noted earlier in Sub section 5.4.3, the questions and the corresponding answers were further developed into a Finnish OpenOffice.org user handbook by the pilot project.

Considering technical support, several OpenOffice.org versions were installed and updated during the pilot project. Both standard installations from the installation CD-ROM's and silent installations based on Microsoft Windows Installer technology and systems management software were used. The documentation which was available from the website of the OpenOffice.org documentation project proved to be sufficient for the management of installations. External expert advice was used twice during the pilot project: once in the preparation of the recommended user settings of OpenOffice.org (the various options in the *Tools* menu) and once in the modification of the *setup.xcu* file in order to customize the settings of the default text template.

Overall, the conclusions regarding the evaluation of support services in the pilot project can be summarized as follows.

There is no need for a continuous help desk contract with a third-party service provider for OpenOffice.org user support. The need for external user support services occurs seldom, and expert services should be acquired on a case-by-case basis.

The installation and maintenance of OpenOffice.org software can be done as internal work by the IT staff of the Ministry of Justice. Third-party technical support services should be acquired on a case-by-case basis.

5.4.5 Software installations and configurations

During the piloting, several installation packages were designed and deployed using OpenOffice.org versions ranging from version 2.0.0 to version 2.0.3. A special installation model based on OpenOffice.org version 2.0.2 was prepared in March 2006 for the installation of OpenOffice.org on the Windows XP platform on all 10 000 workstations of the Ministry of Justice and its administrative sector. The installation model was published in September 2006 as a freely available, general-

purpose OpenOffice.org engineering handbook which gave guidelines in several installation issues (Friman and Karjalainen, 2006). It was written to serve both private persons and organizations in the installation and possible migration to OpenOffice.org. The installation model consisted of the entities shown in Table 5-8.

– Basic installation of the Finnish-language OpenOffice.org version 2
– Recommendations on OpenOffice.org user settings
– Installation of the Swedish language pack to enable the Swedish user interface
– Installation of the Finnish spelling and hyphenation
– Installation of the Swedish spelling and hyphenation
– Installation of spelling and hyphenation for foreign languages
– The design and installation of a customized default text template
– Installation of the MultiSave add-on module
– Installation of the clip art library
– OpenOffice.org settings for Swedish-language offices

Table 5-8. The OpenOffice.org installation model on the Windows XP platform

The installation model and software configuration supported both Finnish and Swedish which are the two official languages of Finland. In addition to spelling and hyphenation in Finnish and Swedish, the bilingual language support included the choice of the OpenOffice.org user interface language which could be selected on the fly by the user. As already discussed in Sub section 5.4.1, the pilot project developed further and localized the MultiSave add-on module which was also included in the installation model. The text default template in the OpenOffice.org configuration was customized to support the Finnish document standard SFS 2487.

In terms of design science research as defined by March and Smith (1995) and Hevner et al. (2004), the installation model and software configuration of OpenOffice.org in Table 5-8 is an example of the instantiation of an artifact produced by the pilot project. In this case the artifact is based on the OpenOffice.org software. The instantiation is the realization and customization of the artifact for the actual deployment in the environment of the Ministry of Justice. Following Hevner et al. (ibid.), artifact instantiation demonstrates the feasibility of the design process and of the designed product.

As discussed in Sub section 5.4.3, the training arrangements of the pilot project included guided OpenOffice.org installations performed by the participants of the training. Instructions and installation CD-ROM's for this purpose had been prepared in the pilot project by the author of this study.

OpenOffice.org Portable, discussed in Sub section 5.4.1, was first used in the pilot project by the project team as a mobile OpenOffice.org installation and test environment. This USB memory stick version of OpenOffice.org was then localized

and customized in the pilot project to follow the installation and configuration model depicted in Table 5-8. Approximately 30 ready-made OpenOffice.org Portable USB memory sticks were then given to decision makers and other key persons in the staff during the pilot project.

Overall, the results regarding OpenOffice.org installations and configurations in the pilot project can be summarized as follows.

OpenOffice.org installation and configurations models based on several OpenOffice.org versions were designed and deployed in the pilot project. In addition to the deployment in the pilot project, the installation model to be also deployed on all 10 000 Windows XP workstations of the organization was designed. As a special OpenOffice.org installation, a localized version of OpenOffice.org Portable on USB memory sticks was prepared and distributed in the pilot project.

Engineering documentation covering OpenOffice.org installations was produced in project. The documentation was made freely available for all interested parties.

5.4.6 Other issues

Before the pilot project, reported OpenOffice.org *security vulnerabilities* had been rare. Secunia[32], a Danish company specializing to software vulnerability analysis, had issued altogether five vulnerability advisories related to OpenOffice.org software during the years 2002-2005. No security attacks based on OpenOffice.org or the ODF file format were experienced during the OpenOffice.org pilot project. However, some vulnerability reports were issued during 2006. The OpenOffice.org Security Team[33] issued altogether four security bulletins and four software patches to OpenOffice.org version 2 during 2006. Secunia issued two vulnerability advisories related to OpenOffice.org version 2 during the same time. CERT-FI, the Finnish authority specializing on information security threats, issued in 2006 a Java software vulnerability which could also affect OpenOffice.org.

Recent studies on OpenOffice.org migrations (Fitzgerald and Kenny, 2004; Rossi et al., 2006; Ven et al., 2006) had indicated that *resistance to change* may be expected during migrations. The importance of training, user support and document conversions had been emphasized in studies by Rossi et al. (ibid.) and Ven et al. (ibid.) in order to increase user acceptance of the software. The pilot project organized basic OpenOffice.org training days to all participants of the project and specialized training days to more advanced users. User support arrangements included the establishment of a browser-based OpenOffice.org e-learning platform and support service resources provided by a contract with an external firm. In-house support was provided by the project team, e.g., in the design and implementation of

32 http://secunia.com/ (cited 9 June 2010)

33 http://www.openoffice.org/security/ (cited 9 June 2010)

document templates for the participating offices. Special attention was given to develop and provide both Finnish OpenOffice.org user handbooks and engineering documentation. Incidents showing or indicating user resistance during the pilot project were rare which is in line with the above actions to increase user acceptance. However, because participation in the project was voluntary, definite conclusions concerning user acceptance of OpenOffice.org were not made in the pilot project which concentrated on functionality and compatibility evaluations. It can be noted that voluntary measures in the initial phases of OpenOffice.org adoption were also recommended by Rossi et al. (ibid.) in their migration study.

Experiences regarding security vulnerabilities and user acceptance or resistance during the pilot project can be summarized as follows.

No security attacks related to the OpenOffice.org software or to the ODF format occurred during the piloting.

Incidents implying resistance to change during the piloting were rare. The experiences supported the importance of actions recommended in other studies to increase user acceptance.

5.4.7 Resources and the cost of piloting

The work effort of the in-house pilot project team was originally estimated to be 150 person days between 1 December 2005 and 30 June 2006. As the piloting was extended by three months until 30 September the amount of work was increased to a total of 250 person days in order to finalize the publications to be produced by the pilot project.

The cost of the pilot project was initially estimated to be 45 000 €. The estimated costs included third-party training and consulting services, purchase of handbooks and other materials, hardware and software costs as well as support service costs. The final costs were 41 000 € divided as shown in Table 5-9.

Manuals and other materials	13 000 €
Purchase of training services	9 000 €
Purchase of support services	11 000 €
Purchase of consulting services	8 000 €
Hardware and software	0 €
Costs total	**41 000 €**

Table 5-9. Piloting costs

The costs in Table 5-9 represent so called budget-relevant costs, i.e. costs resulting from the pilot project. Not-budget-relevant costs, i.e. costs occurring to the

same amount even without the project in question, are not included in the table. The costs of the in-house work, 250 person days, are not-budget-relevant costs and thus not shown in Table 5-9.

The highest budget-relevant costs, 13 000 €, were caused by various expenses related to handbooks. The pilot project initiated the Finnish OpenOffice.org version 2 user manuals and engineering handbooks. If the Finnish documentation would have been available in the beginning, some costs could have been avoided. The piloting was implemented in the regular IT environment in the participating offices. No additional hardware or software purchases were needed to carry out the pilot project.

5.5 Review

The matching stage of the study began in February 2004 when planning activities to fit the innovation to the needs of the organization were started. Rogers (2003, p. 424) considers the matching as a particular type of compatibility of the innovation. The compatibility of OpenOffice.org was discussed in general in Section 5.1 following Rogers' definition of the five key perceived attributes of innovations. In the detailed contents of the matching stage, we complemented Rogers' innovation framework by applying the open source migration guidelines of the IDA programme (IDA, 2003a). Following the guidelines, the two main activities of the matching stage were composed of the building of the business case for the migration in Section 5.2 and the design and implementation of the pilot project in Section 5.4 to test and validate the business case and the suggested problem solution. The contents of the business case followed the structure suggested in the open source migration guidelines (IDA, 2003a). The business case report was completed and published in March 2005 (Karjalainen, 2005a). We designed the actual contents of the pilot project by reasoning from the requirements for performing reality testing of the business case in the pilot project. The pilot project was started in December 2005 and it lasted till the end of September 2006. The final report of the pilot project was published in October 2006 (Karjalainen, 2006b). The time period of the matching stage was thus fairly long, two and half years from February 2004 till October 2006. The duration of the matching stage was lengthened by the long time of the administrative organs to reach decisions and by the delays in the simultaneous migration to the Windows XP platform.

The matching stage aimed at transparency of the outcome of the stage so that the results could easily be used and evaluated also by outsiders. The results were published in the Internet freely available for all interested parties. The business case report (Karjalainen, 2005a) of the matching stage was released in March 2005. The publications covering OpenOffice.org documentation included both OpenOffice.org user handbooks (Karjalainen, 2006a; Karjalainen and Karjalainen, 2006) and engineering documentation (Friman and Karjalainen, 2006). The final report of the

OpenOffice.org pilot project was published in October 2006 (Karjalainen, 2006b). The Finnish OpenOffice.org website was used to deliver also other deliverables of the project like the localized MultiSave add-on module and various document templates complying with Finnish standards for office documents.

5.5.1 Review of the business case

The following list summarizes the main results and findings of the business case of the matching stage.

- The analysis of the office software environment within the Ministry of Justice and its administrative sector showed a diverse set of office products being deployed. The yearly maintenance and support costs of office suite software were included in the analysis. Main integrations between office suite software and back-office application were also included in the analysis.
- The analysis of document formats in the European level showed that support for open document formats in office productivity software was favored in the European level recommendations targeting public sector organizations. The technological platform for open document formats was clearly based on XML technology. National Finnish recommendations favor open interfaces and standards and consider also open source solutions as viable platform alternatives.
- Three migration alternatives were chosen and presented in the business case. The Lotus SmartSuite alternative represented the current software solution, characterized as a "business as usual" alternative. The Microsoft Office alternative involved a complete migration to Microsoft Office 2003. The OpenOffice.org alternative represented a mixed environment where the majority of desktop users (85 %) would be migrated to OpenOffice.org and the rest to Microsoft Office 2003. A complete migration to OpenOffice.org for all desktop users was not considered a practical alternative, e.g., due to the Microsoft technology based integrations in the document handling applications mandated by the Finnish Government.
- The costs of the migration alternatives were evaluated using a 6-year cost evaluation period 2006-2011. The cost factors of the evaluation included license purchases, software maintenance, training, support, document conversions, and modifications to back-office application integrations. The 6-year costs in the Microsoft Office alternative amounted to a total of 9.8 M€, in the OpenOffice.org alternative to 4.2 M€, and in the Lotus SmartSuite alternative to 2.9 M€. Following the approach used in the economic analysis of open source migrations in the study of the Danish Board of Technology (Poulsen et al., 2002), the evaluation of costs concentrated on the parts of the

cost structure where differences between the migration alternatives could be found.

- Results and experiences from several open source migration case studies were presented in order to provide information concerning the feasibility and viability of the OpenOffice.org migration alternative. The case studies included two internationally widely known European open source migrations, the German city of Munich and the Spanish region of Extremadura. The OpenOffice.org migration of the Dutch city of Haarlem represented the same type of mixture of OpenOffice.org and Microsoft Office as the open source alternative in this study. The migration of the small Finnish municipality of Lemi in 2004 was the first publicly reported OpenOffice.org migration within the Finnish public administration. The importance of top management support in the migration was emphasized in the case studies.
- Independent evaluations (Poulsen et al., 2002; OGC, 2004) concluded that OpenOffice.org is a serious technical and economic alternative to proprietary software, and for meeting the requirements of the majority of desktop users. The implementation of XML support in Microsoft Office and the open source counterparts had differences which prevented the use of XML documents to be exchanged between the programs. For interoperability purposes the evaluation by Vestin (2003) recommended to still use the proprietary file formats of the Microsoft Office suite. Document format interoperability between OpenOffice.org and Microsoft Office was found to be high and adequate to the usual needs of users. The evaluations by OGC (2004) and CNIPA (2004) noted that Microsoft Office was needed for certain categories of users, e.g., for those civil servants requiring access to complex facilities not available in the open source alternatives and for tasks where interoperability with Microsoft Office was required due to integrations with external organizations or back-office applications. These conclusions support the migration alternative to deploy a mixed office suite environment involving both OpenOffice.org and Microsoft Office.
- The strengths and weaknesses of the three migration alternatives were presented in the business case. The Lotus SmartSuite alternative had the lowest costs of the alternatives. The lack of development of Lotus SmartSuite gave reason to expect degrading interoperability with other office suite alternatives. Microsoft Office, the dominant office suite market leader, had "de facto" interoperability built-in and strong XML support. On the negative side, the Microsoft Office alternative had clearly the highest costs and notable security risks. The OpenOffice.org alternative formed a cost effective solution supporting open XML-based file format which was also the base of international standardization activities. On the negative side, studies had indicated that resistance to change may be expected in this alternative.

- The following summarizes the key recommendations of the business case.
  - The Ministry of Justice and its administrative sector migrate to the open source OpenOffice.org office suite for 8500 desktop users and to Microsoft Office 2003 for 1500 users.
  - The XML-based ODF format is adopted as the office document file format.
  - OpenOffice.org is installed on all Windows XP workstations.
  - The migration is scheduled to commence from the beginning of 2007 when the migration from Windows NT 4 platform to Windows XP platform has been completed.
  - The final migration decision should be reached by October 2005.

The incidents in October and November 2005, described in Section 5.3, confirmed the importance of top management support. The support shown by the highest ranking officers of the Ministry of Justice allowed the matching stage and the pilot project to be completed without unnecessary pressure and influences caused by outside organizations. Top management support was already emphasized in the open source migration guidelines of the IDA programme (IDA, 2003a) and further confirmed in several early migration case studies, both domestic (ITviikko, 2003a) and foreign (Fitzgerald and Kenny, 2004; Grassmuck, 2005).

5.5.2 Review of the pilot project

Important tasks in the OpenOffice.org pilot project included to in practice test the functionality of OpenOffice.org for the tasks of the administrative sector and the compatibility of OpenOffice.org with Lotus SmartSuite and Microsoft Office software. The following list summarizes the key results and findings of the pilot project.

- The functionality of OpenOffice.org covered the needs of the administrative sector of the Ministry of Justice. In ordinary tasks, only a small part of the features of the software were utilized. The results confirmed the results from several functionality evaluations based on OpenOffice.org versions 1 and 2. As a byproduct the pilot project enhanced the functionality of OpenOffice.org by developing further the open source MultiSave add-on module. Using the question and answer handbook format in the analysis of the functionality and compatibility, the pilot project produced as an offspring a user handbook which became the basis of the most extensive Finnish-language handbook covering OpenOffice.org version 2.

- The compatibility of OpenOffice.org with the different Microsoft Office versions, including Office 2003, was high. OpenOffice.org was able to open and save Word, Excel, and PowerPoint files automatically. Where necessary, OpenOffice.org could also be specified as the default application for Word, Excel, and PowerPoint files. The results confirmed the results from other compatibility evaluations based on OpenOffice.org versions 1 and 2. In spite of high compatibility of the user interface, there were some tasks which should be performed slightly differently in OpenOffice.org than in Microsoft Office. The compatibility between OpenOffice.org and Lotus SmartSuite was only partly automatic. The interoperability required that users knew which file formats were supported by the software packages and that users were able to perform document save and open operations accordingly.
- The framework for the contents of the basic OpenOffice.org training day was designed and tested in practice in 16 training events during the pilot project. One-day training proved to be sufficient to acquire basic skills in the use of OpenOffice.org when the participants already had previous experience in the use of an office suite package. As part of the training, the participants were guided to install OpenOffice.org on their workstations. This procedure facilitated practical work with the software immediately after the training. Together with installation media and instructions which were handed out to participants, the procedure also supported possible installations on home computers. The pilot project initiated the Finnish user documentation of OpenOffice.org version 2. Several handbooks, both basic and advanced, were produced as the result of the pilot project. The user documentation was made freely available for all interested parties. In order to further support training and user support, a browser-based OpenOffice.org e-learning platform was established by the pilot project. The platform was based on the open source Moodle software.
- Regarding support services, the pilot project concluded that there is no need for a continuous help desk contract with a third-party service provider for OpenOffice.org user support. The need for external user support services occurs seldom, and expert services should be acquired on a case-by-case basis. The pilot project also concluded that the installation and maintenance of OpenOffice.org software can be done as internal work by the IT staff of the Ministry of Justice. Third-party technical support services should be acquired on a case-by-case basis.
- OpenOffice.org installation and configurations models based on several OpenOffice.org versions were designed and deployed in the pilot project. In addition to the deployment in the pilot project, the installation model to be also deployed on all 10 000 Windows XP workstations of the organization was designed. As a special OpenOffice.org installation, a localized version of OpenOffice.org Portable on USB memory sticks was prepared and distributed

in the pilot project. Engineering documentation covering OpenOffice.org installations was produced in project. The documentation was made freely available for all interested parties.

- No security attacks related to the OpenOffice.org software or to the ODF format occurred during the piloting.
- Incidents implying resistance to change during the piloting were rare. The experiences supported the importance of actions like training, user support, and document conversions recommended in other studies to increase user acceptance.

The installation model and software configuration of OpenOffice.org as depicted in Table 5-8 defined the instantiation of the OpenOffice.org artifact produced by the pilot project. In addition to the deployment in the pilot project, installations following the model were implemented on all 10 000 Windows XP workstations of the organization. In terms of design science research as defined by March and Smith (1995) and Hevner et al. (2004), the instantiation was the realization and customization of the artifact for the actual deployment in the IT environment of the Ministry of Justice. Following Hevner et al. (ibid.), the instantiation of the artifact demonstrates the feasibility of the design process and of the designed product. The evaluation of the instantiation in design science research is based on the guidelines summarized in Table 3-2. Guideline 3 in the table, design evaluation, requires the utility, quality, and efficacy of the design artifact to be rigorously demonstrated via well-executed evaluation methods. The basic feasibility of the instantiation was confirmed by the pilot project and by the results concerning the functionality and compatibility of the instantiation, together with the development of the localization features and tools to support the deployment of the instantiation in the target environment. However, further evaluation is needed to assess the utility, quality and efficacy of the instantiation in the actual large-scale deployment.

5.5.3 Observations concerning the research framework

An important observation could be made during the matching stage concerning the research framework of the study. The innovation process in an organization has five consecutive stages as depicted in Figure 3-4 in Sub section 3.2.2. The matching stage belongs to the initiation subprocess which is followed by the implementation subprocess. According to Rogers (2003, p. 420), "*later stages in the innovation process cannot be undertaken until earlier stages have been completed, either explicitly or implicitly*". However, this was not confirmed by the events of the matching stage in this study. As noted in Section 5.4, the pilot project was authorized to design the OpenOffice.org installation and configuration model to be deployed on all 10 000 Windows XP workstations of the organization. Migration from Windows

NT 4 to the Windows XP platform occurred simultaneously with the OpenOffice.org pilot project with the consequence that simultaneously with the pilot project, OpenOffice.org was being installed on the Windows XP desktops. Rogers (ibid., p. 421) defines the implementation subprocess "*consisting of all of the events, actions, and decisions involved in putting the innovation into use*". The events from the pilot project showed that some decisions and actions of the implementation subprocess were undertaken before the matching stage of the initiation subprocess was completed. In this study, especially the characteristics of the open source software with no-cost licenses supported the activities to undertake implementation actions before the matching stage was completed. In case of a commercial software with regular license fees to be paid for each workstation installation, the same order of actions would have been highly unlikely.

Following the logic of syllogistic reasoning as presented by Lee and Hubona (2009), the above contradiction is an example of *modus tollens* in the empirical testing of theories. Modus tollens is applied in the empirical inquiry of science to major premises of the form “if *p* is true, then *q* is true” where *p* denotes a theory and *q* denotes facts or data that the researcher expects. Modus tollens applies to minor premises of the form "*q* is not true". The conclusion of modus tollens states "therefore *p* is not true". Modus tollens thus calls the theory *p* to be improved or replaced. The major premise concerning the framework of this study can be stated as follows: if "the stages of the innovation process are consecutive with no concurrency" is true, then "the stages of the innovation process in this study are consecutive with no concurrency" is true. The minor premise in this study took the form "the stages of the innovation process in this study are consecutive with no concurrency" is not true. The logical conclusion of modus tollens in this case thus states: therefore, "the stages of the innovation process are consecutive with no concurrency" is not true.

In general, the incompleteness of stage models was already noted by Mohr (1982) who described stage models as incomplete process models, because they generally lack specification of the mechanism by which subsequent stages come about. Rogers (2003, p. 195) admits this by noting that definitive answer to the existence of the stages is impossible to provide and that sharp distinctions between each stage should not be expected. This was noted by Rogers regarding the innovation-decision process (see Figure 3-3 in Sub section 3.2.1), but the evidence from this study suggests that it also applies to the innovation process in organizations.

The above contradiction in the research framework of the study actually sparked the research also to address the issue of testing Rogers' organizational adoption process model. Originally, the research had accepted Rogers' model as it stands without the testing perspective. The contradiction resulted to include also the testing view in the research where the data, experiences, and conclusions collected during the the open source office suite adoption process were used to test and validate the assumptions in the underlying stage model applied in the study.

An additional observation can also be made concerning the decision activities in the research framework of the study. As depicted in Figure 3-4 in Sub section 3.2.2, the innovation process in an organization has one decision point which occurs between the initiation subprocess and the implementation subprocess. As experienced in the study, the matching stage may involve substantial costs. Sub section 5.4.7 showed that the budget-relevant expenses of the pilot project amounted to 41 000 € with additional not-budget-relevant costs resulting from the 250 person days of in-house work effort. In an organizational setting, the resource allocation of this magnitude requires a clear authoritative decision. As discussed in Section 5.4, it took more than half a year before the administrative organs in the Ministry of Justice reached the decision to carry out the OpenOffice.org pilot project. Applying the open source migration guidelines of the IDA programme (IDA, 2003a), the matching stage of the study was further divided into two major activities: the building of the business case and the design and implementation of the pilot project. The experiences from the study confirm the advantage of dividing the matching stage further into the business case and piloting substages. The advantages come from clear cost control and decision process. The experience from the study suggests that an organizational decision point would be added before the commencement of the pilot project. Based on the results of the business case and on the project plan of the pilot project, either a rejection decision or a decision to continue with the pilot project would be made at this point.

6 Adoption decision

In this chapter we present activities surrounding the adoption decision in this innovation adoption study. Figure 3-4 in Sub section 3.2.2 shows the decision as a dotted line dividing the two stages of initiation subprocess from the three stages of implementation subprocess. Following Rogers (2003, p. 424), "*the matching decision marks the watershed in the innovation process between the initiation and implementation, all of the events, actions, and decisions involved in putting an innovation into use*". Unlike in the innovation-decision process model shown Figure 3-3 in Sub section 3.2.1, Rogers does not consider or discuss the decision in the organizational innovation process as a stage in the innovation process. As noted by Rogers (ibid., 402), the innovation process in an organization is more complex when compared to the innovation-decision process by individuals. Based on the complexity of the innovation process, this study considers the decision as a separate stage in the innovation process. Following Rogers' definition in the innovation-decision process by individuals (ibid., p. 177), the contents of the decision stage involves activities that lead to choice to adopt or reject the innovation. Adoption is considered a decision to make full use of the innovation while rejection is considered a decision to not to adopt the innovation.

Applying the definition of the contents of the individual innovation-decision process presented by Rogers (2003, p. 14), we designed the contents of the decision stage to involve information-seeking and information-processing activities which would reduce uncertainty about the advantages and disadvantages of the innovation. We considered the following topics to be essential in the decision stage of this study:

- After the release of the business case report (Karjalainen, 2005a) in March 2005, additional information concerning OpenOffice.org case studies and evaluations had been published. The recent developments were updated and included in the final report of the OpenOffice.org pilot project (Karjalainen, 2006b), released in October 2006. The updated information is provided for the decision stage. The impact of case studies in the adoption decision was noted in the complementary research approach material of this study where the conclusions in (IDA, 2003b, p. 71) suggest that "*decision makers are awaiting success stories to go further in their decision process*".
- During the agenda-setting stage in Chapter 4, we applied the skill classification suggested by Woods and Guliani (2005) to indicate the expertise required in the deployment of open source products. Using the skill classification, the study organization was found to be at the beginner level which in turn suggested that only mature open source products would be deployed. In order

to support the decision stage, we include the evaluation of the maturity of OpenOffice.org using the open source maturity model suggested by Woods and Guliani (2005).

- The evaluation of the costs of the migration alternatives presented in the business case report (Karjalainen, 2005a) was based on the information available in the beginning of 2005. After the completion of the OpenOffice.org pilot project in September 2006, we considered an update to the cost evaluation necessary. We also considered necessary to evaluate the productivity of OpenOffice.org using information available from productivity evaluations conducted in European organizations. The productivity is indirectly linked to the evaluation of costs: in case there are notable differences in productivity between the migration alternatives, the differences affect the costs in the processing of office documents.

As discussed in Section 5.4, the administrative organs of the Ministry of Justice had postponed the decision to adopt or reject OpenOffice.org until the results of the pilot project would be available. The OpenOffice.org pilot project was completed in September 2006 and the final report of the pilot projected was published in October 2006 (Karjalainen, 2006b). With the results of piloting being available, activities involved in the decision stage could proceed in October 2006.

This chapter is structured as follows. After the release of the business case report (Karjalainen, 2005a) in March 2005, additional information from OpenOffice.org case studies and evaluations had been published. The recent developments were updated and included in the final report of the pilot project. Recent case studies are presented in Section 6.1. In Section 6.2 we evaluate the maturity of OpenOffice.org in order to find out how well the maturity matches the previous skill level evaluation of the study organization considering the probable OpenOffice.org deployment. In Section 6.3 we present recent productivity evaluations of office suite software. Considering the evaluation of alternative costs presented in the business case report, more accurate information was available based on the experiences from the pilot project and on the developments in office software licensing in the Ministry of Justice. In Section 6.4 we present and discuss the updated cost evaluation of the migration alternatives. Next, in Section 6.5 we discuss and summarize activities surrounding the decision process and the outcome of the decision. We summarize the chapter with a section giving a review of the results of the decision stage.

6.1 Recent case studies

Within EU member states, Germany and France have been important promoters of open source software. The activities in Germany were already discussed in Chapter 5 including the internationally widely known open source migration in Munich and the

open source migration guidelines (KBSt, 2005) published by the KBSt unit at the German Ministry of the Interior. While discussing European politics of open source adoption Ghosh (2005) notes that in France, the Prime Minister's IT agency already in 2003 released an OSS license guide for the public sector. The guide provided templates for public tenders giving preferential treatment to OSS without violating anticompetitive rules for public procurement. During 2006, Directorate General for the Modernisation of the State (Direction Générale de la Modernisation de l'Etat - DGME), was established in France. According to IDABC (2006a), DGME prepared an extensive set of tools for French administrations to assist them in their migrations to OpenOffice.org: a CD-ROM for the installation of OpenOffice.org, a training pack, on-line training assistance, a communications pack, and various support tools and guidelines. Ghosh (ibid.) mentions several French public organizations, including the Ministry of Interior, customs and police, which have announced migrations to OpenOffice.org amounting to more than 100 000 workstation computers. In the following, the large-scale migrations in the French Customs and in Gendarmerie Nationale, France's national police force, are discussed in more detail.

The Finnish open source co-operation project OSOS (see Sub section 4.2.3) arranged an open source office software seminar on 2 June 2005 in Helsinki. One of the speakers of the seminar was Department Head Denis Martinez from the IT services of the French Customs. The following information on the OpenOffice.org migration of the French Customs is based on his presentation (Martinez, 2005) in the seminar.

The French Customs is a large organization operating in 1 000 locations throughout the country. The IT environment includes 140 applications and 16 000 Windows XP workstation computers. The migration from Microsoft Office to OpenOffice.org was preceded with an evaluation and piloting phase where 200 employees tested OpenOffice.org version 1 from August 2003 till December 2003. Satisfactory results were shown in the status report released in March 2004. The decision to migrate from Microsoft Office to OpenOffice.org was a strategic and authoritative decision issued by the highest ranking officer of the organization, the General Director. OpenOffice.org version 1 installations started in June 2004 and were completed by January 2005. A team of 140 technicians carried out the installations using desktop installation CD's and automated scripts. Besides the technical evaluation, justifications to the OpenOffice.org migration were based on economy and independence. The alternative to upgrade Microsoft Office would have resulted in license costs over 3 M€ with yearly maintenance costs over 2 M€. The implementation of the OpenOffice.org migration alternative had already resulted in cost savings over 2 M€. The substance of independence in office software was more sovereign IT governance with a wide selection of alternative software vendors and operating system platforms and more flexibility concerning hardware and software upgrades. Impressive measures were taken by the French Customs to support the migration and to overcome resistance to change. A five-day training package was

provided for all in-house trainers while half-day training was considered adequate for regular users having Microsoft Office experience. An e-learning platform was established with self-training tutorials, handbooks, document templates, and discussion groups. The beginner's guide distributed to all employees proved to be so successful that the Prime Minister's IT agency ordered 40 000 copies to be distributed to public organizations. An installation CD was prepared and 5 000 copies were distributed to employees to support home computer installations. The OpenOffice.org configuration was enhanced by the MultiSave add-on tool developed for the needs of the French Customs by StarXpert[34], a French IT service provider, to further facilitate file format management. The success of the migration among users was analyzed conducting quarterly user satisfaction surveys. The organization started to use internally the ODF file format for documents after the installations had been completed in January 2005. Mass conversions of old Microsoft Office documents were not necessary since the level of interoperability with Microsoft Office document formats was acceptable. From the total of 140 applications, 12 applications had built-in integrations to Microsoft Office. Microsoft Office was still kept available to support the back-office integrations which will be modified to support OpenOffice.org at a later phase in the migration.

Information on the experiences and arrangements of the migration in the French Customs was available before the OpenOffice.org pilot project of the Ministry of Justice was commenced. Several practices of the migration in the French Customs could thus be used and applied. As discussed in Section 5.4, the MutiSave add-on tool was used and further developed in the pilot project. Other similarities include installation CD's, e-learning platform, and the development of localized user documentation.

The French Gendarmerie Nationale, composed of the police forces and the military police, is one of the largest public institutions in France having over 100 000 employees. In February 2005 the organization announced an extensive migration plan from Microsoft Office to OpenOffice.org (IDABC, 2005a). Detailed information discussing the open source migration in the Gendarmerie Nationale is available, e.g., from the presentation of Leblond (2007) and from the case study on the OSOR website (OSOR, 2009). During 2005, OpenOffice.org was installed on 70 000 Windows workstation computers. Before the migration, an evaluation and piloting phase was carried out during 2004 with 160 employees testing OpenOffice.org version 1. The migration decision was reached in December 2004. Like in the migration of the French Customs, the decision was strategic and authoritative being issued by the General Director from the top management of the organization. Also similar justifications, economy and independence, were important factors in the decision. The migration from Microsoft Office to OpenOffice.org was expected to deliver cost savings amounting to 2 M€ annually. Independence from proprietary software and the availability of choices considering software platforms

34 http://www.starxpert.fr (cited 9 June 2010)

were important goals to the Gendarmerie Nationale. The organization had already in 2002 decided on open standards policy. The ODF file format supported by OpenOffice.org with the standardization activities in OASIS complied with the open standards policy. In 2006 the organization standardized on the ODF format in editable documents and on the pdf format in the exchange of validated, non-editable documents. The organization had gained OSS expertise in several projects implemented since 2001. The expertise enabled the migration, the technical support and the personnel training to be carried out by in-house staff without third-party service providers. Measures to increase user acceptance included targeted training for three groups of users: operational users performing routine tasks, headquarters personnel, and advanced users. An expert team was also established to facilitate problem solving and quick response times. The migration to OSS was continued in 2006 when Microsoft Internet Explorer and Microsoft Outlook were replaced by Mozilla's Firefox web browser and Thunderbird e-mail client. As a final step in the migration, the Gendarmerie Nationale initiated in 2008 the migration from Microsoft Windows to the Ubuntu GNU/Linux desktop operating system.

The large-scale migration of the Bristol City Council in the United Kingdom is also internationally widely known. The migration plan was announced in 2004 (IDA, 2004b) and in November 2004 Bristol City Council decided to migrate 5 500 Windows workstation computers from a mixed environment consisting of Microsoft Office, Corel WordPerfect, and Lotus 1-2-3 to Sun Microsystems' StarOffice 7, the commercial version of OpenOffice.org 1.1. The decision represented the largest migration to open source office suite software in a UK public administration. Beckett (2005), Beckett et al. (2006b), and Bacon (2006) provide detailed information discussing the background and the actual migration of the Bristol City Council. The decision was preceded with a three-year assessment period evaluating the alternative options and technical, financial, and social issues involved in the migration. The evaluation involved, e.g., a large-scale pilot project with 600 employees in the council's Neighbourhood and Housing Services Department. The evaluation was sparked by problems caused by the mixed environment of several office suite products with many versions of each product in use. The standardization to Microsoft Office was an obvious solution. However, financial constraints of the council made Gavin Beckett, the council's ICT Strategy Manager, to build the business case (Beckett, 2005) to evaluate alternative solutions. The economic efficiency was the main driver in the evaluation. The economic assessment was based on the Gartner's Office Automation Migration cost model with some factors excluded, as they were considered effectively neutral between the options. Two migration options, Microsoft Office and StarOffice, were evaluated in the business case report. StarOffice rather than OpenOffice.org was considered due to the support resources available from Sun Microsystems and additional tools provided for StarOffice customers. The costs of the two migrations options are shown in Table 6-1. It can be noted that total 5-year costs of the StarOffice option are 1 M£ less than the costs of the Microsoft option.

The highest cost items in the 484 000 £ implementation and support cost of StarOffice were 149 000 £ for training and 87 000 £ for software packaging, configurations, installations, and systems testing. The budget assumed that Microsoft Office would be retained on some desktops so that systems that could not use StarOffice for integration could continue to operate.

Options	License, Support and Upgrade	Implementation and Support	Total 5 Year Costs
Microsoft	1 464 684 £	242 000 £	1 706 684 £
StarOffice	186 010 £	484 000 £	670 010 £

Table 6-1. The costs of the migration options in Bristol (Beckett, 2005, p. 27)

The migration to StarOffice on the 5 500 workstations was carried out during 2005-2006, and in 2006 Bristol City Council standardized on the ODF file format for office documents. Beckett et al. (2006b) provide a detailed description of the methods used in the migration and deployment. In conclusion, Beckett et al. (ibid., p. 13) note that StarOffice can be deployed using the standard methods available to any networked infrastructure, ranging from the direct installation from a CD to the use of enterprise software deployment tools. The authors also conclude (ibid., p. 13) that the general principles used in the configuration, deployment methods, and migration will also apply to OpenOffice.org as the software has the same overall structure and approach to its integration with the workstation. When discussing the experiences from the migration, Beckett (2008) notes that the actual costs of the project were slightly less than the budgeted costs shown in Table 6-1. The training approach used in the migration is described in detail by Beckett and Wright (2006). Like in the migration implemented in the French Gendarmerie discussed before, an expert team was also established for the migration in Bristol. The team provided "floor walking service" visiting users at their desks and assisting them to solve problems, e.g., in complex document conversions. Half-day conversion courses were given to key users in each section to transfer their existing level of competence to the StarOffice environment. The in-house IT training unit offered one-day foundation and intermediate courses for StarOffice Writer, Calc, and Impress at the cost of 64 £ per person per day. In addition, an intranet set up was used to deliver self-training materials, like pdf help files explaining how to carry out specific tasks (How To's) and animated tutorial guides as Shockwave Flash files (Show Me's).

An impressive aspect in the migration of Bristol City Council is the amount and quality of publicly available documentation produced by the migration team and especially Gavin Beckett, the key figure and local champion behind the migration. Beckett (2005, p. 14) notes that the pioneering nature of the work and the lack of exemplars lead to the documentation effort so that others could benefit from the

experiences of early adopters. The documentation has been delivered through the Open Source Academy[35] which is the website created by the Office of the Deputy Prime Minister's e-Innovations programme in order to encourage local authorities to use open source software. The documentation includes, e.g., the business case guide (Beckett, 2005), the report on the comparison of office software features (Beckett and Muller, 2005), the deployment and migration report (Beckett et al, 2006b), and the training report (Beckett and Wright, 2006). The documentation has also been used in the analysis of the pilot project of the Ministry of Justice as discussed earlier in Section 5.4.

Finnish Customs[36], a member organization in the Finnish open source OSOS project (see Sub section 4.2.3), evaluated during 2002-2004 alternatives to modernize its office automation system. With a staff of approximately 2 600 employees, Finnish Customs is a fairly large central state agency which is supervised by the Ministry of Finance. The office automation system of Finnish Customs was based on Applixware software deployed on the IBM AIX operating system platform. The Applixware office system included program modules for word processing, spreadsheets, presentations, and e-mail. The three-year assessment period included tasks to specify the requirements for the new office automation system, a small-scale test of OpenOffice.org, and a project to design the technical architecture and to evaluate alternative solutions. As a result, architectures based on Microsoft Office, StarOffice, and OpenOffice.org represented main alternatives to replace the aging office automation system. The evaluation of three-year costs of the alternatives yielded a 6 M€ cost estimate for the Microsoft alternative and a 5 M€ cost estimate for the alternative based on open source software. The actual procurement process of the new system caused disagreement in the organization. The leader of the evaluation project, Chief Systems Analyst from the IT department of the organization, was in favor of organizing a public tendering process open to all alternatives. However, the top management of the organization decided otherwise. Instead of a public tender, Finnish Customs decided in 2005 to join the framework agreement entered by Hansel Ltd, the central procurement unit of the Finnish Government. Hansel had arranged in 2005 a tender among Microsoft resellers concerning the licenses of Microsoft products. The tendering process resulted in a framework agreement which government organizations could join. The decision to join the Hansel framework agreement without organizing a public tender involving all alternatives caused the leader of the evaluation project to issue a complaint to the National Audit Office of Finland which audits the state's finances and asset management in order to ensure that public funds are spent wisely and in compliance with legislation. The complaint (diary number 347/34/05) was issued in September 2005, and the decision of the National Audit Office was released in March 2006. The decision stated that no such defects in the procurement process were found which would require further actions

35 http://www.opensourceacademy.org.uk/ (cited 9 June 2010)
36 http://www.tulli.fi/en/ (cited 9 June 2010)

by the National Audit Office. The procurement in the Finnish Customs proceeded following the terms the Hansel framework agreement with the implementation of the new office automation system being based on Microsoft Office 2003. The Finnish Customs applied additional funding of 8 M€ for the years 2005-2008 from the Ministry of Finance to cover the costs of the implementation of the new system.

The above information concerning the modernization and procurement of the office automation system in the Finnish Customs is available from the public diary of the National Audit Office of Finland (diary reference number 347/34/05). The importance of top management support was clearly demonstrated in the migration case of the Finnish Customs. The open source alternative did not have the top management support which would have been necessary in order to open the tendering process to all alternatives.

Overall, conclusions from the recent large-scale case studies can be summarized as follows.

- The economic efficiency of the open source alternative was an important factor affecting the migration decisions in all cases. Strategic considerations stressing more independent IT functioning with the availability of alternative software vendors and platforms were evident in the migration decisions of the French Customs and the Gendarmerie Nationale.
- The migration decisions were issued from the top management of the organizations stressing the importance of top management support. Without top management support, the open source office suite alternative in the Finnish Customs did not proceed to the tendering phase in the procurement process.
- The implementation of several successful large-scale migrations showed in practice the feasibility of the OpenOffice.org migration. Successful migrations included careful preparations including pilot projects and investments to user training, supportive documentation, and measures to increase user acceptance. The pilot project of the Ministry of Justice was able to adopt some best-practice approaches used in migrations of French Customs and Bristol City Council.
- The successful migrations in the Gendarmerie Nationale and in the Bristol City Council showed that with adequate internal expertise, the migration can be implemented without high exposure to third-party service providers.
- In all migrations, the ODF file format was accepted as the file format for office documents.

6.2 Maturity of OpenOffice.org

The maturity of the innovation is one of the topics which are considered in the adoption decision. Woods and Guliani (2005, pp. 41-44) present an open source maturity model to quantify the maturity of an open source project. The goal of the model is to assist an organization in the adoption decision. Three categories are used in the maturity assessment:

- product criteria (age, supported platforms, momentum, popularity, and design quality);
- use criteria (setup cost, usage cost, and end-user support);
- integration criteria (modularity, collaboration with other products, standards compliance, and developer support).

The product criteria are specifics about the product itself. The use criteria are specifics related to day-to-day deployment of the product. The integration criteria are specifics related to the integration of the product to the IT environment of the organization. For each criterion, a score of 1, 2, or 3 is assigned:

- immature product (score 1), characterized by a product showing weaknesses in several aspects;
- reasonably mature product (score 2), characterized by a sufficiently long history, stable deployments, loyal user base;
- very mature product (score 3), characterized by a long history of stable deployments, broad and vibrant user community, productized services.

Low score values can be used as suggestions for products which involve high risks in business-critical functions. In the following, the maturity model is used as a guiding framework in the maturity evaluation. Table 6-2 presents the maturity criteria and their score values based on our evaluation concerning OpenOffice.org version 2 and the available information at the end of the pilot project of the Ministry of Justice in 2006.

Open source products with *age* less than 6 months are considered to involve high risks in the maturity model. Products with age over two years are characterized as mature products with score 3 in the model. The roots of OpenOffice.org date back to the 1980's. As noted in Sub section 4.2.1, the source code was released to the open source community in 2000 and the first open source version was released in 2002. The age criterion of OpenOffice.org signifies a mature product with score value 3 in the maturity model.

Category	Criteria	Score	Remarks
Product	age	3	product age over 5 years
	supported platforms	3	Windows, Linux, Unix, and Mac OS X
	momentum	3	regular releases
	popularity	2	viable alternative to Microsoft Office
	design quality	3	UNO component model, XML support
Use	setup cost	3	well-documented installation, installation scripts, support forums, third-party services
	usage cost	3	user manuals, support forums, training services
	end-user support	3	well-run forums and mailing lists, third-party services
Integration	modularity	3	UNO API and XML/XSLT integration
	collaboration with other products	2	known integrations
	standards compliance	3	ISO/IEC 26300:2006 support, interoperability with proprietary Microsoft Office file formats
	developer support	3	developer documentation, mailing lists with archives and search, third-party services

Table 6-2. OpenOffice.org maturity evaluation

OpenOffice.org version 2 runs on several hardware architectures and under multiple operating systems. Platform support include Microsoft Windows, Mac OS X, and variants of Linux and Unix. The *supported platforms* criterion signifies a mature product with score value 3.

Considering the *momentum* criterion, OpenOffice.org version 1 was released in May 2002 and version 1.1 in September 2003 as noted in Sub section 4.2.1. Just before the beginning of the pilot project, version 2.0 of OpenOffice.org was released in October 2005. Since the beginning of the piloting till the end of 2006, the following versions (especially considering English, Finnish, and Swedish versions) were released:

- version 2.0.1 in December 2005 (English, Finnish, and Swedish versions);
- version 2.0.2 in March 2006 (English, Finnish, and Swedish versions);
- version 2.0.3 in June 2006 (English, Finnish, and Swedish versions);
- version 2.0.4 in October 2006 (English, Finnish, and Swedish versions);
- version 2.1.0 in December 2006 (English, Finnish, and Swedish versions).

As of version 2.0.3, the release cycle of OpenOffice.org was changed. New versions including new features are released every six months. These so-called "feature releases" are alternating with so-called "bug fix releases" which are being issued between two feature releases. The release history of OpenOffice.org signifies a mature product with regular releases and score value 3 for the momentum criterion.

The *popularity* of OpenOffice.org can be evaluated based on available market share data. The market analysis (IDA, 2003b) indicated that in 2002 Microsoft Office was the dominant vendor having approximately 95% of the worldwide office suite market. The same analysis indicated that by the end of 2003 OpenOffice.org had almost 19 million downloads from its official websites. In October 2006, just after the pilot project of the Ministry of Justice, the number of downloads reported on the OpenOffice.org market share website[37] had tripled to 60 million. The number of downloads is not an accurate deployment measure because all downloads do not result in program installation and active use. However, the numbers indicate continued increase in the deployment. Open source deployment in European public sector organizations was analyzed in the survey (Glott and Ghosh, 2005) conducted by MERIT, University of Maastricht. Glott and Ghosh reported (ibid., p. 19) that OpenOffice.org was being used in 21% of the organizations. However, the results did not specify how widespread the deployment was in these organizations. The study on the economic impact of open source software (Ghosh, 2006) cited the IDC's 2005 Western European software end-user survey of 625 firms to report OSS usage in European firms. The survey indicated (Ghosh, 2006, p. 21) that about 30% of organizations had live deployment of open source personal productivity software with about 15% categorized as significant live deployment. In conclusion, the popularity criterion in the maturity evaluation of Table 6-2 has the score 2 indicating a viable alternative to the market leader in office software.

The *design quality* criterion of the maturity model refers to the effort required to extend and adapt the product for enterprise use. UNO (Universal Network Objects) is the OpenOffice.org component model and API (Application Program Interface) which provides extension capabilities and interoperability between programming languages, other component models, and hardware architectures. Supported languages include, e.g., C++, Java, Python, and the Basic variant of OpenOffice.org. UNO provides the key technology for add-on extensions to OpenOffice.org. For example, the Finnish spelling and hyphenation component Soikko for OpenOffice.org 2.0 was integrated using this technology. Developers and users have extended the capabilities of OpenOffice.org with numerous add-on extensions based on UNO components. The OpenOffice.org documentation project creates and maintains developer guides containing information about programming with OpenOffice.org using its API. In addition, XML support and transformations based on XSLT (Extensible Stylesheet Language Transformations) can be used in adapting document processing functions using OpenOffice.org. In conclusion, OpenOffice.org

37 http://wiki.services.openoffice.org/wiki/Market_Share_Analysis (cited 11 June 2010)

is evaluated as a mature product with score 3 considering the design quality criterion of the maturity model.

The *setup cost* criterion of the maturity model refers to the facilities supporting the installation of the software. OpenOffice.org version 2 has a well-documented installation process. Publicly available setup and administration guides are maintained and released by the OpenOffice.org documentation project. The guides specify the installation and customization of the software on various platforms. The website of the OpenOffice.org community has a setup and troubleshooting forum for specific questions about setup issues. Installation scripts and wizards are available. A typical installation on a Windows desktop computer takes 5 to 10 minutes requiring no specific IT expertise. Third-party services for installation and configuration issues are available, also in Finland. In conclusion, OpenOffice.org is evaluated as a mature product with score 3 considering the setup cost criterion of the maturity model.

The *usage cost* criterion of the maturity model refers to the facilities supporting documentation and training in the deployment of the software. The OpenOffice.org Documentation Project creates and maintains documentation for OpenOffice.org in English. Documentation includes user guides, FAQ (Frequently Asked Questions), HowTos (a collection of instructions on special topics), application help, samples and templates, and training materials. With the introduction of OpenOffice.org version 2.0 in 2005, the following user guides were available from the website of the documentation project:

- Getting Started Guide;
- Migration Guide;
- Writer Guide.

As discussed in Sub section 5.4.3, the OpenOffice.org pilot project of the Ministry of Justice initiated the Finnish user documentation of OpenOffice.org version 2. As the result, the following Finnish handbooks were available in 2006:

- Express Guide (Ruohomäki, 2005);
- Template Guide (Grönroos, 2006);
- Handbook of Questions and Answers (Karjalainen and Karjalainen, 2006).

The website of the OpenOffice.org user community has a well-run forum supporting documentation as an on-line service. Third-party training services are available, also in Finland as experienced in practice in the pilot project. In conclusion, OpenOffice.org is evaluated as a mature product with score 3 considering the usage cost criterion of the open source maturity model.

As the name implies, the *end-user support* criterion of the maturity model refers to the facilities available to the end-users of the software. In addition to the documentation services discussed above, the OpenOffice.org user community website provides well-run forums for discussions and specific user questions. The user community forum services are available in several languages, but not in Finnish. End-user support includes also mailing list service with archives and search facilities. The OpenOffice.org Quality Assurance project provides an Issue Tracker service with facilities to report and lookup possible defects in the software and also to participate in the quality-improvement process of the software. Third-party commercial support services for end-users are available also in Finland, as experienced in practice in the pilot project of the Ministry of Justice. In conclusion, OpenOffice.org is evaluated as a mature product with score 3 considering the end-user support criterion of the open source maturity model.

The *modularity* criterion in the integration category refers to the facilities available in the integration of OpenOffice.org to other applications and to the IT environment of the organization. The integration facilities of OpenOffice.org are based on two interface technologies: (1) the application interface provided by the UNO component model and (2) the document transformations based on XSLT and ODF file format. OpenOffice.org can be used by other programs as an external service module through the UNO interface: documents can be created, read, manipulated, and saved to various file formats through the UNO interface. In these cases OpenOffice.org can also be used in server mode without the graphical user interface. Figure 6-1 illustrates the UNO integration: the external application starts OpenOffice.org using the UNO interface, loads a document template, inserts initial data to the document from the application, and lets the user to modify the document. The application receives the document after modifications and saves it to the document data base.

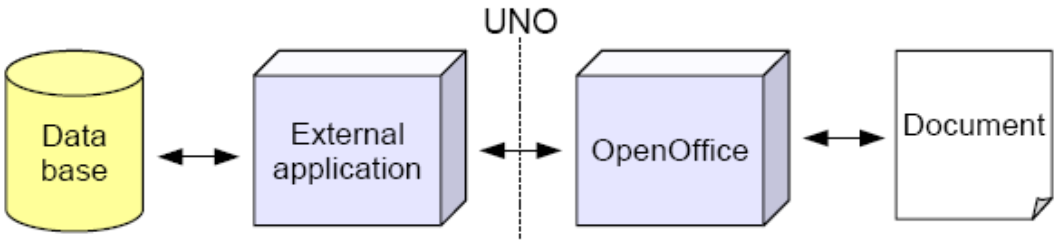

Figure 6-1. OpenOffice.org integration using the UNO Interface

The ODF file format of OpenOffice.org is structured as XML which facilitates integrations based on input-output transformations expressed in XSLT. Using XSLT transformations, an XML document can be further processed to another format, e.g., to another XML document, to HTML as a web page, to plain text, or to pdf. OpenOffice.org version 2 includes Xalan XSLT processor which is developed and

maintained as one of the open source projects of Apache Software Foundation[38]. Figure 6-2 illustrates the integration using the ODF document format. The ODF format defines the interface between the application and OpenOffice.org with XSLT used to process the ODF file. Actually, OpenOffice.org is not essential in this integration scenario, it could be replaced by any office suite capable of processing ODF documents.

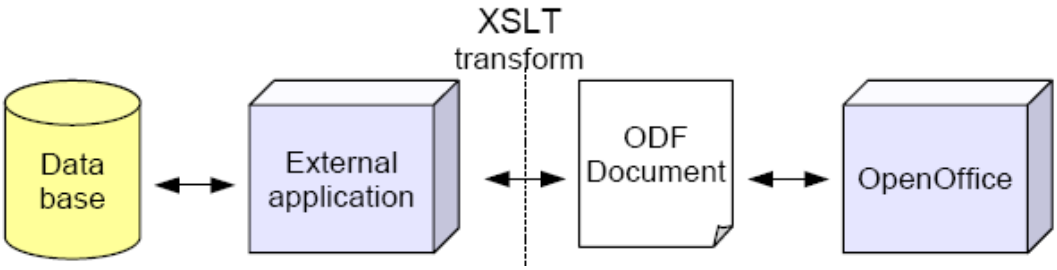

Figure 6-2. OpenOffice.org integration using ODF file format and XSLT

The support for XForms documents is an additional XML-based integration technology introduced in OpenOffice.org version 2. XForms is a device independent standard for electronic forms that was developed by the World Wide Web Consortium (W3C). Forms which are based on XForms collect data in XML format and are able to submit the data as XML to back-end systems. In OpenOffice.org version 2, the XForms document is a special type of text document in ODF format. OpenOffice.org combines two standards, ODF and Xforms, in order to enable the integration of XML forms into any standards compliant infrastructure.

The OpenOffice.org documentation project creates and maintains publicly available developer guides containing information about programming with OpenOffice.org. In conclusion, OpenOffice.org is evaluated as a mature product with score 3 considering the modularity criterion of the open source maturity model.

The criterion *collaboration with other products* in the maturity model refers to the number of documented integration cases with score 1 associated to unknown integrations and score 3 to high amount of documented integrations. As discussed in Sub section 4.2.4, a preliminary evaluation and implementation of OpenOffice.org integration in one application area, the Prisoner Information System, was conducted during the agenda-setting stage in 2003. The integration was based on the UNO application interface and it confirmed the feasibility of the integration technology. However, the number of publicly available and documented integration cases at the time of the pilot project in 2006 does not justify the score 3 to be assigned which would indicate a very mature product considering the collaboration criterion.

The criterion *standards compliance* in the maturity model refers to the support for current industry standards. Low score values are assigned to unknown or proprietary standards or support for outdated standards. As discussed in Sub section

38 http://en.wikipedia.org/wiki/Apache_Software_Foundation (cited 11 June 2010)

5.2.2, international standardization activities around the ODF format started in 2002 via OASIS with the goal to create an open, XML-based file format specification for office applications. As a result, the ODF file format was accepted as an OASIS standard in May 2005 (OASIS, 2005). Thereafter ODF was also accepted as an international ISO standard ISO/IEC 26300:2006 in November 2006 (ISO, 2006). OpenOffice.org version 2 natively supports the ODF standard as the default file format for text documents, spreadsheets, and graphic presentations. Considering the support for the proprietary file formats of Microsoft Office, the interoperability between OpenOffice.org and Microsoft Office was found adequate both in the pilot project of the Ministry of Justice and in several international evaluations discussed earlier in Sub section 5.4.2. In conclusion, OpenOffice.org is evaluated as a mature product with score 3 considering the standards compliance criterion of the open source maturity model.

The criterion *developer support* of the maturity model refers to the facilities available to the developers of the software. Low score values are assigned to software with no or only some forum or mailing list services for developers. The OpenOffice.org community website has numerous projects for various product development projects, e.g., development of word processing, spreadsheet and graphic applications, UNO component model and API, user interface development, quality assurance, and security and performance improvements. The facilities include mailing list services with archives and search facilities. Well-run discussion forums are also provided by the community website. The OpenOffice.org documentation project creates and maintains publicly available developer guides containing information about programming with OpenOffice.org. The website also includes wiki pages for additional developer resources, like descriptions of the architecture and software build system on various platforms. Third-party commercial application development services are available also in Finland, as experienced in the Ministry of Justice in 2003 in the integration of OpenOffice.org and the Prisoner Information System discussed earlier in Sub section 4.2.4. In conclusion, OpenOffice.org is evaluated as a mature product with score 3 considering the developer support criterion of the open source maturity model.

Overall, conclusions from the maturity evaluation of OpenOffice.org can be summarized as follows.

- The maturity evaluation yielded no criteria with score value 1. This implies that considering all criteria of the maturity model, OpenOffice.org is either a reasonably mature or a very mature product. The skill classification, presented earlier in Sub section 4.2.2, classified the study organization to be at the beginner level which in turn suggested that only mature open source products would be deployed. The maturity evaluation complies with the skill level indicating that a possible adoption does not involve high risks.

- Two criteria, popularity and collaboration with other products, yielded score value 2 indicating a reasonably mature product. All other criteria indicated a very mature product. However, the experience from the application integration already implemented in the Ministry of Justice reduces the possible risk considering the collaboration criterion. Even if OpenOffice.org is not the market leader in office suite software, the analysis of the popularity criterion indicated continued increase in the deployment and a fairly large volume in international user base.

6.3 Productivity evaluation

The influence of OpenOffice.org to personnel productivity in document handling was not explicitly measured in the pilot project of the Ministry of Justice. Practical experience indicated that no obvious differences in document handling times could be noticed when compared to Lotus SmartSuite or Microsoft Office. In the following, results from productivity evaluations conducted in several studies are briefly presented.

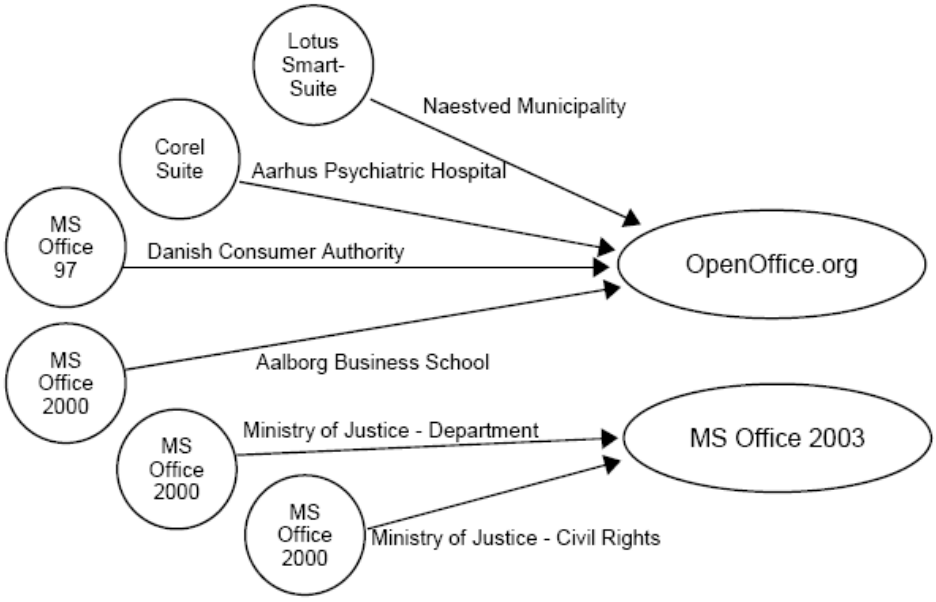

Figure 6-3. Pilot experiments, adapted from Kristensen et al. (2005, p. 6)

The Danish Ministry of Science, Technology and Innovation conducted an experiment with six public organizations using Microsoft Office 2003 and OpenOffice.org version 1.1 as the targets for office software migration (Kristensen et al., 2005). The aim of the experiment was to evaluate cost structures and quality as

well as the economic value of investments in proprietary and open source desktop software. The pilot migrations of the experiment are depicted in Figure 6-3.

The foundation for the conclusions of the experiment was based on a desktop evaluation model developed by the consulting company Devoteam Fischer & Lorenz. The evaluation in the model includes productivity, resource usage, desktop share of total costs, and both functional and technical quality of the desktop software. The following data were used in the evaluation (Kristensen et al., 2005, p. 10):

- files or estimates documenting the time spent in the IT department performing tasks related to the operation of the desktop;
- workshops with end-users about selected work processes, aimed at measuring productivity and the use of resources;
- systematic evaluation of the technical quality performed by the CIOs in the pilot institutions;
- questionnaires to be filled out by the end-users.

The results (Kristensen et al., 2005), released in May 2005, showed that there was no visible economic effect (neither influence in the use of resources nor in productivity) in the workflows, no matter which office suite was chosen. The only difference in the total costs (direct as well as indirect) was related to license fees. The authors also concluded that OpenOffice.org 1.1 is a valid alternative to MS Office 2003. After performing the experiment, the Municipality of Næstved and the Psychiatric Hospital in Aarhus decided to use OpenOffice.org for all users of the organizations. It can be noted that also the two offices in the Ministry of Justice decided to use the new office suite of the experiment (Microsoft Office 2003) for all users after the experiment.

In the 2005 International Conference on Open Source Systems, Rossi et al. (2005) released a research report studying the productivity and users' attitude towards open source. The study was part of the COSPA project (Consortium for the Open Source in the Public Administration), a consortium aiming to analyze the effects of the introduction of open data standards and open source software for personal productivity and document management in European public administrations. The field experiment was conducted in one public organization. Both Microsoft Office and OpenOffice.org were used in the experiment with altogether 22 users participating the study. One group of 11 people experimented the introduction of OpenOffice.org while the other group was used as a control group. A special software (PROMetric) was used in the study to monitor in background the usage of OpenOffice.org and Microsoft Office. The experiment lasted for 32 weeks. The results of the study showed that the usage of OpenOffice.org did not reduce the number of documents handled daily. In addition, the results showed that the usage of OpenOffice.org did not increase the global effort to handle documents.

Confirming results to Rossi et al. (2005) were reported by Russo et al. (2005b) in a study involving ten townships in the Province of Bolzano-Bozen in Italy. Also in this study the productivity was analyzed using two user groups differentiated by the use of OpenOffice.org and Microsoft Office. The same PROMetric software was used also in this study to monitor in background the usage of OpenOffice.org and Microsoft Office. In conclusion, the authors noted that personal productivity was not affected by the introduction of OpenOffice.org. The same conclusion was also reached by Ven et al. (2006) in their study of the transition of the ministerial cabinets of the Brussels-Capital Region in Belgium towards OpenOffice.org. However, Ven et al. (ibid.) note that no formal measurements of the productivity was performed in their study.

The study on the economic impact of open source software on innovation and the competitiveness in the European Union (Ghosh, 2006) included an extensive report on the user-level productivity and relative costs of open source and proprietary software. Table 6-3 depicts the types of organizations and the types of open source migrations evaluated in the report. Altogether six organizations in four countries were involved in the analysis. It should be noted that one of the organizations in Table 6-3, Province of Bolzano-Bozen, is actually the case which was reported by Russo et al. (2005b) and was already discussed.

Organization	Type of migration
SGV (Consorzio dei Comuni della Provincia di Bolzano)	Partial migration from proprietary software
PP (Province of Pisa)	Partial migration from proprietary software
SK (Public Administration of City of Skopje)	Migration from scratch
TO (Törökbálint Nagyközség Polgármesteri Hivatala)	Migration from scratch
ProBZ (Province of Bolzano-Bozen)	Trial migration. Partial migration from proprietary software
Estremadura (Fundecyt in Estremadura)	Migration from scratch

Table 6-3. Types of migrations in the evaluation, adapted from Ghosh (2006, p. 241)

The evaluations were conducted with OpenOffice.org version 1 and Microsoft Office 2003. The following productivity and functionality findings were reported in the evaluation (Ghosh, 2006, pp. 283-284):

- There were no extra costs due to lack of productivity arising from the use of OpenOffice.org. No particular delays or lost of time were reported in the daily work due to the use of OpenOffice.org.

- OpenOffice.org had all the functionalities that public offices need to create documents, spreadsheets, and presentations.

Overall, conclusions from the productivity evaluation studies discussed before can be summarized as follows.

- Productivity evaluations comparing OpenOffice.org and Microsoft Office suggest that personal productivity is not affected by the introduction of OpenOffice.org.
- Productivity evaluations also suggest that there are no extra costs due to lack of productivity arising from the use of the OpenOffice.org. No particular delays or lost of time are reported in the daily work due to the use of OpenOffice.org.

The productivity issue was also discussed by Beckett (2005) in the migration implemented in the Bristol City Council. He suggests (ibid., p. 21) a fairly simple explanation to the observed neutrality in productivity: "*Bristol's experience is that the vast majority of staff in the Council use a very limited set of features in their office software, and that these features are implemented in an effectively identical way in all products. Moreover, StarOffice's compatibility with Microsoft Office is such that these users almost never come across conversion issues.*" The same functionality observation was also done in the pilot project of the Ministry of Justice in Section 5.4, where it was concluded that in ordinary tasks, only a small part of the features of the software was utilized. Beckett also notes that Gartner's Office Automation Migration cost model, which is often used in cost evaluations, contains an assumption that users with Microsoft Office are automatically more productive than those with non-Microsoft office software. Beckett (ibid., p.20): "*Their cost model contains parameters measuring the loss of time per user per week in word-processing, spreadsheets, and presentations, derived from calculations of the time spent managing compatibility issues between Microsoft Office and non-Microsoft Office software.*"

6.4 Revised cost evaluation

The business case analysis presented earlier in Sub section 5.2.4 included the evaluation of the costs of the migration alternatives during the 6-year period 2006-2011. The evaluated costs were presented in Table 5-3. The costs were evaluated in the beginning of 2005. Since then, important changes in the cost factors had occurred. A revised cost evaluation was therefore prepared in October 2006 to reflect the new situation after the pilot project of the Ministry of Justice had been completed. The revised cost evaluation is presented in Table 6-4.

	Lotus SmartSuite alternative	Microsoft Office alternative	OpenOffice.org alternative
License purchases	668 300 €	2 517 000 €	211 000 €
Software maintenance	737 000 €	3 545 000 €	737 000 €
Training and support	200 000 €	370 000 €	580 000 €
Systems development, conversions, and integrations	105 000 €	355 000 €	535 000 €
Costs total	**1 710 300 €**	**6 787 000 €**	**2 063 000 €**

Table 6-4. The revised costs of the migration alternatives 2006-2011

The revised 6-year costs in Table 6-4 for a full Microsoft Office migration would amount to a total of 6.8 M€, for the OpenOffice.org alternative to 2.1 M€, and for the Lotus SmartSuite alternative to 1.7 M€. The relative cost differences between the alternatives are high. The costs of the Lotus SmartSuite and OpenOffice.org alternatives represent 25-30 % of the costs of the Microsoft Office alternative.

The costs of all migration options in Table 6-4 are considerably lower than the costs in Table 5-3. During 2005-2006, the licensing bundle of Lotus Notes client software and Lotus SmartSuite was dissolved. This helped to exclude all costs related to Notes client software from the evaluation. For Lotus SmartSuite, a one-time license charge was negotiated for the Windows XP platform in order to provide the facilities to open old SmartSuite files. The costs of Microsoft Office licenses were reduced when the number of Office Professional licenses was adjusted to follow the new licensing decisions made during 2006. On the other hand, the increase in the number of workstation computers from 10 000 to 10 500 increased the software license costs in the commercial alternatives. Some changes in the costs were also caused by the new government framework agreement regarding the license prices and the software assurance prices of Microsoft Office. The terms of the new framework contract were not known at the time of the business case analysis, but they were reflected in the new cost evaluation in Table 6-4. The experiences from the pilot project allowed some reduction in the training and support costs. As discussed in Sub section 5.4.4, the pilot project concluded that both user support and technical support services should be acquired on a case-by-case basis without continuous support contracts with third-party service providers. This allowed some reduction in the estimated support costs. The experiences from the pilot project also allowed some reduction in the training costs. The amount of third-party training services was reduced as it was experienced that a considerable part of the training effort could be provided by the trainers from the in-house staff.

6.5 The decision

As discussed in Section 5.4, the final adoption decision was originally expected in 2005. However, the actual decision was not reached before 2006. Several reasons caused delays. The release of OpenOffice.org version 2 was delayed from May 2005 to October 2005 which delayed the time frame of the pilot project. The administrative organs of the Ministry of Justice were not ready to make decisions before the results of the pilot project were available. The pilot project lasted till September 2006 and the final report of the project (Karjalainen, 2006b) was released in October 2006.

The target of the decision was defined by the recommendations of the business case analysis, presented earlier in Table 5-5. The essential recommendations included the migration to a mixed office suite environment consisting of OpenOffice.org for 8500 desktop users and Microsoft Office for 1500 desktop users and the adoption of the ODF file format for office documents. As discussed in Section 5.4, one of the original recommendations, the installation of OpenOffice.org on all Windows XP computers, had already been accepted. The installations were then implemented as part of the Windows XP migration project where all desktops were re-installed.

Rogers (2003, p. 14) suggests that the decision process involves information-seeking and information-processing activities which aim to reduce uncertainty about the advantages and disadvantages of the innovation. He further suggests (ibid., p. 177) that one way to cope with the inherent uncertainty about an innovation's consequences is to try out the new idea on a partial basis. Following these guidelines, this study applied several approaches to cope with the uncertainty.

- The results of the OpenOffice.org pilot project presented in Section 5.4 addressed several important issues in the suggested OpenOffice.org migration. The functionality of the software covered the needs of the ministry and its administrative sector. The compatibility of OpenOffice.org with other software packages was adequate. The need for third-party user support and technical support services was low. The pilot project had produced user documentation, engineering documentation, training materials, course frameworks, and various support tools for the migration. No security attacks related to the OpenOffice.org software were experienced during the piloting. Incidents implying resistance to change during the piloting were rare.
- The evaluation of alternative costs in Section 6.4 showed that the economic efficiency of the OpenOffice.org alternative was impressive when compared to the Microsoft Office alternative. Cost savings amounted to more than 4 M€ during the 6-year period 2006-2011. Recent comparable European large-scale migrations had also reported impressive cost savings in comparison to the deployment of Microsoft Office. Example case studies included, e.g., the Dutch

city of Haarlem in Sub section 5.2.5, the French Customs in Section 6.1, the French Gendarmerie Nationale in Section 6.1, and the Bristol City Council in the United Kingdom in Section 6.1. In addition to the economic efficiency, the case studies also confirmed the feasibility and the viability of the migration to an open source office suite in practice. The case studies also confirmed the functionality and compatibility results reported in the pilot project of the Ministry of Justice.

- Open source office suite evaluations had also been conducted in Europe on national level. The evaluations reported results from studies involving several organizations. In Sub section 5.2.5 we discussed results from evaluations in Denmark (Poulsen et al., 2002), in Italy (CNIPA, 2004), and in the United Kingdom (OGC, 2004). Overall, the national evaluations confirmed that both the functionality and the interoperability of OpenOffice.org (or StarOffice) are adequate for the needs of public organizations. The evaluations also concluded that the open source office suite represents a viable technical and economic alternative to proprietary software. The evaluations in Italy and in the United Kingdom suggested that proprietary software would still be supported for certain tasks, e.g., due to integrations with back-office applications or with external organizations. The evaluation in the United Kingdom (OGC, 2004) suggested the viability of a mixed environment where both OpenOffice.org (or StarOffice) and Microsoft Office would be deployed. This approach was also used in practice in the migrations implemented, e.g., in the Dutch city of Haarlem, the French Customs, and the Bristol City Council.
- Results from several office suite productivity evaluations were studied to find out if the introduction of OpenOffice.org might cause productivity losses which would in turn affect the reliability of the economic efficiency of the OpenOffice.org alternative. In Section 6.3 we presented results from evaluations in Denmark involving six public organizations (Kristensen et al., 2005), in Italy in one organization (Rossi et al., 2005), and a user-level productivity analysis involving six organizations in four European countries (Ghosh, 2006). Overall, the evaluations comparing OpenOffice.org and Microsoft Office suggested that personal productivity is not affected by the introduction of OpenOffice.org. The evaluations also suggested that there are no extra costs due to lack of productivity arising from the use of the OpenOffice.org. No particular delays or lost of time were reported in the daily work due to the use of OpenOffice.org.
- The maturity of OpenOffice.org was evaluated in Section 6.2 in order to find out how well the maturity matches the skill level evaluation of the study organization considering the probable deployment of OpenOffice.org. The evaluation was based on the open source maturity model of Woods and Guliani (2005) which has twelve criteria to measure various aspects in the maturity of open source software. Considering all criteria of the maturity

model, OpenOffice.org was found to be either a reasonably mature or a very mature product. The skill classification, presented earlier in Sub section 4.2.2, classified the study organization to be at the beginner level which in turn suggested that only mature open source products would be deployed. The maturity evaluation complies with the skill level indicating that a possible OpenOffice.org adoption does not involve high risks.

- The recommendation to adopt the ODF file format for office documents involves the uncertainty concerning the viability of the ODF format. The international standardization activities reduced this risk considerably. The ODF format was accepted as an OASIS standard in May 2005 (OASIS, 2005) and thereafter as an international ISO standard ISO/IEC 26300:2006 in November 2006 (ISO, 2006). On the European level in public organizations, the importance of internationally standardized document formats was emphasized in the recommendations (IDABC, 2006b) issued in 2006 by PEGSCO (Pan-European eGovernment Services Committee) in co-operation with the IDABC programme of the European Commission. The recommendations invite public administrations to make maximal use of internationally standardized open document exchange and storage formats for internal and external communication and to use only formats that can be handled by a variety of products, avoiding in this way to force the use of specific products on their correspondents. OpenOffice.org version 2 natively supports the ODF standard as the default file format for documents. The ODF file format was also adopted as the default document format in all large-scale migrations presented in Section 6.1.

Within the administration of the ministry, the handling of the office suite recommendations was continued in fall 2006 after the completion of the pilot project. The recommendations were first approved by the IT governance co-operation board of the ministry in October 2006 (research diary: board meeting on 24 October 2006) and then by the board of Department Heads of the ministry in November 2006 (research diary: board meeting on 21 November 2006). The approval of the IT governance co-operation board is usually sufficient in IT matters, but in this case the final decision was left to be issued by the highest ranking officer, the Permanent Secretary of the Ministry of Justice. The approval from the top management was considered essential for the OpenOffice.org adoption, as emphasized in the open source migration guidelines of the IDA programme (IDA, 2003a). Top management decision was also issued in all recent large-scale migrations presented in Section 6.1 and also in all earlier large-scale migrations presented in Chapter 5. The earlier unsuccessful adoption cases in Finland, the city of Turku in Sub section 4.2.4 and the Finnish Customs in Section 6.1, showed how the adoption plans finally failed without top management support. Also the own experiences reported earlier in

Section 5.3 after the release of the business case analysis suggested that the decision issued by the top management is crucial for the implementation activities.

In this study, top management support was also acquired from the state level, even if the Ministry of Justice has the full power to make an independent decision regardless of other ministries or the Finnish state administration. A meeting was arranged in November 2006 with the State IT Management Unit (ValtIT). Attendees included the CIO of the Ministry of Justice, the State IT Director and representatives from both IT organizations, including the author of this study (research diary: ValtIT meeting on 17 November 2006). The OpenOffice.org adoption recommendations were presented to the State IT Management Unit which had no objections to the open source adoption plans.

The adoption decision was issued on 1 December 2006 by the Permanent Secretary and the CIO of the Ministry of Justice. Table 6-5 depicts the essential contents of the decision. The decision is available for anyone interested from the public diary of the Ministry of Justice (the diary reference number is OM 15/042/2005). Unlike in the two Finnish large-scale adoption considerations discussed earlier (the city of Turku and the Finnish Customs), the decision process did not involve strong opposing views or disagreement within the administration of the ministry. The decision can be characterized as being based on pragmatic reasoning, e.g., no decisions on strategic or political level existed which would favor wide-spread and general introduction of OSS solutions in the ministry.

– The Ministry of Justice has decided to migrate to the open source OpenOffice.org office suite. OpenOffice.org will replace the Lotus SmartSuite software, and also part of Microsoft Office software packages will be replaced by OpenOffice.org. After the migration, 85 % of the total document processing will be handled by OpenOffice.org and 15 % by Microsoft Office.
– The Ministry of Justice and its administrative sector will adopt the ODF standard for the file format of office documents.
– The migration is scheduled to commence from the beginning of 2007.

Table 6-5. The OpenOffice.org adoption decision

The adoption decision follows closely the recommendations of the business case given in Table 5-5. The migration from Windows NT 4 to Windows XP was in progress during 2006 with OpenOffice.org installation included in all Windows XP workstations. This provided the beginning of 2007 to be the natural starting point for the remaining migration activities. The status report (Karjalainen, 2007a), released in February 2007, summarizes the business case analysis, the results of the pilot project, the adoption decision, and the initial activities of the migration.

The large-scale adoption decision also caught interest in the public IT media (ITviikko, 2006; Tietokone, 2006; IDABC, 2007). Consequently, the author of this

study gave several presentations on the subject both in national and international seminars during 2007. The migration was first presented in February 2007 in the IDABC workshop on Open Document Exchange Formats in Berlin (Karjalainen, 2007b) and in September 2007 in the open source seminar in The Hague, Netherlands (Karjalainen, 2007c). In Finland, a presentation was given in August in the open source seminar in Helsinki (Karjalainen, 2007f). The migration research report was published and presented in August 2007 in the IRIS30 research seminar in Tampere (Karjalainen, 2007d).

6.6 Review

The research framework of the study, the innovation process in the organizational context as defined by Rogers (2003, p. 421) and depicted in Figure 3-4 in Sub section 3.2.2, does not consider the decision in the organizational innovation process as a stage in the innovation process. However, based on the complexity of the innovation process and the activities surrounding the decision, this study considered the decision as a separate stage in the innovation process. The deviation from the framework suggests that similar approach could also be applied in other organizational innovation adoption studies.

The outcome of the decision stage, the adoption decision was issued in December 2006 by the top management of the Ministry of Justice. The adoption decision closely followed the original recommendations of the business case report released in March 2005. Top management decision was considered essential based both on the practical experiences occurred during the study and on the information from several large-scale migration studies, both successful and unsuccessful.

The decision stage involved several information-seeking and information-processing activities in order to reduce uncertainty about the advantages and disadvantages of the innovation. The following list outlines topics and activities which we considered essential in the decision stage of the study.

- The outcome of the OpenOffice.org pilot project yielded several conclusions reducing uncertainty about the advantages of the OpenOffice.org alternative. Especially conclusions considering the functionality, the compatibility, user support requirements, technical support requirements, and training were favorable to OpenOffice.org.
- The feasibility and viability of the migration to an open source office suite was confirmed by several comparable large-scale migrations already implemented in European public organizations. Case studies reviewed in the research included, e.g., the Dutch city of Haarlem, the French Customs, the French Gendarmerie Nationale, and the Bristol City Council in the United Kingdom. In addition to case studies, also national evaluations based on several

organizations in Denmark, Italy, and United Kingdom were discussed in the study. The national evaluations concluded that the open source office suite represents a viable technical and economic alternative to proprietary software. The case studies and national evaluations also confirmed the functionality and compatibility results reported in the pilot project of the Ministry of Justice.

- The evaluation of alternative costs indicated impressive economic efficiency of the OpenOffice.org alternative. Economic efficiency was also reported in the large-scale migrations already implemented in European public organizations.
- The study reviewed results from office suite productivity evaluations conducted in Denmark, in Italy, and also in a multinational study involving six organizations in four European countries. Overall, the productivity evaluations comparing OpenOffice.org and Microsoft Office suggested that personal productivity is not affected by the introduction of OpenOffice.org. The evaluations also suggested that there are no extra costs due to lack of productivity arising from the use of the OpenOffice.org.
- Using the open source maturity model introduced by Woods and Guliani (2005), the maturity of OpenOffice.org was evaluated in order to find out how well the product maturity matched the skill level of the study organization considering the probable deployment of the software. OpenOffice.org was found to be either a reasonably mature or a very mature product. The maturity complied with the skill level indicating that a possible OpenOffice.org deployment does not involve high risks.
- The international standardization activities reduced the uncertainty concerning the viability of the ODF file format. The ODF format was accepted as an OASIS standard in 2005 and as an international ISO standard in 2006. OpenOffice.org version 2 natively supports the ODF standard as the default file format for documents. The viability of the ODF format was also shown in practice in the European large-scale migrations which had adopted ODF as the default document format.

The adoption decision and a summary of activities preceding the decision during 2005-2006 were published in the status report by Karjalainen (2007a). The author of this study gave several presentations on the migration in national and in international seminars during 2007. The migration was presented in February 2007 in the IDABC workshop on Open Document Exchange Formats in Berlin (Karjalainen, 2007b) and in September 2007 in the open source seminar in The Hague, Netherlands (Karjalainen, 2007c). In Finland, a presentation was given in August in the open source seminar in Helsinki (Karjalainen, 2007f). The migration research report was published and presented in August 2007 in the IRIS30 research seminar in Tampere (Karjalainen, 2007d).

7 Redefining and restructuring

In this chapter we present the redefining and restructuring stage of this innovation adoption study. Following Rogers (2003, p. 424), the innovation is modified and re-invented at this stage to fit the organization's needs, and organizational structures are altered. In the organizational innovation process shown in Figure 3-4, the redefining and restructuring stage is the first stage in the implementation subprocess which consists of all activities involved in putting an innovation into use. According to Rogers, both the innovation and the organization are expected to change to some degree during this stage. Rogers suggests (ibid., p. 425) that the implementation of a technological innovation in an organization results to a mutual adaptation of the innovation and the organization because the innovation almost never perfectly fits in the adopting organization. Regarding open source innovations, Woods and Guliani (2005, p. 66) share the same view arguing that adapting even the most mature open source solution to the IT environment will usually involve learning something new. Wareham and Gerrits (1999) give suggestions and guidelines based on business best practices to support the change involved in the incorporation of new technology in the organization. In business best practice, an organization is building on the experience and knowledge of other organizations to exploit the technology rather than generating the knowledge organically.

As the result of redefining and restructuring activities, the innovation imported from outside the organization gradually looses its foreign character.

Considering the activities involved in the redefining and restructuring, Rogers (ibid., p. 426) draws on the classification presented earlier by Tushman and Nadler (1986) by introducing the concept of *radical (discontinuous) innovations* which involve such a major change that they represent new paradigms for carrying out some tasks. The more radical an innovation and the more knowledge is required in the adoption of the innovation, the more uncertainty it creates and the more difficult the implementation gets. *Incremental innovations* represent routine innovation adoption. They do not require new paradigms to carry out tasks, they require less technical expertise in the implementation and create less uncertainty.

OpenOffice.org can be characterized as an incremental innovation in the classification between radical and incremental innovations. As noted in Section 5.1, OpenOffice.org has been designed to facilitate possible adoption by replicating many of the familiar features and functions in the user interface of the dominant office software product, Microsoft Office. In addition, conclusions from the functionality evaluation in Sub section 5.4.1 showed that in ordinary tasks, only a very limited set of features of the software are used. Beckett (2005, p. 21) noted that the basic features are implemented in an effectively identical way in office software products. Also the interoperability was found adequate in the compatibility

evaluation in Sub section 5.4.2 and in the case studies and evaluations presented in Sub section 5.2.5 and in Section 6.1. The compatibility with existing products suggests that OpenOffice.org does not require any paradigm shift in carrying out routine tasks in the office environment. The conclusions from the OpenOffice.org pilot project of the Ministry of Justice in Sub sections 5.4.4 and 5.4.5 suggest that OpenOffice.org does not present high requirements for technical expertise in the implementation. Rogers notes (ibid., p. 426) that radical innovations create uncertainty which in turn may foster resistance to the technology. The incremental character of OpenOffice.org suggests that the implementation should not involve special difficulties due to the changes in the tasks of the users or due to the uncertainty and the resulting resistance to the new technology being adopted.

The chapter is structured as follows. In Section 7.1 we present the modifications and re-invention involved in the redefining of the innovation. Next, in Section 7.2 we present restructuring activities. We summarize the chapter with a section giving a review of the results of the redefining and restructuring stage.

7.1 Redefining the innovation

Rogers (2003, p. 424) uses the general term redefinition to signify the adaptation of the innovation to fit the organization's needs. In the context of this research, we interpret the redefinition to consist of the following possible adaptations:

- OpenOffice.org is a software innovation which means that modifications may involve modifications to the source code. Because OpenOffice.org is open source software, the source code is available and the licensing terms allow source code modifications to be performed by the adopter organization. Source code modifications facilitate fundamental modification possibilities because they allow changes both to the user interface of the innovation and also to the internal logic and functions provided by the software.
- The OpenOffice.org installation can be supplemented with add-on components to provide additional functionality. Language packs can be downloaded from the OpenOffice.org website to provide support for additional user interface languages. Spelling, hyphenation, and thesaurus dictionaries to various languages are available as extensions. Also a plentiful of other add-on components, including the MultiSave tool discussed before in Sub section 5.4.1, are available as extensions from the OpenOffice.org extensions web service[39]. The exploitation of add-on components does not involve any changes to the source code of the OpenOffice.org software.
- OpenOffice.org may also be adapted to the organization's needs by modifying various settings provided by the software. These include, e.g., options available

39 http://extensions.services.openoffice.org (cited 11 June 2010)

from the *Tools* menu, keyboard assignments, toolbar settings, and default template specifications. The exploitation of settings does not involve any changes to the source code of the OpenOffice.org software.

The concepts of redefinition and re-invention are related. Re-invention is defined by Rogers (2003, p. 180) as the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation. The above redefinition adaptations facilitate different re-inventions with changes to the source code providing the utmost possibilities in the modification of the innovation. Rogers (ibid., p. 187) argues that some form of re-invention occurs when an innovation must be adapted to the structure of the organization that is adopting it.

In practice, the specific instantiation of the redefinition adaptations is realized in the OpenOffice.org installation and configuration model which is first designed and then deployed in the IT environment of the adopter organization.

As discussed in Sub section 5.4.5, the OpenOffice.org installation and configuration model which was used in the deployment during the implementation stages was already designed during the matching stage in March 2006. Also the actual desktop installations were carried out during the matching stage, starting immediately after the installation and configuration model had been finished.

The OpenOffice.org desktop installation was based on OpenOffice.org version 2.0.2 which was adapted to the needs of the Ministry of Justice. In this case, the redefinition of the innovation consisted of the following adaptations:

- support for bilingual user interface (Finnish and Swedish);
- support for additional spelling and hyphenation languages (Finnish, Swedish, and French);
- OpenOffice.org user settings and keyboard shortcut assignments;
- additional installation settings for Swedish-language offices;
- customized default text templates complying with Finnish document standards;
- support for multiple saves in one save operation (MultiSave).

The above adaptation of OpenOffice.org was mostly implemented using suitable add-on components to the basic installation package. Support for bilingual user interface was implemented using language packs available as downloads from the website of the OpenOffice.org community. The support for additional spelling and hyphenation languages was implemented using dictionaries available as downloads from the OpenOffice.org community. As discussed in Section 5.4, the Finnish spelling and hyphenation component (Soikko) was an exception to the ready-made download extensions in the sense that adjustments to the Soikko component were required in order to support version 2 of OpenOffice.org. As discussed in Sub section

5.4.1, also the open source MultiSave add-on component was developed further for the needs of the Ministry of Justice by adjusting it to multiple languages, including Finnish. The exploitation of the MultiSave component represents best practice technology transfer from another organization, in this case the French Customs. Wareham and Gerrits (1999) argue that in most cases some adaptation of the best practice is needed. The adaptation of the MultiSave component in the migration confirms the argument.

Other adjustments to the Finnish environment in the installation included Finnish and Swedish default text document templates complying with the Finnish document standard SFS 2487. In order to support smooth migration from SmartSuite WordPro to OpenOffice.org, some keyboard shortcuts were assigned to paragraph styles which were familiar to WordPro users, like the function key F4 for the hanging indent paragraph style. Also the default user settings of OpenOffice.org, available mainly through the *Tools – Options* menu, were adjusted to the IT environment of the Ministry of Justice. These included, e.g., path settings, font settings, print settings, and settings to control the interoperability with Microsoft Office document formats.

The installation model described above was published in September 2006 as a freely available, general-purpose OpenOffice.org engineering handbook (Friman and Karjalainen, 2006). The handbook was written to serve both private persons and organizations in Finland in the OpenOffice.org installation and migration issues.

The above redefining activities were carried out in March 2006 to support the first OpenOffice.org version (version 2.0.2) to be used in the organization-wide deployment within the Ministry of Justice and its administrative sector. The redefining activities were done mostly as in-house work. One day of external third-party services was acquired in the preparation of the recommended user settings of OpenOffice.org (the various options available in the *Tools* menu). Rogers (2003, pp. 425-426) suggests that innovation adoption is facilitated if a good deal of re-invention occurs within the adopting organization with the organizational units having opportunities to participate in the re-invention. The low exposure to external third-party services in the redefinition of OpenOffice.org thus suggests supportive conditions to the OpenOffice.org migration in the study organization.

During the actual deployment, a new version of OpenOffice.org was introduced and installed on Windows XP workstation computers in early 2009. Both versions 3.0.0 (released in October 2008) and 3.0.1 (released in January 2009) were tested for the new installation model. The redefining activities were finalized with version 3.0.1 in February 2009 using the same approach as with version 2.0.2 consisting of the following adaptations:

- support for bilingual user interface (Finnish and Swedish);
- support for additional spelling and hyphenation languages (Finnish, Swedish, and German);
- OpenOffice.org user settings and keyboard shortcut assignments;

- additional installation settings for Swedish-language offices;
- customized default text templates complying with Finnish document standards;
- support for multiple saves in one save operation (MultiSave);
- support to modify pdf files (PDF import).

With the new version 3 of OpenOffice.org, also new versions of the extensions were included in the installation model. The Finnish spelling and hyphenation module Soikko was discontinued and replaced with the new open source Voikko spelling and hyphenation extension. Some minor changes in the user settings were incorporated, and some additional paragraph and page styles were included in the default text templates. Two new extensions were included in the installation model: the extension to support the editing of pdf files in OpenOffice.org (*PDF import*) and the extension to disable the OpenOffice.org registration during the first start-up of the program (*Disable First Start Wizard*). Overall, the compatibility between OpenOffice.org versions 2 and 3 was high requiring no special adjustments to the installation model of version 3. Following the same procedure as with version 2, the installation model of version 3 was published as a freely available, general-purpose OpenOffice.org engineering handbook (Karjalainen, 2009a) in March 2009. In the new handbook, more emphasis was given to detailed instructions on how to carry out automatic silent installations without user interactions.

Considering the redefining activities with version 3 of OpenOffice.org in 2009, changes in the organization of the IT service function of the ministry resulted more technical work being acquired from third-party service providers. This resulted to three days of external third-party services being acquired in the redefining of OpenOffice.org version 3 compared to one day of third-party services acquired in 2006 in the redefining of OpenOffice.org version 2. With version 3, external services regarding the Microsoft Windows Installer technology were acquired in the preparation of the OpenOffice.org installation procedure for Windows workstations.

The installation of OpenOffice.org version 3 on the Windows XP platform was carried out at the same time when all workstation computers where re-installed in 2009. During 2009, an extensive software and hardware upgrade was performed. The software renewal included, e.g., the upgrade of the Windows XP service pack, the upgrade from Lotus Notes version 6 to version 8 and upgrades to both systems management and security software. The OpenOffice.org installation model was included in the basic Windows XP installation package together with other common infrastructure software components. According to the internal systems documentation, over 8 000 new workstations were acquired in the upgrade with the Windows XP installation package pre-installed at the factory. The remaining old computers where re-installed by the IT support staff of the Ministry of Justice.

The redefining activities also resulted to the design and distribution of the OpenOffice.org installation model on CD-ROM's and on USB memory sticks. In

December 2006, altogether 2 000 CD-ROM's were prepared (research diary: delivery of ready-made CD-ROM's from the service firm on 11 December 2006). The CD-ROM's were equipped with the installation components and supportive documentation. CD-ROM's were given to interested staff members during training sessions to encourage home computer installations. CD-ROM's were also distributed to outside organizations showing interest in OpenOffice.org.

As discussed in Sub section 5.4.1, OpenOffice.org Portable on USB memory stick was first used in the pilot project by the project team as a mobile OpenOffice.org installation and test environment. The author of this study then localized and customized the USB memory stick version of OpenOffice.org to follow the same installation and configuration model as on the Windows XP workstation computers of the Ministry of Justice. Close to 400 USB memory sticks with OpenOffice.org Portable have been distributed to the staff members and also to outside organizations since the commencement of the migration in 2007.

Redefining activities of OpenOffice.org were also carried out in the study as the result of Finnish Parliament actions. In October 2007, Member of Parliament Jyrki Kasvi posed a question (identification code KK 389/2007 in the Parliament question diary) to the Speaker of the Parliament regarding, inter alia, the inability of several public administrations to open documents received in the ISO standardized ODF format. The answer to the question was given in November 2007 by Minister of Justice, Ms Tuija Brax, who brought up the possibility that Ministry of Justice could help public administrations by preparing USB memory sticks equipped with ready-made OpenOffice.org installation and supporting ODF documentation. In October and November 2007 the author of this study prepared the required OpenOffice.org Portable USB memory stick distribution which was based on OpenOffice.org version 2.2.1 (research diary: USB memory stick 2.2.1 installation completed on 31 October 2007; delivery to the Ministry of Finance confirmed in an e-mail on 2 November 2007). In August 2008 the USB stick distribution was further upgraded by the author of this study to OpenOffice.org version 2.4.1 (research diary: USB memory stick 2.4.1 installation completed on 14 August 2008; delivery to the Ministry of Finance confirmed in an e-mail on 15 August 2008). Ministry of Finance (2008) released the upgraded distribution as a zip-compressed download file from the website of the Finnish Local Government IT Management Unit (KuntaIT) in October 2008. In April 2009 the USB stick distribution was further upgraded by the author of this study to OpenOffice.org version 3.0.1 (research diary: USB memory stick 3.0.1 installation completed on 13 April 2009; delivery to the Ministry of Finance confirmed in an e-mail on 13 April 2009). Ministry of Finance (2009a) published the upgraded distribution which was made available as a zip-compressed download file by the *oopfin* project (Finnish OpenOffice Portable) from the OSOR website[40] in May 2009. The *oopfin* project was the first Finnish open source project to provide distribution through the OSOR website.

40 http://forge.osor.eu/projects/oopfin/ (cited 11 June 2010)

It can be noted that the redefining activities described above did not include any changes to the source code of OpenOffice.org. All adjustments were carried out using various add-on components and settings which were supported by OpenOffice.org. Open source software offers technically utmost possibilities to re-invention because the source code is available and can be freely adjusted to serve any special needs by the adopter. In this case, source code changes were avoided for several reasons. The involvement with programming a large program like OpenOffice.org consisting of more than 4 million lines of C++ code (Behrens, 2006) would have required technical expertise beyond the current resources available in the Ministry of Justice. In addition, in case source code changes would be implemented, technical expertise and resources in maintaining the software would be continuously required during the deployment years of the software. The approach to use the software with unmodified code base and to implement possible adjustments using available extension and setting facilities was considered the preferred approach. The *Extension Manager*, available through the *Tools − Extension Manager* menu command, provides extension and adaptation facilities to the OpenOffice.org installation without requirements for source code changes. Extensions are available as downloads from the OpenOffice.org extension services. Even the available redefinition facilities were utilized cautiously avoiding, e.g., changes to program menus and toolbars which would have required maintenance activities when new versions of the software would be introduced in the future. Major changes to program menus and toolbars would also have limited the usefulness of general OpenOffice.org user documentation. Thus rather than finding an optimal design using all available redefinition possibilities of the innovation, the approach in redefining was to find a satisfactory design (Simon, 1996) for the actual software deployment.

7.2 Organizational restructuring

Restructuring activities are related to changes in the organization which is expected to change to some degree during the adoption of the innovation. Rogers (2003, p. 404) defines an organization as a stable system of individuals who work together to achieve common goals through a hierarchy of ranks and a division of labor. Following this definition of an organization, the restructuring activities thus target changes in the system of individuals during the adoption of the innovation.

Overall, it can be concluded that the implementation of OpenOffice.org adoption did not result in any permanent administrative changes in the organization. For example, no new organizational units were established and no administrative re-organization of existing units was considered necessary. Fixed-term project organizations were used during the implementation to perform the tasks required in the OpenOffice.org adoption.

The initial fixed-term implementation project and the corresponding steering group were established in the beginning of 2007. The implementation project consisted of members from the in-house IT staff having experience with training, IT support, word processing, document templates, and software installations and configurations. In addition to the in-house IT staff, a temporary training secretary was hired for six months to the implementation project in 2007. The author of this study acted as the project leader. The implementation project carried out the training of the staff and, supported document and template conversions, and provided the initial user support and technical support in the OpenOffice.org deployment.

For the implementation of the remaining application integrations with OpenOffice.org, another fixed-term project was established in 2009. The project team included members from the in-house IT staff and from the organization units owning the applications. Project members also included experts from third-party service providers maintaining the application software. The author of this study acted as the project leader also in this project.

While administrative restructuring resulted only to temporary fixed-term project structures, the building of in-house skills resulted to more lasting influences in the organization. As the result of the implementation project, the in-house skills regarding OpenOffice.org training and user support developed to the extent that OpenOffice.org training and user support were incorporated into the regular activities in the IT training and in IT support provided by the IT service function of the Ministry of Justice. Woods and Guliani (2005, p. 115) suggest that productization provides an opportunity for in-house skill building. This opportunity was applied in the migration with the emphasis being on writing both end-user and engineering documentation. In addition to internal skill building, the productization efforts also did a service for the Finnish OpenOffice.org community. The end-user documentation included general OpenOffice.org handbooks (Karjalainen and Karjalainen, 2006; Karjalainen and Karjalainen, 2007) and engineering documentation (Friman and Karjalainen, 2006; Grönroos and Karjalainen, 2007; Karjalainen, 2009a). The in-house skills of the organization were also developed by participating and contributing to the OpenOffice.org user support forums and OpenOffice.org Quality Assurance project[41]. As an example of the participation, issues 95907 (Writer defect) and 95943 (Impress defect), opened on 6 November 2008 and on 7 November 2008 in the Quality Assurance project documentation, were registered by the implementation project of the Ministry of Justice. Both issues were related to defects in OpenOffice.org version 3.0, and they were scheduled to be fixed in version 3.2. Cohen and Levinthal (1990) argue that gradual learning and skill building also develop the absorptive capacity of the organization which facilitates the implementation of an innovation.

Changes in the organization include new skills to be acquired by the users of office suite software to exploit and embed OpenOffice.org in daily work routines.

41 http://qa.openoffice.org/index.html (cited 30 July 2010)

Huy (2001) proposes four ideal types of change intervention approaches for altering organizational elements. The four types are commanding (to change formal structures), engineering (to change work processes), teaching (to change beliefs), and socialization (to change social relationships). Huy argues that a large-scale change involves an alteration of multiple organizational elements and requires the application of multiple change approaches. This conclusion was confirmed in this study. Commanding, teaching, and engineering approaches were applied in the OpenOffice.org migration of the Ministry of Justice. The commanding approach involved the authoritative adoption decision, discussed in Section 6.5, which was issued from the top management of the organization. In Sections 8.3 and 8.4 we discuss the engineering intervention approach which involved the efforts to provide new document templates and the implementation of changes in the back-office application interfaces to support OpenOffice.org. The teaching intervention in Section 8.3 includes excessive training activities implemented by the migration project in order to provide end-users with skills needed in the exploitation of the new office suite software.

As discussed earlier in this chapter, OpenOffice.org was characterized as an incremental innovation representing routine innovation adoption. Contrary to radical innovations, incremental innovations do not require new paradigms to carry out tasks and they require less technical expertise in the implementation. The experience from the restructuring activities in this study supports the incremental character of OpenOffice.org. The experience also suggests that the restructuring activities in OpenOffice.org adoption involve only minor administrative changes with the emphasis in restructuring being on skill building.

7.3 Review

The redefining and restructuring activities were partly initiated already during the matching stage in 2006 when the OpenOffice.org installation and configuration model which was used in the deployment during the implementation stage was designed and installed on Windows XP workstation computers. However, the main part of redefining and restructuring was performed during the years 2007-2009 after the commencement of the OpenOffice.org migration in 2007.

The following summarizes the main results and findings of the redefining and restructuring stage.

- Rogers (2003, p. 424) argues that both the innovation and the organization are expected to change to some degree during this stage. The results of the redefining and restructuring stage confirm this argument.
- Business best practices from other organizations were applied to support the change involved in the incorporation of new technology in the organization.

Wareham and Gerrits (1999) argue that in most cases some adaptation of the best practice is needed. The results of the redefining activities confirm this argument.

- In the redefinition of the innovation, we identified three types of possible adaptations: (1) source code modifications, (2) add-on components available as extensions, and (3) facilities for various settings provided by the software. The last two adaptations do not involve changes to the source code. All three adaptations facilitate different re-inventions with changes to the source code providing the utmost possibilities in the modification of the innovation. Rogers (2003, p. 187) argues that some form of re-invention occurs when an innovation must be adapted to the structure of the organization that is adopting it. The exploitation of add-on components and various OpenOffice.org settings confirms the argument in this study.
- Two major OpenOffice.org redefining activities were performed during the study. First for the initial version 2.0.2 in March 2006 and then for version 3.0.1 during the actual deployment in February 2009. Redefining activities included the design and implementation of the installation and configuration of the software. Redefining was implemented mostly as in-house work with third-party services acquired only for one day for version 2.0.2 and for a total of three days for version 3.0.1. The redefining activities were published as freely available, general-purpose OpenOffice.org engineering handbooks (Friman and Karjalainen, 2006; Karjalainen, 2009a). Rogers (2003, pp. 425-426) suggests that innovation adoption is facilitated if a good deal of re-invention occurs within the adopting organization with the organizational units having opportunities to participate in the re-invention. The low exposure to external third-party services in the redefinition of OpenOffice.org suggests supportive conditions to the OpenOffice.org migration in the study organization.
- The redefining activities did not include any changes to the actual source code of OpenOffice.org. Source code modifications were avoided due to the lack of programming resources required in the implementation and in the maintenance of the software. All adjustments to fit OpenOffice.org to needs of the Ministry of Justice were carried out using various free extension components and settings which were supported by OpenOffice.org. With version 2.0.2, minor adjustments were implemented in two extension components while only ready-made free add-on extensions were used with version 3.0.1. Following Simon (1996), the redefining activities were more concerned with finding a satisfactory design for the software deployment rather than finding an optimal design using all available redefinition possibilities.
- Additional redefining activities were performed in order to provide installation CD-ROM's and USB memory stick distributions of OpenOffice.org Portable. Overall, 2 000 CD-ROM's and close to 400 USB memory sticks were

distributed to staff members and also to outside organizations. USB memory stick distributions for several OpenOffice.org versions were also prepared in the study for Finnish public administrations to be delivered as downloads from the website of the Finnish Local Government IT Management Unit (KuntaIT) and from the European open source OSOR website.

- OpenOffice.org was found to be an incremental innovation representing routine innovation adoption. Contrary to radical innovations, incremental innovations do not require new paradigms to carry out tasks and they require less technical expertise in the implementation. The incremental character of OpenOffice.org suggests that the implementation should not involve special difficulties due to the changes in the tasks of the users or due to the uncertainty and the resulting resistance to the new technology being adopted. The experience suggests that the restructuring activities in OpenOffice.org adoption involve only minor administrative changes with the emphasis in restructuring being on skill building.
- As the result of the redefining and restructuring activities, the in-house skills regarding OpenOffice.org training and user support developed to the extent that OpenOffice.org training and user support were incorporated into the regular activities in the IT training and in IT support provided by the IT service function of the study organization. Following Cohen and Levinthal (1990), gradual learning and skill building also develop the absorptive capacity of the organization which in turn facilitates the implementation of an innovation. As suggested by Woods and Guliani (2005, p. 115), productization efforts were used as an opportunity for in-house skill building with emphasis being on writing both end-user and engineering documentation. The extensive productization efforts also did a service for the Finnish OpenOffice.org community. In addition to the extensive training and productization efforts, the in-house skills of the organization were also developed by participating and contributing to the OpenOffice.org user support forums and quality assurance activities.
- Changes in the organization included new skills to be acquired by the users of office suite software to exploit and embed OpenOffice.org in daily work routines. Confirming the results presented by Huy (2001), several change intervention approaches were applied for altering organizational elements. The OpenOffice.org migration applied commanding, teaching, and engineering change intervention approaches.

8 Clarifying

In this chapter we present the clarifying stage of this innovation adoption study. In the organizational innovation process shown in Figure 3-4 in Sub section 3.2.2, the redefining and restructuring stage is followed by the clarifying stage where the relationship between the organization and the innovation is defined more clearly. As the result, the innovation gradually becomes embedded in the organizational structure. Following Rogers (2003, p. 427), at this stage the innovation is put into more widespread use in the organization, so that the meaning of the new idea gradually becomes clearer to the organization's members through a social process of human interaction.

We designed the contents of the clarifying stage to involve activities necessary in putting OpenOffice.org into more widespread use in the study organization. We considered the following topics to be essential in the process of usage expansion and human interaction:

- The basic approach in extending the use of the innovation may be based either on a gradual or on a rapid migration process. This topic is discussed in the migration path approach where IDA (2003a) and KBSt (2005) provide the complementary concepts and guidelines to Rogers' framework addressing open source innovations.
- The usage expansion of OpenOffice.org requires communication and training efforts so that the organization's members become aware of the innovation and its intended use and are provided with skills needed in the exploitation of the innovation. Document conversions is a special migration topic in the exploitation of the office suite software. In the communications and training approach, we draw on the open source migration experiences and approaches presented by Beckett et al. (2006a) and Beckett and Wright (2006).
- Widespread use of OpenOffice.org in the study organization calls for development efforts to application integrations in order to intertwine OpenOffice.org also with organizational routines which require integrations to back-office applications. Because application integrations do not require redefinition activities to OpenOffice.org, we considered the integration issue as a part of the clarifying stage.

According to Rogers (ibid., 428), the management of the innovation process is difficult and complicated especially at the clarifying stage because unwanted side effects or misunderstandings regarding the innovation may occur. He suggests (ibid.,

p. 428) that innovation champions usually play an important role in the clarifying process.

The clarifying stage is structured as follows. In Section 8.1 we discuss the basic approach concerning the implementation actions during the clarifying stage. In the following section we discuss the role of communication and related activities in the implementation. Next, in Section 8.3 we present principles and activities concerning training and document conversions. In Section 8.4 we present approaches in the integration of OpenOffice.org with back-office applications. We summarize the chapter with a section giving a review of the results of the clarifying stage.

8.1 Migration path

At the clarifying stage, there are two main paths to proceed in the implementation of the migration process. The KBSt migration guide (KBSt, 2005, p. 448) defines *one-step migration* (also known as *big bang*) as an approach meaning rapid transition from the old system to the new system in a short time in one step which has a defined commencement date and a defined end date. At the extreme case, the transition can even be implemented on the same day for all users. *Phased migration* or *gradual migration* is the opposite of big bang meaning a transition where the target is clear but where the time frame is defined only very generally, with the migration process taking place in several distinctive steps. The steps can, e.g., be based on user groups or components of the IT system. Rogers (ibid., p. 427) gives examples of implementation problems and failures resulting from undue haste and suggests that too rapid implementation of an innovation at the clarifying stage can lead to disastrous results.

The implementation of OpenOffice.org adoption facilitates both big bang migrations and gradual migrations. Leonard-Barton (1988) defines the divisibility of an organizational innovation as the ability to divide the implementation by stages or by sub-populations. In a gradual migration, the OpenOffice.org adoption can be implemented in an organization in stages which can, e.g., be based on the requirements of user groups or on the requirements of back-office integrations.

The open source migration guidelines of the IDA programme (IDA, 2003a, p. 19) clearly suggest avoiding big bang migrations which typically have large resource requirements during the changeover and high risk of failure due to many variables to be controlled by the management. The guidelines suggest that the big bang migration scheme is only likely to appeal to small organizations. Gradual migration approach is preferred in the OpenOffice.org migration study by Rossi et al. (2006) where the authors also suggest voluntary measures to be applied in the initial phases of OpenOffice.org adoption. However, also the big bang approach has been been applied in OpenOffice.org migrations. The OpenOffice.org study by Ven et al. (2006) reports a big bang migration involving eight ministerial cabinets in the

Brussels public administration. Mandatory measures, including the removal of Microsoft Office from workstations simultaneously with the introduction OpenOffice.org, were applied in the migration which was based on the authority decision issued by the Government of the Brussels-Capital Region. Altogether a total of 400 Windows XP desktops were involved in the migration which was implemented in one month during January-February 2005.

The gradual migration approach was chosen in this study. The big bang approach with plenty of simultaneous activities including the training of thousands of employees, document template conversions, and modifications to various back-office applications would have resulted to high resource requirements in a short time concerning expenses, implementation personnel, and know-how. In a gradual approach the necessary resource requirements can be more evenly distributed to several years. The phased migration also enables gradual development of skills needed in the OpenOffice.org migration. Starting with activities requiring less expertise enables the implementation skills to grow and develop which in turn yields more expertise being available when more complex implementation tasks are tackled. As argued by Cohen and Levinthal (1990), gradual learning and skill building develop the absorptive capacity of an organization which facilitates the implementation of an innovation. The gradual development of skills is only possible if the skills remain available for the organization during the implementation period. This in turn supports the approach to emphasize the involvement of the own IT staff in the implementation as opposed to the approach to base the implementation to the acquisition of temporary third-party resources.

Following the phased migration approach together with the approach of gradual skill building, the first migration activities, started in January 2007, were targeted to offices and to user groups with no complex requirements concerning back-office integrations. This enabled initial implementation efforts to concentrate on OpenOffice.org training and necessary document conversions and templates. The target offices with no complex requirements included, e.g., district courts, enforcement offices, and State legal aid. These offices alone employ more than 4000 employees. Migration activities involving more complex IT requirements were scheduled to later phases in the implementation.

8.2 Communications

Following Rogers (2003, p. 427), a social process of human interaction is involved at the clarifying stage in the dissemination of understanding about the innovation to the organization's members. The purpose of communication activities in this study is to facilitate the dissemination of information and understanding concerning the OpenOffice.org migration in the Ministry Justice.

User acceptance has been identified as an important issue in the implementation of innovations. As noted by Templeton et al. (2009) and Kaplan (2006), the focus on users is critical in the implementation in order to reduce the risk of innovation rejection by organizational members. Templeton et al. (ibid.) suggest several points to consider while interacting with organizational members during acceptance. These include the stimulation of dialogue and collaboration, wide participation of users, and modular approach by adopting elements as needed focusing on alleviating possible organizational limitations. In the StarOffice migration carried out by Bristol City Council, Beckett et al. (2006a) defined three main goals for the communication during the migration project:

- *To increase the level of acceptance and usage for the new software*. Lack of knowledge had been found a significant cause for resistance. Answering questions and showing the software in practice would begin to address user concerns.
- *To reduce the project team resources needed for deployment and migration*. Several known questions and problems considering the deployment of the software can be solved in advance. With suitable communication and self help facilities the effect of these known issues to the implementation project can be reduced.
- *To assist in planning the change to business processes generated by the move to the new software*. Communication about the planned migration activities supports preparations concerning new document templates and integrations to other software.

	The decision	**Implementation plan**	**Migration activities**
Presentations	To management and functional groups as they are affected		To each team as part of preparation for migration
E-mails	To all at start of project		Specific prompts for information or notification of planned events
Intranet site	FAQ and background information	Current plan and state of progress	Self help information, course bookings, technical contacts

Table 8-1. Bristol City Council communication strategy (Beckett et al., 2006a, p. 9)

Based on the goals of the communication, Beckett et al. (2006a) split the communication strategy in three elements. Following the progress of the migration,

the communication activities were focused (1) on the migration decision, (2) on the implementation plan, and (3) on the actual migration activities affecting end-users. Main communication methods used in the migration carried out by Bristol included presentations, e-mail, and an intranet site. Table 8-1 summarizes the communication strategy applied in the migration of the Bristol City Council.

The OpenOffice.org migration of the Ministry of Justice shares several aspects with the migration implemented in Bristol City Council. In the following, the communication framework depicted in Table 8-1 is used to discuss the principles and methods of communication in the OpenOffice.org the migration of the Ministry of Justice. Using the guidelines of Wareham and Gerrits (1999, p. 47), the experience and knowledge of the communication framework presented by Beckett et al. (2006a) has been applied in the migration of the Ministry of Justice to facilitate the change process involved in the migration.

Once the decision to adopt OpenOffice.org had been made in December 2006, the decision and its background were communicated widely in the organization in order to provide accurate information and to prevent misinformation from circulating. Information on the decision was posted on the intranet site, and in December 2006 the Office of the CIO sent an information package to all 300 offices of the organization consisting of the following materials (research diary: delivery of information package on 20-21 December 2006):

- the adoption decision issued by the Permanent Secretary and the CIO of the Ministry of Justice;
- OpenOffice.org and ODF migration guide;
- OpenOffice.org user handbooks (Karjalainen, 2006a) and installation CD-ROM's.

The 9-page migration guide provided general answers to questions regarding the background of the adoption decision in order to help the staff to understand how the migration will affect them. It also presented some general features of OpenOffice.org. The migration guide was later on updated regularly and distributed by e-mail and by intranet site to staff members during the progress of the migration. More detailed information was provided in the accompanying OpenOffice.org user handbooks. It should be noted that OpenOffice.org had already been installed on the workstations at that point, as discussed in Section 7.1. This allowed fairly detailed information to be distributed because more advanced users were immediately able to use the software on their workstations.

As the result of redefining activities discussed in Section 7.1, installation CD-ROM's and USB memory stick distributions of OpenOffice.org had been prepared. Communication activities included the distribution of thousands of installation CD-ROM's and OpenOffice.org Portable USB memory sticks to users to support trial use and home computer installations. Following Rogers (2003, p. 236), the distribution

of free installation media can be regarded as incentives given to users to encourage the change and to increase user acceptance of the innovation. Similar approach had also been used in other OpenOffice.org migrations, e.g., in French Customs (Section 6.1), in the Brussels public administration (Sub section 5.4.3), and in the Spanish region of Extremadura (Sub section 5.2.5).

In the dissemination of understanding about the innovation, presentations combined with question and answer sessions enable face to face communication in a short time for groups of people. Presentations on the decision were given to critical groups and managers, both initially and at intervals during the migration. The initial presentations were given by the author of this study in the largest offices situated in Helsinki, Tampere, Turku, Espoo, Vantaa, and Oulu (research diary: the first presentations in the District Court of Helsinki on 9 February 2007). Presentations were created and shown using OpenOffice.org in order to reassure staff on the capabilities of the software and at the same time to familiarize staff with OpenOffice.org.

An intranet site is a useful communication tool which provides access to necessary information at any time to all staff members. The OpenOffice.org pilot project, discussed in Section 5.4, implemented the initial browser-based OpenOffice.org e-learning platform and intranet which was based on the open source Moodle software. The intranet site was then developed further and used also in the actual implementation project for several purposes. The implementation plan and the diary of implementation activities and progress were maintained using a wiki on the intranet site. The intranet contained frequently asked questions (FAQ), handbooks, training materials as well as discussion pages and OpenOffice.org news and product information. An example screen of the migration intranet is shown in Figure 5-2 in Sub section 5.4.3.

E-mail notifications to targeted user groups about migration activities and planned events were extensively used in the migration. E-mail is also an efficient communication tool to provide detailed instructions for individual users when direct face to face contact is not possible. Within the Ministry of Justice and its administrative sector, each office has a staff member nominated as the main IT contact person of the office. All planned activities and training events were first agreed with the IT contact persons using extensively e-mail as the communication tool. E-mail proved to be a useful communication tool also in the information dissemination when document conversion workshops were arranged with smaller groups of more advanced users.

8.3 Training and document conversions

The migration to OpenOffice.org and to the ODF document format was scheduled to commence from the beginning of 2007. However, important preliminary activities

supporting the training and document conversions had already been completed as the result of the OpenOffice.org pilot project discussed in Sub section 5.4.3:

- Finnish-language user documentation was made available. The documentation included OpenOffice.org Handbook of Questions and Answers (Karjalainen and Karjalainen, 2006), OpenOffice.org Express Guide (Ruohomäki, 2005), and OpenOffice.org Template Guide (Grönroos, 2006).
- The framework depicted in Table 5-6 was designed in the pilot project for the contents and structure of a basic OpenOffice.org training day. The framework was also tested in practice in the 16 training events arranged during the pilot project. Experience had shown that one-day training is sufficient to acquire basic skills in the use of OpenOffice.org when the participants already had previous experience in the use of an office suite package.
- The browser-based OpenOffice.org e-learning environment with frequently asked questions, handbooks, training materials as well as discussion and problem solving pages had been designed and implemented in the pilot project. The platform was based on the open source Moodle software.
- OpenOffice.org document templates complying with the Finnish document standard SFS 2487 were produced as the result of the piloting.

As discussed in Section 8.1, the migration followed the phased migration approach with the first migration activities addressing offices and user groups with no complex requirements concerning, e.g., back-office integrations. The first courses on OpenOffice.org were given in January 2007 by the author of this study (research diary: the first training events on 11-12 January 2007). The initial training activities were organized in the largest offices situated in Helsinki, Tampere, and Turku involving staff from district courts, enforcement offices, and State legal aid.

The organizational approach to the training was completely implemented through the implementation project established in 2007. The project team consisted of members from the in-house IT staff having experience with training, IT support, and document templates. In addition, a temporary training secretary was hired for six months to the implementation project. The members of the implementation project actually gave the majority of the training. External training service providers were used mainly to balance the training load and to give some specialized training, e.g., in the design and implementation of document templates. External training services were also used in the training of in-house trainers. The emphasis on using own IT staff in the training facilitated the development of in-house OpenOffice.org expertise and thus the absorptive capacity of the organization during the implementation, as suggested by Cohen and Levinthal (1990). In total, 523 training sessions were given in the implementation project during the years 2007-2009. In-house instructors gave 497 (95 %) of the training sessions. The remaining 26 training sessions (5 %) were

given by external training service providers. Altogether 13 in-house staff members acted as instructors in the training, most of them being local IT support employees giving training in the offices in their proximity. The author of this study was the most active instructor giving altogether 245 training sessions.

The establishment of a general level of competence in the new software and targeted training appropriate to the needs of various user groups were major drivers to ensure efficient use of the software. Because all users have not used office automation software or have very limited competence in using word processing and spreadsheet software, it was considered necessary to provide training classes where participation would be open to as many as possible. This was facilitated by open invitations to participate training and by covering the costs of the training from the funds allocated to the implementation project.

A mixture of training methods was used to meet the needs of groups of users and to adjust training to the resources available.

The Ministry of Justice has several classrooms suitable for IT training. The classrooms are equipped with desktop workstations and they are situated in offices throughout the country. Conventional classroom based training with typically 8 to 12 participants and led by the instructor was the most often used training method both in the basic and in the advanced training sessions. Course outlines were based on the framework depicted in Table 5-6 and adjusted to the needs and skill level of users participating the training sessions. One-day basic training course could cover all three programs (Writer, Calc, and Impress) or a combination of the programs, depending on the needs and skill level of the participants. Also half-day courses concentrating on one program were often given, especially when participants had difficulties in attending a whole day for the training. Course materials typically included the course outline, the OpenOffice.org handbook, a migration guide summary, and a compact description of the user interface of OpenOffice.org. In order to provide useful practical course material and to facilitate smooth migration, the instructor often prepared beforehand standard letter, memorandum and fax templates equipped with the contact information of the participants' offices. The main IT contact persons of the offices played an important role in adjusting the general training framework of Table 5-6 for the specific courses to be delivered.

Conventional classroom based training was also often used when training sessions covering more advanced functions of the software were arranged. Advanced functions in Writer typically involve the mastering of a combination of software features, like the automated generation of the table of contents which is based on the concept of paragraph styles. More complicated documents often involve several page numbering methods which in OpenOffice.org requires the understanding of page styles and headers and footers. Typical other advanced functionalities in Writer include mail/merge and the printing of labels. In general, the mastering of various options to control the printing of documents is a common subject in advanced training regarding all programs in the OpenOffice.org office suite. Typical advanced

subjects in the mastering of the Calc program include expressions (formulas), cell referencing options, functions, charts, and spreadsheet protection. In Impress presentations, typical advanced subjects include the management of master pages, custom animations, and tools to handle drawings and other graphics.

Workshop training was used as a training method especially with small groups of advanced users on specialized subjects. Workshops did not follow a predefined course program led by the instructor. Instead, the contents evolved through conversations with the participants, the goal being to solve specific tasks and problems related to OpenOffice.org. Typical subjects for workshops were document templates, document conversions, and advanced functions of the software. Workshops could be arranged in the classroom environment or in the regular office rooms depending on the available facilities and the size of the group.

The intranet site which was originally developed during the OpenOffice.org pilot project and developed further during the migration was the basis of computer based self-training. Course materials and detailed instructions how to carry out specific activities can be provided using the intranet and made available at any time to all users. The intranet site offers an alternative for users who have not participated formal training led by the instructor. The site can also be used to provide additional training materials not covered in the formal training. Figure 5-2 in Sub section 5.4.3 shows an example screen of the Moodle intranet of the OpenOffice.org migration. The Moodle software has advanced functions which could also be used in the development of user documentation. For example, the *book* tool can automatically generate a handbook based on the material presented in the intranet as frequently asked questions (FAQ). This feature proved to be useful in the implementation project.

The implementation of training in the migration of the Ministry of Justice shares several methods used also in the migration implemented in the Bristol City Council as described by Beckett and Wright (2006). In both migrations, half-day and one-day courses on the basic or advanced level for Writer, Calc, and Impress were delivered using conventional classroom based training led by instructors. Both migrations also set up an intranet to facilitate self-training. The training approach in Bristol did not include workshop training, but instead provided "floor walking service" where an expert team visited users at their desks and assisted them to solve problems, e.g,. in complex document conversions. In the migration of the Ministry of Justice, this type of highly personalized training was not considered practical due to the vast geographical distribution of the offices. Differences can also be found in the organizational approach to training. The training courses in Bristol were provided by the in-house IT training unit whereas the courses in the migration of the Ministry of Justice were provided by the migration project. Training provided by the migration project was preferred in order to facilitate the development of in-house OpenOffice.org expertise during the implementation. Confirming business best practice suggestions presented by Wareham and Gerrits (1999), the experience and

knowledge in the implementation of training practices in Bristol City Council required adaptations when applied in the migration implemented in the Ministry of Justice.

In addition to training activities, the migration needs to address issues related to the conversion of old documents and to the introduction of document templates. Document templates play an important role in the efficient use of the software by immediately providing users with facilities for uniform document format and contents. Tailored and ready-made templates decrease the learning curve of the software thus facilitating the migration.

Following Karjalainen (2007e), all text templates developed during the migration were based on the OpenOffice.org default template which was modified to comply with the Finnish document standards. No automatic conversion facilities from the old templates were applied. Some of the old templates were originally developed using WordPerfect and then converted to either Lotus SmartSuite WordPro or Microsoft Word. If further converted to ODF format, the templates would inherit features and formatting assignments which would not always be immediately shown but could cause unexpected behavior later on when the templates would be used in document production. The basis for the templates was already provided in the installation model of OpenOffice.org. As discussed in Section 7.1, the default text template of OpenOffice.org was customized to comply with the Finnish document standard SFS 2487. Thus additional templates created using the default text template would be based on the Finnish document standard.

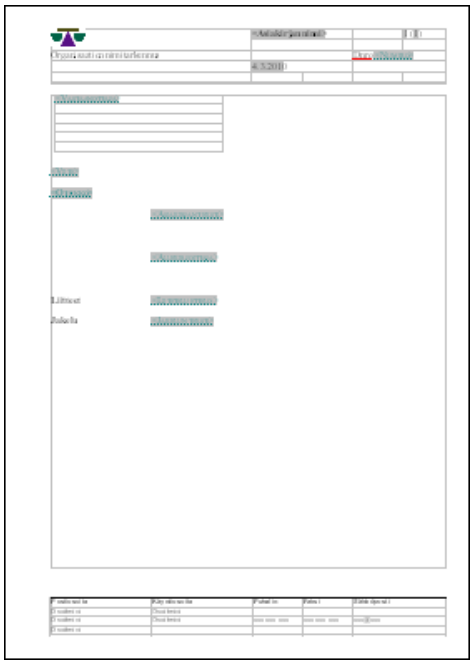

Figure 8-1. Typical text template for letters

Typical contents in document templates include formatted text, images, and various fields like date and time, page numbering, and text placeholders. Figure 8-1 depicts a miniature view of a basic template for letters. Predefined positions for several fields and constant text, like the contact information of the office, are specified using text tables. For clarity reasons the table borders are shown in the figure, but they would not be shown in the actual print-out of the document.

The number of templates may be excessive in a large-scale migration. Schießl (2007) estimates that close to 14 000 objects are involved in the large-scale OpenOffice.org migration in the German city of Munich. A total of 3100 templates were provided during the years 2007-2009 in the OpenOffice.org migration of the Ministry of Justice. Some typical templates designed during the migration are listed in Table 8-2.

– Letter, memorandum and report templates in several languages	– Slide presentation templates in several languages
– Fax templates in several languages	– Printing label templates
– Meeting agenda	– Minutes of meeting
– Statement and certificate templates	– Personnel management forms
– Fine conversion form	– Court judgment templates
– Power of attorney	– Crime register form
– Divorce application template	– Appeal templates
– Last will	– Estate inventory deed
– Calender templates	– Interest calculation templates

Table 8-2. Typical templates designed during the OpenOffice.org migration

Using the characterization of change management introduced by Orlikowski and Hofman (1997), the design and introduction of the 3100 document templates can mostly be characterized as the result of *anticipated change* where the change is planned ahead and occurs as intended by the originators of the change. However, templates were also introduced as the result of *emergent* and *opportunity-based change* activities. In an emergent change, a new template is first created just for personal use in a local environment. In an opportunity-based change, the personal template is thereafter purposefully generalized by the migration project to be appropriate for extensive use in several offices. Emergent and opportunity-based development of document template was also reported by Simonsen and Hertzum (2008). The authors discuss a labor inspection service where some employees started developing document templates of standard forms. Initially, the templates were merely for personal use but they quickly spread also to other employees. However, in shared use the need for more robust templates was experienced. This triggered the

opportunity-based change in which a number of more advanced templates were developed and distributed among the employees.

Considering also other documents than templates, mass conversion of old documents was not performed in the OpenOffice.org migration. The compatibility results of the pilot project discussed in Sub section 5.4.2 indicated that the interoperability with Microsoft Word, Excel, and PowerPoint document formats is high justifying the approach taken to the conversion. The same approach not to perform mass conversion activities was also applied in the OpenOffice.org migration implemented in the French Customs discussed in Section 6.1. In addition, because the workstation environment also has some Microsoft Office licenses, more complicated interoperability issues can be handled using the available Microsoft Office programs. Mass conversion of old Lotus SmartSuite documents was also not included in the migration, because SmartSuite was still available on the Windows XP workstations. Old text documents could be opened with Smartsuite WordPro and document contents could be copied to OpenOffice.org documents using normal Windows copy facilities. With OpenOffice.org version 3, an additional new open source extension called *lwpfilter* became available. With *lwpfilter* installed, OpenOffice.org version 3 can directly open SmartSuite WordPro files thus making the conversion of WordPro documents unnecessary.

8.4 Application integrations

The office software evaluation report (Karjalainen, 2005a), written during the matching stage of the study, presents several integrations where office suite software had been intertwined with organizational routines and back-office applications in the Ministry of Justice. Both Microsoft Office and Lotus SmartSuite software had been integrated to back-office applications. The integrations extend and adapt office suite software for organizational use. In the following, approaches to the replacement of these integrations with technologies facilitating the use of OpenOffice.org are discussed.

The engineering handbook by Grönroos and Karjalainen (2007) discusses the principles in the integration of OpenOffice.org and the XML-based ODF file format to other software applications. Figures 6-1 and 6-2 in Section 6.2 present two basic approaches in the integration, the UNO component model and XSLT transformations. UNO is the OpenOffice.org component model and API providing extension capabilities and interoperability to other software applications. By using software components supporting XSLT transformations, an XML document such as an ODF document, can be further processed to another format, e.g., to another XML document, to plain text, or to pdf.

The Prisoner Information System, discussed in Sub section 4.2.4, was originally integrated to Microsoft Word and Excel for document print-outs. The application

was based on Visual Basic programming and Microsoft COM (Component Object Model) and ActiveX technologies in the integration of Word and Excel document templates to the data base of the application. A preliminary evaluation and implementation of OpenOffice.org integration to the Prisoner Information System was conducted during the agenda-setting stage in 2003. The integration, based on the UNO API, confirmed the feasibility of the integration technology.

The actual substitution of Word and Excel with OpenOffice.org in the print-outs in the Prisoner Information System was commenced rather late in the migration, in January 2009 (research diary: meeting with the application maintenance team on 14 January 2009). The implementation of the integration is based on the UNO API which supports Visual Basic through the Microsoft COM component technology. Visual Basic program starts OpenOffice.org with the appropriate ODF report template and populates the report with the data from the data base. Bookmarks included in the report template are used to mark the places to be populated with the data from the data base. Figure 8-2 depicts the integration of OpenOffice.org in the Prisoner Information System.

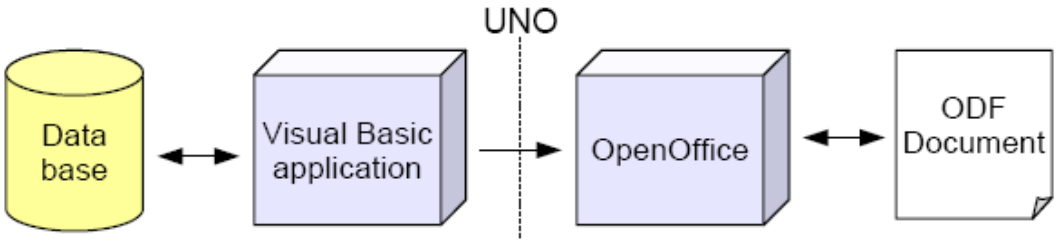

Figure 8-2. OpenOffice.org integration in the Prisoner Information System

Technically, the control of OpenOffice.org by external applications in the UNO API is provided by first instantiating the service manager component. The service manager requires to be created before obtaining any other UNO objects. It is a COM component with the programmatic identifier *com.sun.star.ServiceManager* (OOoDeveloper, 2009). It is instantiated like any ActiveX component, depending on the language used. The examples below show the instantiations in Microsoft Visual Basic and in IBM LotusScript.

- Microsoft Visual Basic:
  Dim objManager As Object Set objManager=CreateObject("com.sun.star.ServiceManager")
- IBM LotusScript:
  Set objServiceManager = CreateObject("com.sun.star.ServiceManager")

The service manager is then used to create additional objects which in turn provide other objects. All objects provide functionality that can be used by invoking the appropriate functions and properties. By using appropriate objects the

programmer is able to provide the desired functionality in the external control of OpenOffice.org.

In addition to the Prisoner Information System, also court case management systems have integrations to office suite software. The administrative courts, the Supreme Administrative Court, the courts of appeal, the Supreme Court, and the Insurance Court are integrated to the Lotus SmartSuite WordPro program. These applications are based on the IBM Notes/Domino platform. The court applications include modules written in the LotusScript language for the integration of Lotus Notes forms to the WordPro program. The LotusScript modules start the WordPro program with the appropriate document template and let the user to modify the document. Typically the templates contain predefined text passages used in the court judgments. In total, around 1000 templates are in use. The WordPro document is finally saved as an attachment to the Lotus Notes form. The form also has an *Edit* button to support further modifications to the document.

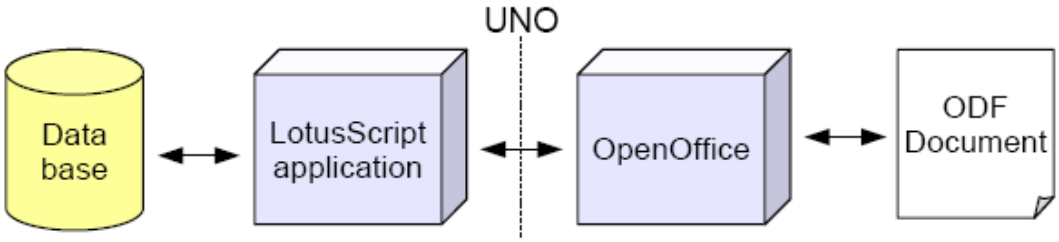

Figure 8-3. OpenOffice.org integration in the court case management systems

The substitution of WordPro with OpenOffice.org in the court applications was commenced in August 2009 (research diary: meeting with the application maintenance team on 17 August 2009). The implementation of the new integration is based on the UNO API which supports the LotusScript language. Using the UNO API the LotusScript module starts OpenOffice.org with the appropriate ODF template, populates the document with the data from the Lotus Notes form and lets the user to modify the document. Typical data to be transferred from the Lotus Notes form to the ODF template include, e.g., the diary number of the court case, the parties concerned, and the introducer of the case in the court. The templates contain special markings which identify the places to be populated with external data from the Notes form. For example, *<Diary_number>* could be used to mark the place for the diary number of the court case. The data fields of the Lotus Notes form and these markings are linked together when the ODF templates are registered in the case management application. The UNO API has functions which support searching and replacing text. These functions are then used to search for the special markings and to replace them with the external data from the Lotus Notes form. The ODF document is finally saved as an attachment to the Lotus Notes form. The form also has an *Edit* button to support further modifications to the document. Figure 8-3 depicts the integration of OpenOffice.org in the court case management systems.

However, there are also office suite integrations which are currently not being developed further to support technologies facilitating the use of OpenOffice.org. As discussed in the analysis of the software environment in Sub section 5.2.1, the Ministry of Justice shares some document handling applications with all other ministries of the State. These applications are used to prepare documents for the cabinet and also for the activities in the administration of the European Union. The applications are based on Microsoft technology using VBA macros and binary Word and Excel file formats. No substitution of Word and Excel with OpenOffice.org in these applications are planned. The Microsoft Office is thus still supported for these tasks which require binary interoperability with Microsoft Office due to the integrations with external organizations. The practical reasoning for mixed environments with both OpenOffice.org and Microsoft Office supported was already recognized in the analysis of the Office of Government Commerce in the United Kingdom (OGC, 2004).

8.5 Review

The clarifying activities were spread among several years after the commencement of the OpenOffice.org migration in 2007. Following Rogers (2003, p. 428), the innovation gradually becomes embedded in the organizational structure as the result of the clarifying activities. The essential clarifying activities identified in the OpenOffice.org migration included communications, user training, document conversions, and application integrations.

The following summarizes the main results and findings of the clarifying stage.

- The implementation of OpenOffice.org adoption was found to have the divisibility characteristic as defined by Leonard-Barton (1988). The divisibility facilitates both big bang and phased approaches to the migration. Following the implementation suggestions of Rogers (2003, p. 427) and the open source migration guidelines of the IDA programme (IDA, 2003a, p. 19), the phased approach was chosen for the migration process. With a phased approach the necessary resource requirements could be evenly distributed to several years. The phased migration also enabled the gradual development of skills and the development of absorptive capacity of the organization to facilitate OpenOffice.org migration. Following the phased migration approach together with the approach of gradual skill building, the first migration activities were targeted to offices and to user groups with no complex requirements concerning, e.g., back-office integrations.
- A mixture of communication activities was applied in order to facilitate the dissemination of information and understanding concerning the migration. As noted by Templeton et al. (2009) and Kaplan (2006), the focus on users in the

communication facilitates user acceptance of the innovation. Communication can also be used to reduce the project resources needed for the migration. Following Beckett et al. (2006a), the communication activities can be split in three elements following the progress of the migration (1) the migration decision, (2) the implementation plan, and (3) the actual migration activities affecting end-users. As in the migration carried out in the Bristol City Council (Beckett et al., ibid.), communication methods used in the migration included presentations, e-mail, and an intranet site. Following the approach used in several other OpenOffice.org migrations, the communication activities also included the distribution of thousands of installation CD-ROM's and OpenOffice.org Portable USB memory sticks as incentives to users to support trial use and home computer installations and to increase user acceptance. The implementation plan and the diary of implementation activities and progress were maintained using a wiki on the intranet site. Because OpenOffice.org had already been installed on the workstations in the beginning of the migration, detailed information, including the migration guide and handbooks, could be early distributed to users. The IT contact persons of the offices played an important role in the communication regarding training and other migration activities.

- The organizational approach to the training was completely implemented through the implementation project established in 2007. The centralized approach also included the costs of the training which were covered from the funds allocated to the implementation project. The project team consisted of members from the in-house IT staff having experience with training, IT support, and document templates. In total, 523 training sessions were given in the implementation project during the years 2007-2009 with in-house instructors giving 95 % of the training. The emphasis on using own IT staff in the training facilitated the development of in-house OpenOffice.org expertise and the development of in-house absorptive capacity needed during the implementation, as suggested by Cohen and Levinthal (1990). Altogether 13 in-house staff members acted as instructors in the training. The author of this study was the most active instructor giving altogether 245 training sessions. The training included both basic and advanced classes using the training framework developed during the pilot project. Other training methods included workshop training and self-training using intranet services. Course materials and detailed instructions how to carry out specific activities were provided using the intranet and made available at any time to all users. The intranet site offered an alternative for users who had not participated formal training led by the instructor. The site was also used to provide additional training materials not covered in the formal training.
- Business best practice guidelines as presented by Wareham and Gerrits (1999) were applied both in the implementation of communication and training

practices in the migration. As suggested by Wareham and Gerrits (ibid.), the communication and training practices required adaptations when applied in the migration implemented in the Ministry of Justice.

- Regarding document conversions, document templates were given special attention in the migration. Following Karjalainen (2007e), all text templates developed during the migration were based on the OpenOffice.org default template which was modified to comply with the Finnish document standard. No automatic conversion facilities from old SmartSuite WorPro or Microsoft Word templates were used in the development of new templates. In total, 3100 OpenOffice.org templates were provided by the implementation project during the years 2007-2009. Considering also other documents than templates, no mass conversion of old documents was applied. Based on the compatibility results of the pilot project discussed in Sub section 5.4.2, the interoperability with Microsoft Office and Lotus SmartSuite was considered acceptable. Because the workstation environment also supports old office suite licenses, they can be used to handle more complicated interoperability issues.
- Grönroos and Karjalainen (2007) discuss the principles in the integration of OpenOffice.org and the XML-based ODF file format to other software applications. The UNO component model and XSLT transformations technology define two basic approaches in the integration. UNO is the OpenOffice.org component model and API which provides extension capabilities and interoperability to other software applications and programming language platforms. XSLT transformations can be applied to process an XML document such as an ODF document, to another format, e.g., to another XML document, to plain text, or to pdf. The UNO interoperability support to Microsoft Visual Basic and IBM LotusScript languages was applied in the migration when the UNO component model was used to replace old office suite integrations to back-office applications with integrations using OpenOffice.org as the office suite software.
- Rogers (2003, p. 428) suggests that innovation champions usually play an important role in the clarifying process. The author of this study had an important role in the migration being the project leader in the implementation activities. In the clarifying stage, the author gave the presentations to managers and critical user groups and was the most active trainer giving almost half (245) of all training sessions during the years 2007-2009. Combined with the central role of the author also in the earlier stages of the organizational innovation process of the study, the author can be characterized as being the innovation champion. The central role of the author in the clarifying process in this study supports Rogers' proposition concerning the importance of champions.

9 Routinizing

In this chapter we present the routinizing stage of this innovation adoption study. Routinizing denotes the last stage in the organizational innovation process depicted in Figure 3-4 in Sub section 3.2.2. At that point, the innovation has become institutionalized by the adopter organization and the innovation process is completed. Following Rogers (2003, p. 428), routinizing occurs when an innovation has become incorporated into the regular activities of the organization and has lost its separate identity.

At the time of writing this study in summer 2010, the routinizing stage has not yet been fully completed. In Section 8.4 we discussed several application integrations where office suite software was integrated with back-office systems. The substitution of other office suite software with OpenOffice.org in these integrations was commenced in 2009. The substitutions are needed in order to allow old office suite software to be finally phased out. All required substitutions have not yet been completed by by summer 2010.

The discussion on the routinizing stage is based on Rogers' framework where the sustainability of an innovation provides the basic conceptual lens to address issues related to routinizing. Drawing on March and Smith (1995) and Hevner et al. (2004), we provide additional viewpoints and guidelines to routinizing from design research. We complement Rogers' framework from Woods and Guliani (2005) to address OSS-related sustainability issues. In the discussion of sustainability, we also use complementary research resources from Katz and Shapiro (1986) and Markus (1987) in addressing the effects of network externalities and Shapiro and Varian (1999) in addressing the effects of compatibility standards.

The routinizing stage is structured as follows. In section 9.1 we discuss the sustainability and possibly discontinuance of an innovation during the routinizing stage. In the following sections we discuss the performance evaluation of the deployment of OpenOffice.org based on measurements of actual use and on the evaluation of realized costs during the migration and deployment. We summarize the chapter with a section giving a review of the results of the routinizing stage.

9.1 Sustainability of the innovation

The sustainability concept is closely related to routinizing. Rogers (2003, p. 429) defines sustainability as the degree to which an innovation continues to be used after initial efforts to secure adoption have been completed. The discontinuance of an innovation can occur for several reasons during the routinizing stage. Participation of the members of the organization in the innovation process, the degree of re-invention,

and the involvement of a local champion belong to factors which Rogers argues to be positively related to sustainability. Several of these factors were favorable for the sustainability of OpenOffice.org. As discussed in Chapters 7 and 8, emphasis has been given on the participation of staff members in the implementation activities. The building of in-house skills has been one of the goals in the implementation resulting, e.g., altogether to 13 in-house staff members to participate as instructors in the training of OpenOffice.org. The author of this study has been the local champion in the migration. As discussed in Section 7.1, the redefinition activities in the implementation resulted in several installation and configuration models of OpenOffice.org to be developed by the in-house staff.

Both Rogers (ibid., p. 429) and Woods and Guliani (2005, p. 88) identify key-person problem as one of the sustainability risks. As a key-person risk Rogers mainly considers a situation where an authoritative innovation-decision has been made. If one of the powerful authoritative individuals happens to leave the organization, the sustainability of the innovation is at risk. The authoritative adoption decision of the Ministry of Justice, discussed in Section 6.5, was issued in 2006 by the Permanent Secretary and the CIO of the Ministry of Justice. Since then, both of these top management authorities have retired creating a risk in the sustainability of OpenOffice.org in the study organization. Woods and Guliani in turn consider a general danger in OSS and also in other areas of IT where vital IT system knowledge is concentrated in one person. The sustainability of the IT system is at risk in case that key-person happens to leave the organization. Woods and Guliani note that organizations often rely on vendors and consultants to avoid this vulnerable situation. Another approach suggested by Woods and Guliani to avoid key-person problem is institutional skill building where the skills of the organization are preserved by maintaining an appropriate level of IT system documentation and by transferring skills from one person to other staff members as the result of regular group work activity. In the migration of the Ministry of Justice, the possibility for this type of key-person risk is associated with the author of this study. The risk has been addressed by providing excessive end-user and engineering documentation discussed in Chapters 7 and 8 and by developing the in-house skills needed in the implementation and deployment of OpenOffice.org in the organization.

The discontinuance of an innovation may also be the result of adopting another innovation which is considered to better address the needs of the organization. Rogers (ibid., p. 190) calls this type of discontinuance a replacement discontinuance. According to March and Smith (1995), IT artifacts are perishable. As the needs change, the artifacts to meet those needs also change creating thus conditions for replacement discontinuance. As Hevner et al. (2004) have noted, advances in the technology can invalidate the results of IT implementation efforts before adequate payback has been be achieved. The discontinuance of an innovation may also result from dissatisfaction to the performance of the innovation in the actual deployment environment. Acknowledging the sustainability and discontinuance risk of open

source software, Fitzgerald (2009) indicated five levels of open source assimilation, the last level being the abandonment level where the organization has discontinued live use of OSS. Considering the discontinuance of an innovation, Järvinen (2004) introduced the concept of *recycling* where the innovation (the old IS system) to be discontinued is taken away from use and its components are recycled as much as it is possible.

High user interdependencies as the result of network externalities is a possible sustainability risk in the routinization of OpenOffice.org. Katz and Shapiro (1986), Markus (1987), and Rogers (2003, p. 350) define network externality as an effect where the utility of the innovation to a user increases as the number of other users increases. E-mail is a well-known IT innovation subject to the network externality effect. Considering office suite software and network externality, we identify the document format as an effect creating an interdependence among communicating members who exchange documents. All communicating members need to be able to process the documents. The increasing number of adopters increases the benefits of document exchange among all communicating members. Proprietary document formats defined by the software vendors for use with their own particular products, e.g., the lwp format in SmartSuite WordPro or the doc format in Microsoft Word, create interoperability problems. The dominant market position of Microsoft Office suite has created a situation where the network externality effect is favorable for the Microsoft Office suite.

Rogers suggests (ibid., p. 351) that the effects of network externalities on the rate of innovation adoption often depend on compatibility standards. Shapiro and Varian (1999) further suggest that compatibility standards are an important factor to prevent the development of vendor lock-in and high switching cost as the result of network externalities. In recent years there has been active standardization development in the area of office document formats. ODF which is the default file format of, e.g., OpenOffice.org, was first accepted as an OASIS standard in 2005 (OASIS, 2005) and thereafter as an international ISO standard ISO/IEC 26300:2006 in 2006 (ISO, 2006). Office Open XML (OOXML) is a file format originally developed by Microsoft Corporation as a successor to its earlier Office 2003 file formats. In 2006 Office Open XML became an ECMA standard ECMA-376. In 2008 a revised version of ECMA-376 became an ISO standard ISO/IEC 29500:2008 (ISO, 2008). According to a Microsoft press release (Microsoft, 2008), the ISO standard ISO/IEC 29500:2008 will be supported in Microsoft Office version 2010 (code-named "Office 14"). With the introduction of internationally accepted open standards, the conditions for document interoperability will eventually improve. However, it takes time before office suite software packages will provide high-quality support for the new standards. Interoperability problems are likely to prevail for some time in the coming years which maintains conditions for sustainability risk in the routinization of OpenOffice.org.

9.2 OpenOffice.org usage

In the literature review conducted by Petter et al. (2008), the authors note that empirical studies have adopted multiple measures of IS use, including intention to use, frequency of use, self-reported use, and actual use. Comparing both self-reported and computer-recorded measures of systems usage, Straub et al. (1995) suggest that system usage should be factored into self-reported (subjective) system usage and computer-recorded (objective) system usage. To overcome self-reporting bias in IS research, Jeyaraj et al. (2006) and Venkatesh et al. (2003) suggest to study also actual system usage which is an objective measure typically obtained from logs.

For design science research, Table 3-2 from Hevner et al. (2004) summarizes the guidelines for the requirements of effective research involving IT artifacts. Guideline 3, design evaluation, emphasizes rigorous evaluation methods. March and Smith (1995) stress the importance of developing metrics and the measurement of artifacts according to those metrics. Metrics are used to assess the performance of an artifact.

In OpenOffice.org migration studies, the actual usage of the software has been measured using computer-based automatic measurements. Rossi et al. (2005), Russo et al. (2005b) and Ghosh (2006) used a special software (PROMetric) to monitor in background the actual usage of OpenOffice.org during the migration.

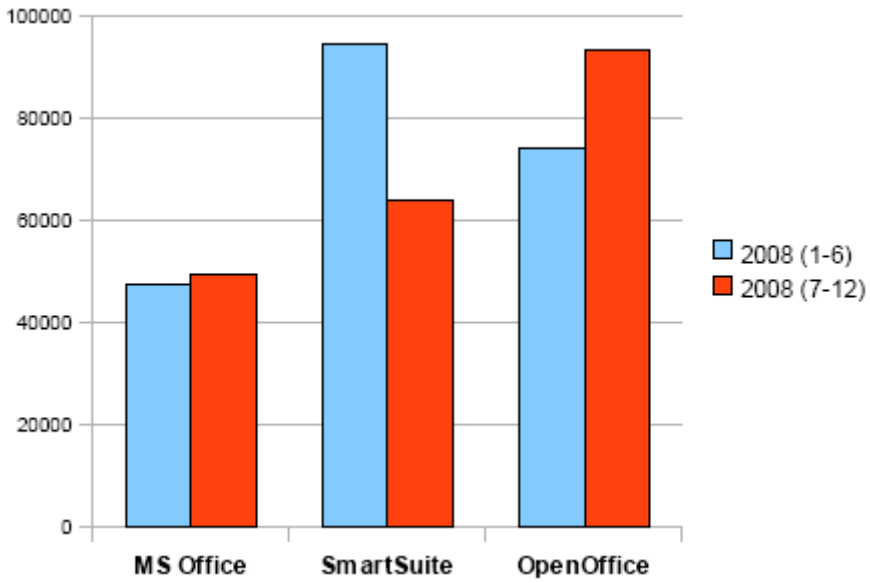

Figure 9-1. Number of office software documents created in 2008

OpenOffice.org usage in the migration of the Ministry of Justice was measured by counting the number of various office document files from file backup storage. The measurement of the actual number of office documents gives an indication of the

actual use of office software. Based on the file modification dates and the file extension identifiers, the monthly usage can be divided between various office suite software packages. Figure 9-1 shows the number of documents produced using Microsoft Office, Lotus SmartSuite, and OpenOffice.org during the first and second halves of the year 2008.

The measurement presented in Figure 9-1 was calculated in March 2009 from the log of file backup service (research diary: summary of backup log was received on 27 March 2009). The log represents altogether the office suite deployment of 6800 persons from the total of 10 000 persons employed by the Ministry of Justice. The file extension identifiers were used to identify the usage of the software packages as follows:

- Microsoft Office files (extensions doc, xls, ppt);
- IBM Lotus SmartSuite files (extensions lwp, 123, prz);
- OpenOffice.org files (extensions odt, ods, odp).

The file extension identifier is not a quite accurate measure of software usage because, e.g., doc files can also be produced with other software packages, like OpenOffice.org and Lotus SmartSuite. Because this is quite common in practice, the actual usage of MS Office is somewhat lower than shown in Figure 9-1. It should also be noted that there are other additional file extension identifiers which were not used in the measurement shown in Figure 9-1, like the extension identifiers for template files.

It can be concluded from Figure 9-1 that year 2008 was a turning point in the migration in the sense that in the second half of 2008 OpenOffice.org bypassed other software packages being the most often used office software suite to process documents. On a monthly basis in 2008, over 15 000 ODF documents per month were created using OpenOffice.org. Because the migration has been implemented as a gradual approach as discussed in Section 8.1, the deployment of other software packages still continues but their role will diminish with the progress of the migration. With the completion of the application integrations commenced in 2009 and discussed earlier in Section 8.4, the deployment of other software packages will be further reduced.

The usage of OpenOffice.org was also measured using the information available from the help desk data base of the study organization (research diary: the log of help desk service requests from 18 months starting from 1 January 2007 was received on 21 July 2008). The ICT Service Centre of the Ministry of Justice provides a centralized help desk service which users can contact in all IT problems, e.g., via telephone or e-mail. The help desk personnel tries to solve the problem immediately or transmits the problem to second tier experts in case an immediate solution cannot be provided. Contacts to the help desk and problem solutions are registered to the data base of the help desk application. Information in the help desk data base can be

used, e.g., to evaluate the need for support in various IT matters, the types of problems occurring, and problem solutions.

Around 2 000 contacts are registered each month to the help desk data base. Close to half of all problems are associated with the usage of specific applications supporting the processes of organizational units, e.g., the case management systems of the courts. Various hardware and printing problems, problems with user names, and forgotten passwords are other causes to help desk contacts occurring most often. Problems associated to office suite software represent only 1-2% of all help desk contacts. The deployment of Lotus SmartSuite and Microsoft Office has a long history in the organization, and typically only 5-10 help desk contacts associated with each of these office suite packages are registered monthly in the help desk data base. During the first 18 months since the commencement of OpenOffice.org migration in January 2007, altogether 258 OpenOffice.org help desk contacts were registered averaging 14 contacts per month during the period. The number of OpenOffice.org contacts is somewhat higher than with Lotus SmartSuite or Microsoft Office which can also be expected due to the early phase in the deployment of the new software.

The above information from the help desk system confirms the conclusions presented in Sub section 5.4.4 regarding the need for user support services. All 258 user support requests during the first 18 months of OpenOffice.org deployment were solved by in-house staff which indicates that the need for third-party user support services occurs seldom. The number of help desk contacts regarding OpenOffice.org problems was on the same level with other office suite software. Overall, problems associated to all office suite programs represented a minor factor in the total load of user support requests registered in the help desk system data base.

The information from the help desk data base was also used to evaluate the types of problems occurring in the deployment of office suite software. The classification shown in Table 9-1 was designed to evaluate the types of user support requests.

Problem	Description
Setup	Installation, configuration, and setup issues, e.g., file associations, setup options
Error	Error situations, e.g., problems due to document recovery, locked documents, program not responding
Open	Problems with opening documents, e.g., finding files, file format control
Edit	Problems with editing documents, e.g., paragraph formating and other functions
Print	Problems with print-outs, e.g., page layout, page break, and margin control
Save	Problems with saving documents, e.g., file locations, file format control
Misc	Miscellaneous other problems

Table 9-1. Categories of user support requests for office suite software

Figure 9-2 shows the proportional distribution of OpenOffice.org help desk calls during the period 1/2007-6/2008 using the classification of Table 9-1. Various setup problems were the most common cause for help desk contacts representing 26% of the total. When analyzed in more detail, almost half of the setup problems were caused by missing file associations concerning the opening of rtf (Rich Text Format) files. For some users, the default application for rtf files had not been properly defined causing the problem. Various error situations represented another frequent cause for help desk contacts (20%). Most of the errors were due to locked documents which may be caused by simultaneous use of the same document by several users. Also the abnormal termination of the program by the user may leave the open document to a locked state. Document opening problems (15%) usually result from difficulties experienced by the user to find the proper file folder where the document is located. Advise on options to define the default folder assignments often helps in this situation. Problems with editing (18%), printing (10%), and saving (5%) documents can be considered as core problems related to the management of specific functionalities of the program. User contacts with problems in setup, error, and document opening situations often relate to the control of the environment and they typically occur in the beginning of the software deployment whereas the management of the vast number of functionalities of the office suite software is a continuous source for possible contacts to the help desk service.

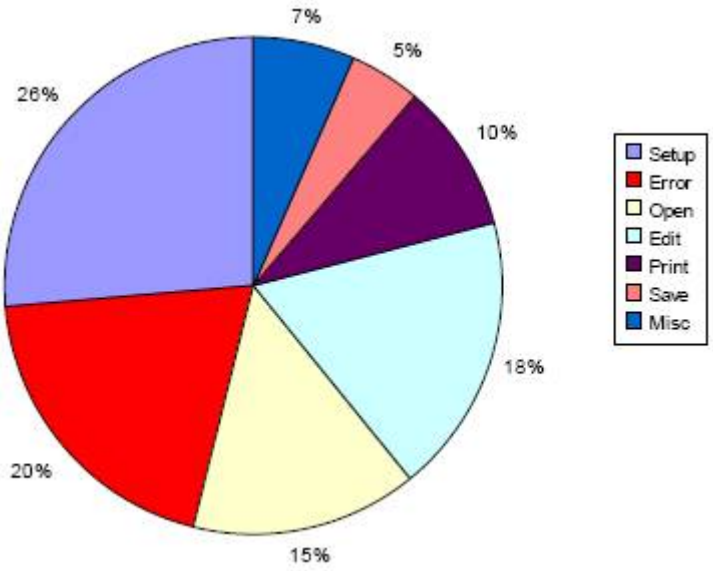

Figure 9-2. Distribution of OpenOffice.org help desk contacts during 1/2007-6/2008

In comparison, Figure 9-3 shows the proportional distribution of help desk contacts concerning all three office suite packages during the same time period. It can be seen from Figure 9-3 that the distribution of help desk contacts concerning

Microsoft Office represent a reasonably mature situation where user problems are often related to the core functionalities (edit, print, save) of the software. The distribution of Lotus SmartSuite help desk contacts shows a large proportion of various setup problems (almost 40% of the total). The setup problems in this case were caused by some unfortunate shortcomings in the installation and configuration model of Lotus SmartSuite when the migration to the Windows XP platform was prepared.

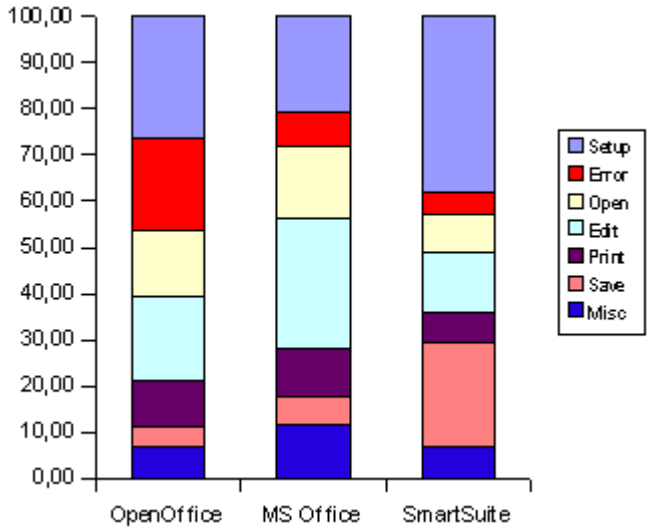

Figure 9-3. Distribution of office suite software help desk contacts

9.3 Migration and deployment costs

The cost evaluation presented earlier in Table 6-4 in Section 6.4 was prepared in October 2006 for the adoption decision before the implementation of the of the migration was commenced. Table 6-4 showed the estimated costs of the three migration alternatives for the 6-year period 2006-2011. The cost evaluation was updated in June 2010 to reflect the accumulated costs of OpenOffice.org migration. Table 9-2 shows both the original 2006 cost evaluation of the OpenOffice.org migration alternative and the updated evaluation of costs in 2010 for the same 6-year period 2006-2011. The updated evaluation of costs includes the realized costs of the years 2006-2009 and the estimation for the remaining years 2010-2011.

Table 9-2 indicates that the final OpenOffice.org migration and deployment costs for the years 2006-2011 will be be slightly below (5%) the original cost estimate of 2.1 M€. The first 4 years have not brought any special cost surprises in the migration, but the final figures for the 6 years will be available in 2011. However, it can be noted that during the years 2006-2009 the number of workstation computers had increased from 10 500 to 11 600 in the organization. Due to the benefits of open

source licensing, the increase of workstations did not involve increases in the office suite licensing costs.

	OpenOffice.org alternative Cost evaluation (10/2006)	OpenOffice.org alternative Cost evaluation (6/2010)
License purchases	211 000 €	211 000 €
Software maintenance	737 000 €	719 000 €
Training and support	580 000 €	561 000 €
Systems development, conversions, and integrations	535 000 €	468 000 €
Costs total	**2 063 000 €**	**1 959 000 €**

Table 9-2. OpenOffice.org migration and deployment costs 2006-2011

9.4 Review

At the time of writing this study in summer 2010, the routinizing stage has not yet been fully completed. Application integrations commenced in 2009 and discussed in Section 8.4 have not yet been fully completed. The completion of application integrations denotes the last step in the OpenOffice.org migration where old office suite software will be phased out and substituted by OpenOffice.org.

In the organizational innovation process framework introduced by Rogers (2003), the sustainability of an innovation provides the basic conceptual lens to address issues related to routinizing. Based on Rogers' framework and on the complementary research resources from design research and OSS-specific issues, we could in our analysis identify several key factors addressing the sustainability or possible discontinuance of an innovation. Table 9-3 gives a summary of the key factors discussed in our analysis.

The specific situations concerning the factors listed in Table 9-3 may support the sustainability of an innovation, but they can also provide discontinuance risks during the routinizing stage. In our analysis of the last factor in Table 9-3, we evaluated the performance of the innovation's actual use with various measurements. The measurements indicated the level of the deployment of OpenOffice.org, the need for user support requests during the deployment, and the realized costs during the migration and deployment of OpenOffice.org.

– Participation of organization's members in the innovation process
– Degree of re-invention
– Involvement of an innovation champion
– Key-person risk
– Advances in technology
– Network externalities
– Performance evaluation of the innovation's actual use

Table 9-3. Routinizing and sustainability factors

The following summarizes the results and findings of the routinizing stage.

- Several of the factors identified by Rogers (2003, p. 429) to support the sustainability of an innovation were found to be favorable for the sustainability of OpenOffice.org in the migration of the Ministry of Justice. The favorable factors included participation of the members of the organization in the innovation process, the degree of re-invention, and the involvement of a local champion in the process.
- Considering the sustainability of an innovation, both Rogers (ibid., p. 429) and Woods and Guliani (2005, p. 88) identified key-person problem as one of the sustainability risks. The authoritative adoption decision of the Ministry of Justice, discussed in Section 6.5, combined with the retirement of the top management decision-makers, has created a prevailing risk for the sustainability of OpenOffice.org. Another situation causing a possible key-person problem may evolve from the concentration of vital IT system knowledge in one person, in this case the author of this study. Following the suggestions of Woods and Guliani (ibid.), this key-person problem has been addressed with institutional skill building by providing excessive end-user and engineering documentation discussed in Chapters 7 and 8 and by developing the in-house skills needed in the implementation and deployment of OpenOffice.org in the organization.
- Sustainability risk and possible discontinuance of an innovation may also be the result of adopting another innovation which is considered to better address the needs of the organization. According to March and Smith (1995), IT artifacts are perishable. As the needs change, the artifacts to meet those needs also change creating thus conditions for the discontinuance of an innovation. As Hevner et al. (2004) have noted, advances in the technology can invalidate the results of IT implementation efforts before adequate payback has been been achieved. The discontinuance of an innovation may also result from dissatisfaction to the performance of the innovation in the actual deployment

environment. The study by Fitzgerald (2009) gives an example where the discontinuance actually happened due to the dissatisfaction in the context of an open source based desktop office suite, Sun StarOffice, whose deployment was ultimately unsuccessful and abandoned in the Irish Hibernia Hospital.

- High user interdependencies as the result of network externalities is a possible sustainability risk in the routinization of OpenOffice.org. We found network externality to result from document formats which create an interdependence among communicating members who exchange documents. In proprietary document formats defined by the software vendors for use with their own particular products, the network externality effect has been favorable for the Microsoft Office suite due to its dominant market share. Shapiro and Varian (1999) suggest that compatibility standards are an important factor to prevent the development of vendor lock-in and high switching cost as the result of network externalities. Two international ISO standards for office document format have been accepted in recent years, the ODF format (ISO/IEC 26300:2006) and the OOXML format (ISO/IEC 29500:2008). With the introduction of the ISO standards, the conditions for document interoperability will eventually improve. However, it takes time before office suite software packages will provide high-quality support for both of these new standards. Interoperability problems are likely to prevail for some time in the coming years which maintains conditions for sustainability risk due to the effects of network externalities in the routinization of OpenOffice.org.
- Following suggestions and practices in the evaluation of IT systems (March and Smith, 1995; Hevner et al., 2004; Rossi et al., 2005; Russo et al., 2005b; Ghosh, 2006), various measurements of OpenOffice.org deployment were performed in the study. The usage of OpenOffice.org was measured by counting the number of office document files from the file backup log. The measurement of the actual number of office documents gives an indication of the actual use of office software and addresses possible concerns related to self-reporting bias in the study. Based on the file modification dates and the file extension identifiers, the monthly usage was divided between various office suite software packages. The measurement indicates that year 2008 was the turning point in the migration in the sense that in the second half of 2008 OpenOffice.org bypassed other software packages being the most often used office software suite. The measurement represented the office suite deployment of 6800 persons from the total of 10 000 persons employed by the Ministry of Justice. It should be noted that the file extension identifier is not a quite accurate measure of software usage because in addition to Microsoft Office, e.g., doc files can also be produced with other software packages, like OpenOffice.org and Lotus SmartSuite.
- The usage of OpenOffice.org was also measured using the information available from the centralized help desk data base of the organization. It turned

out that problems associated to all office suite software packages represent only 1-2% of all help desk contacts representing thus a minor factor in the total load of user support requests. Altogether 258 OpenOffice.org help desk contacts were registered during the first 18 months since the commencement of OpenOffice.org migration in January 2007. The number of OpenOffice.org contacts was somewhat higher than with Lotus SmartSuite or Microsoft Office which can also be expected due to the early phase in the deployment of the new software. All user support requests were solved by the in-house staff without using third-party services. The information from the help desk system confirmed the pilot project conclusions presented in Sub section 5.4.4 regarding the need for user support services. The centralized implementation of the help desk system increases the reliability of the available user contact information. However, it should be noted that the reliability is also affected by the fact how comprehensively all support requests are in practice recorded in the help desk system.

- The information from the help desk data base was also used to evaluate the types of problems occurring in the deployment of office suite software. Setup problems, error situations, and document opening problems were considered as typical environment problems representing altogether 61% of all OpenOffice.org support requests. Problems with editing, printing, and saving documents were considered as core problems in the usage of office suite software and they represented 33% of all OpenOffice.org support requests. From Microsoft Office support requests, 45% were related to core problems and 44% to environment problems. The differences suggest that environment problems occur more frequently in the early phases of the deployment of new software.
- The original cost evaluation performed in 2006 was updated in 2010 to reflect the realized costs of the OpenOffice.org migration. The updated cost evaluation indicates that the final OpenOffice.org migration and deployment costs for the years 2006-2011 will be be slightly below (5%) the original cost estimate of 2.1 M€ despite the fact that the number of workstation computers had increased from 10 500 to 11 600 in the organization during the years 2006-2009. Due to the benefits of open source licensing, the increase of workstations did not involve increases in the office suite licensing costs.

10 Discussion and conclusions

This study has explored the adoption of the OpenOffice.org open source office suite in the context of one large public Finnish organization, the Ministry of Justice and its administrative sector. The organization has a staff of approximately 10 000 employees and an IT environment consisting of more than 10 000 Windows workstations. As a longitudinal study this research has provided rich insight and understanding based on an in-depth analysis in a single case context. The OpenOffice.org adoption of the study is the first large-scale transition in Finland to an open source office suite. There is a shortage of studies covering large-scale open source desktop adoptions. This first large-scale open source adoption study has provided contributions both to the research and to the practice.

The research objectives for this study were presented in Section 1.4. According to the objectives, the study seeks to provide answers to the following research questions:

- Q1: Is the transition to an open source office suite feasible in a large-scale context?
- Q2: Is the open source office suite a viable alternative to proprietary software?
- Q3: Can the benefits, e.g., cost reductions of the OSS solution be realized?
- Q4: What factors support or prevent the transition to an open source office suite?
- Q5: What practical guidelines can be given to organizations considering the adoption of an open source office suite?

In this chapter we present a summary and discussion of the results of the study in the context of the research objectives. The identifiers of the research questions (Q1-Q5) are used in the discussion to reference results addressing the research questions. We also discuss the issue of testing Rogers' organizational adoption process model which was not addressed in the initial research objectives but included later on to the research approach during the matching stage of the study in Section 5.5.

In Section 10.1 we present the scientific merits of the research. The study has a number of implications for organizations who are embarking on open source adoption, and these contributions to practice are presented in Section 10.2. Next, in Section 10.3, we discuss reliability and validity issues regarding the study. In Section 10.4 we discuss the limitations of the research and give suggestions for further studies. We summarize our experiences with concluding remarks in Section 10.5.

10.1 Implications to research

The research approach of this study, discussed in Chapter 3, has two main lenses which have been applied in the study.

The taxonomy of scientific studies by Järvinen (2008) provides the first lens classifying the study to design science where the utility of the innovation plays an important role. Based on the two dimensional framework presented by March and Smith (1995), design science research consists of innovation-building studies and innovation-evaluation studies. The innovation (artifact) of this study is based on the open source OpenOffice.org software. The innovation-building part of the study created an instantiation of the innovation including the installation and configuration of the OpenOffice.org platform, the development of supportive tools and documentation, and the development of integrations to support the migration. The innovation-evaluation part of the study included the analysis of software functionality and interoperability, the evaluation of adoption costs, and measurements of software usage.

The second lens of the study is based on the specific research domain which is concerned with the organizational adoption of an open source office suite. The principles of innovation diffusion research as presented by Rogers (2003) provided the study with a widely accepted and applied research model to explore the adoption process. Rogers suggests that the innovation process in an organization consists of five stages, two stages in the initiation subprocess (agenda-setting and matching) and three stages in the implementation subprocess (redefining/restructuring, clarifying, and routinizing). The study has applied this adoption process model in detail. The chapters from Chapter 4 to Chapter 9 which present the analysis and findings of the study, have been arranged to follow closely the innovation process model. Each chapter provides a review section summarizing the findings of the chapter.

After having applied the innovation process model of the research framework, some surprising findings emerged in the study. It turned out that the observations made during the practical adoption process gave reason to suggest improvements to the innovation process model. As discussed in detail in Section 5.5, the events in the matching stage of the study did not confirm the underlying assumption in the innovation process model which states that "*later stages in the innovation process cannot be undertaken until earlier stages have been completed, either explicitly or implicitly*" (Rogers 2003, p. 420).

> The events from the pilot project showed that some decisions and actions of the implementation subprocess were undertaken before the matching stage of the initiation subprocess was completed. The study gives reason to conclude that especially the characteristics of the open source software with no-cost licenses supported the activities to undertake implementation actions before the matching stage was completed.

In case of a commercial software with regular license fees to be paid for each workstation installation, the same order of actions followed in the study would have been highly unlikely. In the example situation, the low cost of open source licenses made it possible to include OpenOffice.org to the organization-wide re-installation of workstations in a cost-effective manner already during the matching stage before the implementation subprocess. In the example case, no negative consequences were noticed as the result of the early installation of the software. However, in order to prevent possible negative user experiences, the early software installation could be combined with training activities to support users willing to try out the new software.

The logic of syllogistic reasoning as presented by Lee and Hubona (2009) defines the contradiction in the underlying innovation process model as modus tollens which calls the underlying model to be improved or replaced. In general, the incompleteness of stage models was already noted by Mohr (1982) who described stage models as incomplete process models, because they generally lack specification of the mechanism by which subsequent stages come about. Rogers (2003, p. 195) admits this by noting that definitive answer to the existence of the stages is impossible to provide and that sharp distinctions between each stage should not be expected. This was noted by Rogers regarding the innovation-decision process discussed in Sub section 3.2.1, but the evidence from this study suggests that it also applies to the innovation process in organizations.

An additional observation can also be made concerning the underlying research framework and the decision activities in the framework.

> As depicted in Figure 3-4 in Sub section 3.2.2, the innovation process in the organizational context includes one decision point which occurs between the initiation subprocess and the implementation subprocess. Unlike in the innovation-decision process model shown Figure 3-3 in Sub section 3.2.1, Rogers (ibid.) does not consider or discuss the decision in the organizational innovation process as a stage in the innovation process.

As noted by Rogers (ibid., p. 402), the innovation process in an organization is more complex when compared to the innovation-decision process by individuals. Based on the complexity of the innovation process, this study considered the decision as a separate stage which was presented in Chapter 6 of the study. Following Rogers' definition in the innovation-decision process by individuals (ibid., p. 177), the contents of the decision stage involved activities that lead to the choice to adopt or reject the innovation. The deviation from the framework in this study suggests that similar approach could also be applied in other organizational innovation adoption studies. This is a general suggestion concerning the organizational innovation process and not limited just to the innovation process involving OSS innovations.

Applying the open source migration guidelines of the IDA programme (IDA, 2003a), the matching stage of the study was divided into two substages: the building

of the business case and the design and implementation of the pilot project. Experiences in the study indicate that the matching stage may involve substantial costs. Sub section 5.4.7 showed that the budget-relevant expenses of the pilot project amounted to 41 000 € with additional not-budget-relevant costs resulting from the 250 person days of in-house work effort. In an organizational setting, the resource allocation of this magnitude requires a clear authoritative decision.

> The experiences from the study confirm the advantage of dividing the matching stage further into the business case and piloting substages in the organizational innovation process.

The advantages come from clear cost control and decision process especially when there are needs to improve the absorptive capacity of the organization as was the situation in the study. Following Cohen and Levinthal (1990) and Zahra and George (2002), absorptive capacity involves the organization's ability of acquire, assimilate, and exploit knowledge in order to recognize the value of an innovation and to put the innovation into practice. Because the advantages of dividing the matching stage into business case and piloting substages are not limited just to open source innovations, the study suggests that the same division of the matching stage would also benefit the organizational innovation process in other types of innovations. In addition, the experience from the study suggests that an organizational decision point would be added before the commencement of the pilot project. Based on the results of the business case and on the project plan of the pilot project, either a rejection decision or a decision to continue with the pilot project would be made at this point.

An additional observation can also be made concerning the underlying research framework and the redefining and restructuring stage of the implementation subprocess. As it turned out in Chapter 7, two major OpenOffice.org redefining activities were performed during the study. First for the initial version 2.0.2 in 2006 and then for version 3.0.1 during the actual deployment in 2009. In addition to OSS innovations, this type of redefining is characteristic to software innovations in general. During the deployment years of a software product, several versions of the software are being introduced. Each new version typically requires some redefining activities (e.g., installation design, configuration settings, conversion considerations) before it can be deployed in the IT environment of the organization. Thus the redefining and restructuring stage is repeated several times during the implementation subprocess. This is a contradiction to the underlying innovation process model which assumes linearly successive stages during the organizational innovation process.

> The findings of the study give indication to suggest that in case of software innovations, either the redefining and restructuring stage is repetitive or the

> whole implementation subprocess consisting of the redefining/restructuring, clarifying, and routinizing stages is repetitive.

Another approach which could also be applied in the organizational innovation process is to consider each new software version a completely new innovation where the possible adoption of each version of the software would trigger the whole organizational innovation process.

In terms of design science research as presented by March and Smith (1995), the study included both innovation-building tasks and innovation-evaluation tasks. The instantiation of OpenOffice.org was the realization and customization of the artifact for the actual deployment in the IT environment of the Ministry of Justice. Hevner et al. (2004, p. 84) argue that the instantiation of the artifact demonstrates the feasibility of the design process and of the designed product. Considering contributions in design science research, Hevner et al. (ibid., p. 87) present three types of possible research contributions which are based on the novelty, generality, and significance of the designed artifact. The assessment of relevance guides the application of research to the problems of the environment. Hevner et al. (ibid.) established seven guidelines, summarized in Table 3-2 in Section 3.1, for the requirements for effective design science research. In the following, the guidelines are used as the basis to evaluate the design research contributions of this study.

- ***Guideline 1****: Design as an artifact (the research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation).*
  - As discussed in detail in Sections 7.1 and 8.4, the instantiation of the OpenOffice.org artifact defined the implementation of the installation models and software configurations of OpenOffice.org for the deployment on more than 10 000 Windows XP workstations of the Ministry of Justice and its administrative sector. In addition, instantiations applicable for USB memory stick usage were produced for Finnish public administrations in general and delivered as downloads from the website of the Finnish Local Government IT Management Unit (KuntaIT) and from the European open source OSOR website. The research thus has produced several instantiations of the artifact.
  - In the form of constructs, the study has suggested several improvements to Rogers' organizational innovation process model. As a new model and method, the study has provided a complementary framework for the instrumentation and documentation of the OSS-related innovation process in the organizational context.
  - The artifacts address the research question Q1 (feasibility).
- ***Guideline 2****: Problem relevance (the objective of the research is to develop technology-based solutions to important and relevant business problems).*

  - The instantiation of OpenOffice.org was applied as the office suite platform for the deployment of the Ministry of Justice and its administrative sector. The evaluation of costs in Section 6.4 and the cost measurements in Section 9.3 indicate that the migration to the open source platform brings the benefits of cost savings in the order of magnitude of several million Euros during the 6-year period 2006-2011 when compared to the deployment of a comparative proprietary office suite platform. The implementation of OpenOffice.org deployment also brings the benefits of open document exchange and storage formats as the result of the transition from vendor-specific, proprietary document formats to the internationally standardized ODF (ISO/IEC 26300:2006) document format. The relevance of the problem can also be identified from the interest shown by public and professional media to the OpenOffice.org migration of the study (Tietoviikko, 2005; IDABC, 2005b; ITviikko, 2006; Tietokone, 2006; IDABC, 2007; Tietoviikko, 2007; Hämeen sanomat, 2007; Berlingske Tidende, 2009).
  - The results of problem relevance address the research questions Q2 (viability) and Q3 (benefits).
- ***Guideline 3****: Design evaluation (the utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods).*
  - The evaluation of the artifact was based on careful analysis using recommendations from international best-practice open source guidelines (IDA, 2003a; KBSt, 2005). Following the guidelines, the design was initiated in Section 5.2 with a management level business case report giving a detailed analysis of the problem area and alternative problem solutions. Next, an OpenOffice.org pilot project, discussed in Section 5.4, was carried out to test and validate the business case and the suggested problem solution. The pilot project evaluated the functionality, the compatibility and the support service needs of the problem solution, and provided the basis for training and software installations. From the evaluation methods suggested by Hevner et al. (2004, p. 86), this study has applied case study as the observational method and architecture fit as the analytical method. Hevner et al. (ibid., p. 85) stress the importance of the business environment in the evaluation noting that the business environment establishes the requirements upon which the evaluation of the artifact is based and that the integration of the artifact within the technical infrastructure of the business environment is part of the evaluation. Throughout the study starting from the business case and the pilot project up to the implementation and to the deployment of OpenOffice.org, the business environment of the study has been the actual deployment platform and the basis of the design evaluation. The

findings of the evaluation have been analyzed and compared using information from other relevant office suite migrations and evaluations. During the actual deployment of OpenOffice.org, the performance of the usage of OpenOffice.org was measured using information from multiple sources. The results of the measurements are presented in Sections 9.2 and 9.3. Usage metrics were based on the actual number of documents produced with office suite software, on the analysis of user support requests in the centralized help desk system, and on the actual costs of the OpenOffice.org migration and deployment. Measurements based on actual system usage are objective and address possible concerns related to self-reporting bias in the research. The measurements indicate that the year 2008 was the turning point in the migration in the sense that in the second half of 2008 OpenOffice.org bypassed other software packages being the most often used office software suite in the organization. The analysis of user support contacts revealed that problems associated to all office suite software packages represented a minor factor, only 1-2% of all help desk contacts, in the total load of user support requests. All user support requests were solved by the in-house staff without using third-party services. The information from the help desk system confirmed the pilot project conclusions presented in Sub section 5.4.4 regarding the need for user support services. The comparison of the estimated costs and the actual costs of the migration and deployment of OpenOffice.org indicate that the final OpenOffice.org migration and deployment costs for the years 2006-2011 will be be slightly below (5%) the original cost estimate of 2.1 M€ despite the fact that the number of workstation computers had increased from 10 500 to 11 600 in the organization during the years 2006-2009. Due to the benefits of open source licensing, the increase of workstations did not involve increases in the office suite licensing costs.

  - The research approach of this study, discussed in Chapter 3, provides an implementation-oriented view of the innovation process. The design evaluation reflects the selected research approach and addresses the evaluation from the implementation viewpoint. Complementary views are given less attention in the study and in the design evaluation. Further discussion on complementary views is provided in Section 10.3 (reliability and validity issues) and in Section 10.4 (limitations and suggestions for further studies).
  - The results of the design evaluation address the research question Q2 (viability).

- ***Guideline 4****: Research contributions (effective research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies).*

  - The instantiation of the OpenOffice.org artifact combined with the OpenOffice.org adoption implemented in the Ministry of Justice and its administrative sector denotes the first large-scale transition in Finland to an open source office suite. Because the office suite software is highly visible and in direct interaction with the end-users of the software, artifact instantiations in foreign language environments do not provide directly applicable basis for the feasibility and viability of an office suite artifact in a new local language environment. By presenting the first local language implementation of the artifact in a large-scale organizational environment in Finland this study addresses an important unsolved problem which is the basis of the design research contributions of the study. Referring to Figure 3-1 in Section 3.1, the contributions of the study extend the knowledge base of IS research providing knowledge which can further be applied in other IS research activities.
  - Research contributions in the form design artifact also include the documentation environment developed in the research including end-user and engineering documentation and the implementation of the intranet with various facilities to support e-learning and the progress of the adoption process. The evaluation framework developed and used in the study for the adoption of open source office suite software provides contributions to design foundations. Redefining activities in Chapter 7 and application integrations in Section 8.4 provide contributions to design methodologies in design research.
  - The instantiation of the artifact address the research question Q1 (feasibility).
- ***Guideline 5****: Research rigor (the research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact).*
  - Research rigor of the study is based on careful use of the IS knowledge base in order to apply methodologies applicable to the research domain. The organizational innovation process model developed by Rogers (2003) provided the study with a research framework to explore the OpenOffice.org adoption process. The organizational model has been rigorously applied in the study. Wareham and Gerrits (1999) and Huy (2001) have provided the study with general best practice guidelines in the incorporation of new technology in the organization. The guidelines have been augmented with specific best practices concerning open source adoptions (IDA, 2003a; KBSt, 2005; Woods and Guliani, 2005). As discussed in Section 7.1, specific best practices were applied in the installation and configuration of the artifact using several add-on extension components available through the open source community. Throughout the study, the instantiation of the artifact has been exercised

in the actual deployment environment of the organization. The discussion concerning Guideline 3 above shows how the evaluation of the artifact was measured using information from multiple sources. The evaluation metrics were based on the actual number of documents produced with office suite software, on the analysis of user support requests, and on the actual costs of the OpenOffice.org migration and deployment. However, considering the research rigor, we have not required for optimal solutions in the construction and evaluation of the design artifact. Following Simon (1996, p. 130), we have been more concerned with finding a satisfactory design.

- ***Guideline 6****: Design as a search process (the search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment).*
  - The search for the effective OpenOffice.org artifact has been an iterative process utilizing best practices in open source adoptions (IDA, 2003a; Woods and Guliani, 2005). Several OpenOffice.org versions and installation models were tested in the target organization of the study during the pilot project in Sub section 5.4.5. The process resulted in 2006 to the first organization-wide deployment model which was based on version 2.0.2. of OpenOffice.org. The results of the pilot project provided the basis for the assessment of the validity of the design. As discussed in Section 7.1, the search process was repeated three years later in order to produce the second, updated organization-wide deployment model based on OpenOffice.org 3.0.1. Following guidelines presented by Hevner et al. (2004, p. 88), the design has been guided by the knowledge of both the application domain (e.g., requirements and constraints) and the solution domain (e.g., technical and organizational). Redefining activities were required to meet the needs of the Ministry of Justice. Adjustments included, e.g., automatic support for local languages in the user interface and in spelling and hyphenation, environment settings, and customization of templates to comply with Finnish document standards. Despite the fact that open source innovations are strong regarding redefinition capabilities because the source code is available, no source code modifications to OpenOffice.org were necessary. All adjustments to fit OpenOffice.org to the needs of the organization and to provide a satisfactory solution could be carried out using various free extension components and settings which were supported by OpenOffice.org.
- ***Guideline 7****: Communication of research (the research must be presented effectively both to technology-oriented as well as management-oriented audiences).*

- The study has provided excessive documentation covering various aspects in the adoption of open source office suite software. For easy access, the documentation has been made publicly available in the Internet free of charge for all interested parties, including IT professionals and managers, end-users of OpenOffice.org software, and the research community.
- Following Hevner (2004, p. 90), technology-oriented audiences need detailed information to enable the construction and deployment of the artifact within an appropriate organizational context. The OpenOffice.org installation handbooks (Friman and Karjalainen, 2006; Karjalainen, 2009a), the engineering documentation of the ODF document format (Grönroos and Karjalainen, 2007; Karjalainen, 2007e), and the documentation of the OpenOffice.org pilot project (Karjalainen, 2006b) address the needs of technology-oriented audiences.
- User documentation addresses the needs of end-users and covers both basic functions of OpenOffice.org and advanced features needed in more specialized tasks. In general, the user documentation produced in the study became the basis of Finnish-language documentation covering OpenOffice.org version 2. User handbooks included OpenOffice.org express guide (Ruohomäki, 2005), OpenOffice.org question and answer handbooks (Karjalainen, 2006a; Karjalainen and Karjalainen, 2006; Karjalainen and Karjalainen, 2007), and OpenOffice.org template guide (Grönroos, 2007).
- Following Hevner (2004, p. 90), management-oriented audiences need sufficient detail to determine if organizational resources should be committed to adopting the artifact within their specific organizational context. The business case report (Karjalainen, 2005a) and the results of the OpenOffice.org pilot project (Karjalainen, 2006b) address the needs of management-oriented audiences in Finland. For international audiences, a migration report was prepared and thereafter presented in international seminars and workshops to management-oriented audiences (Karjalainen, 2007a; Karjalainen, 2007b; Karjalainen, 2007c). During the study, several presentations of the OpenOffice.org adoption have been given to Finnish management-audiences and IT professionals (Karjalainen, 2005b; Karjalainen, 2005c; Karjalainen, 2007f; Karjalainen, 2009b; Karjalainen, 2009c; Karjalainen, 2009d).
- The above documentation for the technology-oriented and management-oriented audiences also addresses some of the needs of the research community although the documentation is mainly in Finnish. The migration report (Karjalainen, 2007d), published in the proceedings of the Scandinavian IRIS30 research seminar, was the first presentation of

the migration study for the research audience. However, the main presentation of the results of the study to the research audience is based on this dissertation.

During the course of the study, several additional research findings could be noticed. They are briefly summarized in the following.

- During the agenda-setting stage in Chapter 4, several propositions by Rogers (2003) were confirmed: (1) a shock to the organization caused the problem, (2) the agenda-setting stage took a long time to complete, and (3) the importance of communication channels in the process, both mass media and interpersonal, was evident.
- The importance of top management support in the adoption of open source desktop software was systematically emphasized in the case studies presented in the research. Also the general guidelines concerning open source adoptions (IDA, 2003a; KBSt, 2005; Daffara, 2009) emphasize the importance of top management support. In the analysis of 51 organizational IT-based innovation adoptions, Jeyaraj et al. (2006) found that top management support was among the best predictors of IT adoption together with external pressure, professionalism of the IS unit, and external information sources. The results of this study confirm the importance of top management support. The support was evidenced during the matching stage of the study in Section 5.3, when the support shown by the highest ranking officers of the Ministry of Justice allowed the matching stage and the pilot project to be completed without unnecessary pressure and influences caused by outside organizations. On the other hand, the OpenOffice.org adoption plans in the city of Turku (Sub section 4.2.4) and in the Finnish Customs (Section 6.1) were not able to proceed due to the lack of top management support.
  - The importance of top management support addresses the research questions Q4 (supportive/preventive factors) and Q5 (practical guidelines).
- Rogers (2003, p. 414) argues that the presence of an innovation champion contributes to the success of an innovation in an organization. He defines a champion as a charismatic individual who throws his or her weight behind an innovation and overcomes indifference or resistance that the new idea may provoke in an organization. Rogers stresses the importance of the champion especially during the clarifying and routinization stages in the innovation process. The presence of an innovation champion could be noticed in several open source adoptions presented in the study, e.g., in SuPer (the Finnish Union of Practical Nurses which implemented the first publicly reported successful OpenOffice.org migration in a Finnish organization, discussed in Sub section

4.2.4), in Lemi (a small Finnish municipality which implemented the first publicly reported OpenOffice.org migration within the Finnish public administration, discussed in Sub section 5.2.5), in the German city of Munich (Section 5.2), and in the Bristol City Council in the United Kingdom (Section 6.1). The author of this study can be characterized as being the innovation champion in the OpenOffice.org adoption of the Ministry of Justice and its administrative sector. The author had an important role in the migration being the project leader both in the initiation subprocess and in the implementation subprocess. As discussed in Section 8.5, the author also gave the presentations to managers and critical user groups and was also the most active trainer giving almost half (245) of all training sessions during the years 2007-2009. The study suggests that the presence of innovation champions is important in the organizational adoption of innovations based on open source solutions.

  - The presence of innovation champions addresses the research question Q4 (supportive/preventive factors).

- Open source software is developed as a community project representing various stakeholders from volunteers to commercial companies. Even though private companies offer services based on the results of the community effort, the adoption of open source innovations can diffuse among users and user organizations without direct involvement by outside service providers. The classical innovation diffusion model typically involves change agents which Rogers (2003, p. 366) considers as representatives of a change agency which tries to influence clients' innovation decision in a direction deemed desirable by the agency. The diffusion of open source innovations does not necessarily involve external change agents at all. This situation emphasizes the presence of an innovation champion in the organizational innovation adoption. Schön (1971) challenged the classical centralized innovation diffusion model involving external change agencies and change agents by noting that it fails to capture decentralized diffusion systems where innovations are spread by horizontal networks among local innovators and adopters. This study suggests that the diffusion of open source innovations has the characteristics of decentralized diffusion where users have the capacity to manage their own diffusion.
- Rogers (2003, p. 424) argues that both the innovation and the organization are expected to change to some degree during the redefining and restructuring stage. The results of the study confirm this argument. As discussed in Section 7.1, several OpenOffice.org redefinition activities were performed in order to provide the installation model required by the deployment of the software in the organizational environment of the study. The implementation of the migration involved minor administrative fixed-term changes in the organization. Systematic learning and skill building activities were necessary

in order to develop the absorptive capacity of the organization and to incorporate OpenOffice.org into the regular activities of the organization.

  - The importance of skill building and absorptive capacity addresses the research question Q4 (supportive/preventive factors).

- In the redefinition of the innovation, we identified three types of possible adaptations: (1) source code modifications, (2) add-on components available as extensions, and (3) facilities for various settings provided by the software. The last two adaptations do not involve changes to the source code. All three adaptations facilitate different re-inventions with changes to the source code providing the utmost possibilities in the modification of the innovation. OpenOffice.org as open source software facilitates all three possible adaptations. However, even if the source code of OpenOffice.org was available, no source code modifications were considered necessary in the redefinition activities of the study. Rogers (2003, p. 187) argues that some form of re-invention occurs when an innovation must be adapted to the structure of the organization that is adopting it. The exploitation of add-on components and various OpenOffice.org settings confirms the argument in this study.
- Business best practices were applied in the study to support the change involved in the incorporation of new technology in the organization. Wareham and Gerrits (1999) argue that in most cases some adaptation of the best practice is needed. The adaptation of the MultiSave component in the migration (Section 7.1) and the implementation of the training practices (Section 8.3) confirm the argument.
- In the dichotomy between radical and incremental innovations, OpenOffice.org was found in Chapter 7 to be an incremental innovation representing routine innovation adoption. Following Rogers (2003, p. 426), incremental innovations do not require new paradigms to carry out tasks and when compared to radical innovations, they require less technical expertise in the implementation and create less uncertainty.

  - The incremental characteristic of OpenOffice.org addresses the research question Q4 (supportive/preventive factors).

- In Section 8.1, the implementation of OpenOffice.org adoption was found to have the divisibility characteristic as introduced by Leonard-Barton (1988). The divisibility of an organizational innovation is defined as the ability to divide the implementation by stages or by sub-populations. The divisibility facilitates both big bang and gradual approaches to the migration. In a gradual migration, OpenOffice.org can be implemented in an organization in stages which can, e.g., be based on the requirements of user groups or on the requirements of back-office integrations.

  - The divisibility characteristic of OpenOffice.org adoption addresses the research question Q4 (supportive/preventive factors).

- In Section 9.1, several of the factors identified by Rogers (2003, p. 429) to support the sustainability of an innovation were found to be favorable for the sustainability of OpenOffice.org in the migration of the Ministry of Justice. The favorable factors included participation of the members of the organization in the innovation process, the degree of re-invention, and the involvement of a local champion in the process. Key-person problem was identified as one of the risks to the sustainability of the innovation in the target organization of the study. The risk could be identified to involve both decision-makers and the concentration of vital IT system knowledge in one person in the organization. Based on complementary research resources from design research, also advances in technology and results from performance evaluation of the innovation's use were identified as possible factors addressing the sustainability or possible discontinuance of an innovation. The effect of network externalities caused by rapid developments in the office suite document formats was found to maintain conditions for sustainability risks in the routinization of OpenOffice.org.
  - The sustainability of an innovation addresses the research question Q4 (supportive/preventive factors).

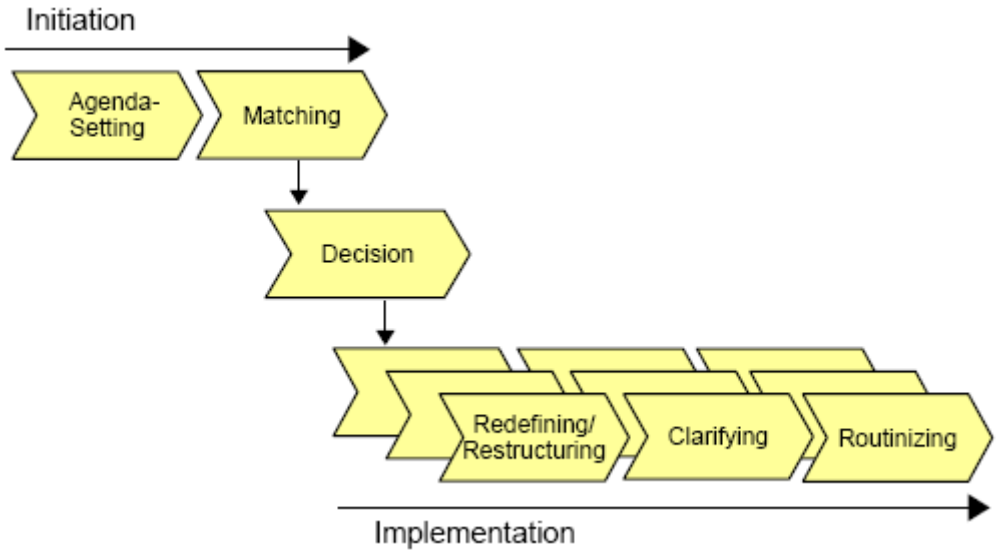

Figure 10-1. The improved model for the organizational innovation process

In Figure 10-1 we summarize some key findings of the study by presenting the indicated improvements to Rogers' original organizational innovation process model. When compared to the original model in Figure 3-4 in Sub section 3.2.2, the

improved model in Figure 10-1 retains the original key components and highlights the additional characteristics of the innovation process discovered in the study:

- The activities related to the adoption decision are presented as a separate stage between the initiation subprocess and implementation subprocess. This is a general suggestion to the organizational innovation process and not necessarily related just to OSS innovations.
- The improved model supports the situation where decision and implementation activities can be initiated before the matching stage has been completed. This improvement is related to the characteristics of OSS innovations.
- In case of an innovation with the divisibility characteristic, series of implementation stages may be proceeding simultaneously in the innovation process. This is a general suggestion concerning all innovations with the divisibility characteristic. The process in Figure 10-1 also supports the finding that in case of software innovations with successive releases, either the redefining and restructuring stage is repetitive or the whole implementation subprocess consisting of the redefining/restructuring, clarifying, and routinizing stages is repetitive.

From a methodological perspective this study has applied multiple research approaches. The principles of innovation diffusion research as presented by Rogers (2003) provided the study with a widely accepted and applied research framework to explore the OpenOffice.org migration adoption as a longitudinal process study. As a new model and method, the study has provided a complementary framework for the instrumentation and documentation of the OSS-related innovation process in the organizational context. Design science approach was utilized in conducting design research which stresses the utility of artifacts. Based on the framework of March and Smith (1995) and Hevner et al. (2004), the design research approach consisted of innovation-building and innovation-evaluation research activities. The innovation (artifact) of the study was based on the open source OpenOffice.org software. The innovation-building part of the study created an instantiation of the innovation for the deployment in the target organization of the study. The innovation-evaluation part of the study presented the analysis and measurements of the deployment of the innovation in the target environment.

> Considering the research questions Q1-Q4 of the study, the research contributions can be summarized as follows:
>
> - The study confirms previous results showing the feasibility and viability of the migration to an open source office suite in a large-scale context. As a new finding, the feasibility and viability is shown in the context of a large Finnish organization.

- The findings of the study indicate that the often cited benefits of open source solutions, e.g., cost reductions and open standards, can be realized as the result of the transition to an OSS office suite.
- Considering supportive factors in the adoption of an OSS office suite, the study confirms several results from previous research and practice, especially the importance of top management support, the presence of an innovation champion, and the development of the absorptive capacity of the organization as the result of institutional skill building. The study also suggests that the incremental and divisibility characteristics are supportive factors in the adoption of an OSS office suite.
- The study confirms previous results which suggest that favorable factors for the sustainability of an innovation include participation of the members of the organization in the innovation process, the involvement of a local champion, and the degree of re-invention. Considering risks to the sustainability, key-person problem was identified as one of the risks in the target organization of the study. The risk could be identified to involve both decision-makers and the concentration of vital IT system knowledge in one person. Additionally, the effect of network externalities caused by rapid developments in the office suite document formats was found to maintain conditions for sustainability risks.

10.2 Implications to practice

This study has presented a real-life adoption of the OpenOffice.org open source office suite in the context of a large public Finnish organization. The adoption, consisting of more than 10 000 Windows workstations, denotes the first large-scale transition in Finland to an open source office suite. The novelty and the rich insight provided by the research should benefit other organizations considering open source office suite adoptions both from the perspectives of management and implementation.

The research has presented a practical solution to an important and relevant business problem. Open source software with the generous licensing terms carries the promise of substantial cost savings to be realized through open source solutions. Combined with an internationally standardized document format, open source office suite software also promises enhanced cross-platform interoperability, support for the long-term accessibility of documents, and increased vendor independence. Despite these promises the actual initiatives in Finnish organizations have been somewhat hesitant. The study shows that the transition to an open source office suite is feasible in a large-scale context and that substantial benefits can be achieved as the result of the transition.

In addition to the OpenOffice.org adoption in the target organization of the study, the research has reviewed several other organizational adoptions based on open

source office suite software both in Finland and in other European countries. Table 10-1 briefly characterizes other adoption cases discussed in the study. The selected cases represent different situations and outcomes providing thus valuable information to practitioners considering open source adoptions.

Organization	Adoption characteristics	Study discussion
The Finnish Union of Practical Nurses (SuPer)	The first publicly reported OpenOffice.org migration in a Finnish organization	Sub section 4.2.4
The Finnish municipality of Lemi	The first publicly reported OpenOffice.org migration within the Finnish public administration	Sub section 5.2.5
The Finnish city of Turku	Publicly well-known OpenOffice.org migration plans which failed due to the lack of top management support	Sub section 4.2.4
Finnish Customs	OpenOffice.org/StarOffice migration plans which failed due to the lack of top management support	Section 6.1
Beaumont Hospital, an Irish public sector organization	StarOffice migration which was one of the first to include the evaluation of cost savings	Sub section 4.2.4
The German city of Munich	Widely known large-scale migration to open source platform including OpenOffice.org	Section 5.2
The Spanish region of Extremadura	Widely known society-wide open source platform adoption including OpenOffice.org	Sub section 5.2.5
The Dutch city of Haarlem	OpenOffice.org migration and deployment in a mixed environment with Microsoft Office; includes cost evaluation	Sub section 5.2.5
French Customs	Large-scale OpenOffice.org migration and deployment in a mixed environment with Microsoft Office; includes cost evaluation	Section 6.1
French Gendarmerie Nationale	Migration to OpenOffice.org and to open source platform in a large police organization; includes cost evaluation	Section 6.1
Bristol City Council in the United Kingdom	Widely known StarOffice migration which is exceptionally well publicly documented	Sections 6.1, 8.2, and 8.3
Eight ministerial cabinets in the Brussels public administration	Big bang migration to OpenOffice.org	Sub section 5.4.3 and Section 8.1
Hibernia Hospital, an Irish public sector organization	StarOffice migration and deployment which was ultimately unsuccessful and abandoned due to dissatisfaction among users	Section 2.2, Section 2.4, and Section 9.4

Table 10-1. Office suite adoption cases discussed in the study

The office suite adoption cases in Table 10-1 range from small IT environments (such as the municipality of Lemi with around 50 workstations) to large IT environments, the largest single organization being French Gendarmerie Nationale which implemented OpenOffice.org migration on 70 000 workstations. This study together with several other OpenOffice.org migration cases in practice show the feasibility and viability of the open source office suite platform. It can be noticed that all large-scale migrations which have been discussed in the study have been based on organizational authority decision and have had the top management support of the organization. It can also be noted that two OpenOffice.org migration plans in two Finnish organizations in Table 10-1 failed due to the lack of top management support. This in practice emphasizes the importance of top management support in the planning and implementation of OpenOffice.org migrations.

The presence of an innovation champion in the organization is obvious both in this study and in several of the migration cases presented in Table 10-1. As members of the organization, innovation champions actively promote the goals of the adoption and push the project over approval and possible implementation difficulties. One of the generalizations presented by Rogers (2003, p. 414) states that the presence of an innovation champion contributes to the success of an innovation in an organization. The findings of the study support this argument and suggest that organizations pay attention to facilitate circumstances where the internal will and power resources are available for the adoption of the innovation.

The migration implemented in the target organization of the study deploys a mixed office suite environment including both OpenOffice.org and Microsoft Office. In practice, the implementations of mixed environments are common and are also deployed in several of the migrations presented in Table 10-1. In a mixed environment the majority of users, typically around 85-90%, deploys OpenOffice.org or StarOffice. The Microsoft Office suite is supported on the rest of the workstations, e.g., to provide access to complex facilities not available in the open source alternative and for tasks where integrations with external organizations or back-office applications are based on the proprietary technology provided by Microsoft Office. For organizations considering the adoption of open source office suite solutions, the study suggests to consider as one alternative the implementation of a mixed environment which has the benefit to facilitate the realization of economic efficiency through open source deployment and at the same time to support proprietary technologies in the IT environment of the organization.

For the user organizations of open source software, lower cost has been the most commonly cited benefit and one of the main reasons for adopting open source (Glott and Ghosh, 2005; West and Dedrick, 2008). The results of several independent evaluations (Poulsen et al., 2002; OGC, 2004; Kristensen et al., 2005; Ghosh, 2006) suggest that open source office suite software is a viable technical and economical alternative to proprietary software. The results of the evaluations are confirmed by this study which has shown that substantial cost savings can be achieved as the result

of the adoption of open source office suite software. The evaluation of costs in Section 6.4 and the cost measurements in Section 9.3 indicate that the migration to the open source platform will benefit the target organization of the study with cost savings of more than 4 M€ during the 6-year period 2006-2011 when compared to the deployment of a comparative proprietary office suite platform.

With the exception of the city of Munich and the Brussels administration, cost savings were one of the main considerations in the office suite adoption cases presented in Table 10-1. Other considerations included strategic goals like the facilitation of more sovereign IT governance and the reduction of vendor dependence through open source solutions and open standards. The implemented office suite adoptions referenced in Table 10-1 showed impressive cost savings as the result of the migrations. However, the cost savings are not directly comparable due to the differences in cost structures used in the evaluations. Calculating IT costs is a complex issue requiring the consideration of many factors, including software acquisition and maintenance, hardware purchase and maintenance, personnel training, user support, and administrative costs (Russo et al. 2005a). The evaluation of costs in this study concentrated on the parts of the cost structure where differences between the considered alternatives could be found. The same approach was also used in the economic analysis of open source migrations presented in the study of the Danish Board of Technology (Poulsen et al., 2002). The cost evaluation structure used in this study included software acquisition and maintenance, personnel training, user support, application integrations, and document conversions. Both Russo et al. (2005a) and Poulsen et al. (2002) note that the actual categories structuring an IT cost evaluation are strongly driven by the context. The experiences of this study confirm the context-sensitivity of costs and suggest cautious approach when comparing cost evaluations among organizations. For example, the old office suite platform with the IBM Lotus SmartSuite software in the target organization of this study had a special impact on the costs thus complicating the comparison of costs in other contexts with different software platforms.

Considering practical measures in the planning and implementation of the OpenOffice.org adoption, the study applied the open source migration guidelines of the IDA programme (IDA, 2003a). The guidelines present both management and technical recommendations for the evaluation of open source migration issues. Among other things, the guidelines suggest the following best practices for the migration:

- *Building the business case for the migration*. The business case is presented as a management level report based on detailed analysis of the problem area and alternative problem solutions. The report should present the cost of the existing environment over a reasonable length of time, the cost of alternative environments, and the cost of migration. The business case should also analyze the strengths and weaknesses of the current environment and the various

alternatives and give recommendations for the implementation of the suggested solution.

- *Pilot projects*. Assuming the business case has been made, small-scale pilot projects are recommended, preferably in a self contained environment with a small number of users. Pilot projects represent reality testing and validation of the business case and the suggested problem solution.

The findings of the study suggest similar approach to be applied also by other organizations. The approach provides clear practical milestones for migration considerations and especially for the decision-making process of the organization. In this study, the results of the milestones were presented as publicly available reports in Karjalainen (2005a) and Karjalainen (2006b), suitable for management-oriented audiences. Several important practical OpenOffice.org migration issues were tested, evaluated and published in the pilot project including software functionality and compatibility, support service and training needs, and software installation and configuration. The findings supported international evaluations (OGC, 2004; Kristensen et al., 2005; Ghosh, 2006) which concluded that the functionality and interoperability were adequate for the usual needs in public administration. The extensive public documentation produced during the pilot project and during the years 2007-2009 includes both engineering handbooks and end-user documentation which address the practical needs of other organizations considering the adoption of OpenOffice.org.

In addition to engineering documentation and user handbooks, the study has provided practical resources for Finnish organizations considering the adoption of OpenOffice.org. Ready-made Finnish versions of OpenOffice.org applicable for USB memory stick usage were prepared in the study and delivered as downloads for Finnish public organizations. Other resources included various document templates complying with Finnish document standards and the Finnish version of the MultiSave extension component to OpenOffice.org.

Cohen and Levinthal (1990) and Woods and Guliani (2005) emphasize the importance of skill building in order to reduce knowledge barriers for the adoption and to facilitate the implementation of an innovation. The systematic skill building in the target organization of the study has facilitated the implementation to the extent that training, user support, and technical support could be provided by in-house staff with minimal use of third-party services. The findings of this study suggest that pilot projects, training, phased implementation of the migration, and documentation efforts to facilitate software productization provide opportunities for organizational skill building to facilitate the implementation of OpenOffice.org migration.

The OpenOffice.org migration in the Ministry of Justice and its administrative sector involved also the adoption of the ODF file format for office documents. The ODF format was accepted as the ISO standard ISO/IEC 26300:2006 in 2006 and it is natively supported by OpenOffice.org as the default file format of the software.

The standardized and vendor neutral document exchange and storage format facilitates, e.g., long-term accessibility of information and interoperability across software platforms. The ODF file format was adopted by several large-scale migrations referenced in Table 10-1, e.g., French Customs, French Gendarmerie Nationale, and Bristol City Council. The practical approach followed by the target organization of the study was to adopt the ODF file format internally within the organization and to support several file formats in external communication. In addition to ODF, OpenOffice.org supports, e.g., the widely used pdf, doc, xls, and ppt formats. The MultiSave extension to OpenOffice.org further facilitates document exchange in several formats by providing the functionality to save a document in multiple file formats in one save operation. The study suggests that organizations considering the adoption of OpenOffice.org would evaluate the benefits of also adopting the standardized ODF file format for document storage and exchange. The support of other file formats is a practical necessity in external communication, and it is facilitated by the OpenOffice.org software. The experiences of the study also suggest that organizations would consider redesigning document templates in the ODF file format and avoiding extensive reuse of previously developed templates which were made using proprietary tools. The redesign of document templates in the native ODF format of OpenOffice.org facilitates the reduction of formatting and style differences that may arise when one format is translated into another, e.g., in document exchange required by external communication. The same best practice is also suggested by Daffara (2009). As discussed in Section 8.3, more than 3000 document templates were redesigned in the ODF file format during the years 2007-2009 in the target organization of the study.

The sustainability of an innovation denotes the degree to which the innovation continues to be used after initial efforts to secure adoption have been completed (Rogers, 2003). Supportive factors for the sustainability include, e.g., wide participation of users and the involvement of a local champion in the innovation process. The key-person problem is a typical sustainability risk denoting a situation where the continued use of the innovation is dependent on the availability and knowledge of one person. The key person problem was identified in the OpenOffice.org migration of the study. The experiences of the study support the practical approach suggested by Woods and Guliani (2005) to avoid the key-person problem by institutional skill building where the skills of the organization are preserved by maintaining an appropriate level of IT system documentation and by transferring skills from one person to other staff members as the result of regular group work activity. High user interdependencies as the result of network externalities is a prevailing sustainability risk in the deployment of OpenOffice.org. Network externality was found in the study to result from document formats which create an interdependence among communicating members who exchange documents. In proprietary document formats defined by the software vendors for use with their own particular products, the network externality effect has been favorable

for the Microsoft Office suite due to its dominant market share. Shapiro and Varian (1999) suggest that compatibility standards are an important factor to prevent the development of vendor lock-in and high switching cost as the result of network externalities. Two international ISO standards for office document format have been accepted in recent years, the ODF format (ISO/IEC 26300:2006) and the OOXML format (ISO/IEC 29500:2008). With the introduction of the ISO standards, the conditions for document interoperability will eventually improve. However, it takes time before office suite software packages will provide high-quality support for both of these new standards. Interoperability problems are thus likely to prevail for some time in the coming years which maintains conditions for sustainability risk due to the effects of network externalities.

To summarize the study's findings to practice, we briefly review the contributions considering the research question Q5 which calls for practical guidelines for organizations considering the adoption of an open source office suite. In Section 10.1, some of the guidelines have already been presented, including the importance of top management support, the presence of an innovation champion as an internal change agent, the development of the absorptive capacity of the organization, and wide participation of the members of the organization in the adoption process. Considering open source office suite adoption risks, key-person problem was identified in Section 10.1 as one of the risks in addition to the effect of network externalities caused by rapid developments in the office suite document formats. Additional guidelines can be summarized as follows:

- The experiences of the study suggest the following general approaches to be followed: (1) preparing a management level business case report analyzing the problem area, alternative problem solutions, and costs and (2) carrying out pilot project(s) to test and validate the business case and the suggested solution.
- The experiences of the study also suggest that pilot projects, training, phased implementation of the migration, and documentation efforts provide practical opportunities for organizational skill building.
- For organizations considering the adoption of open source office suite solutions, the study suggests to consider the implementation of a mixed environment consisting of both open source and proprietary office suite. The mixed environment can facilitate the realization of economic efficiency and the support of proprietary technologies.
- The experiences of the study suggest organizations to consider redesigning document templates in the ODF file format and avoiding extensive reuse of previously developed templates which were made using proprietary tools.

- OpenOffice.org provides numerous add-on components (e.g., MultiSave and spelling and hyphenation tools) which can be be used provide an office suite environment with extended capabilities.
- The experiences of the study suggest cautious approach when comparing cost evaluations among organizations. The categories structuring cost evaluations are often strongly driven by the context which complicates comparisons.

10.3 Reliability and validity

Procedures addressing the reliability and validity of the research are important quality control measures. *Research reliability* is concerned with the consistence with which the operations of the study can be repeated with the same results (Yin, 2003; Järvinen, 2004, Gummeson, 1988). The goal of reliability is to minimize errors and biases in the study. The documentation of the procedures followed in the study is a prerequisite for reliability. Also the transparency and accessibility of the research process are important in addressing research reliability. Research validity is concerned with the degree to which observations measure what they purport to measure (Järvinen, 2004). The goal of validity is to obtain accuracy so that the theories, models, or concepts of the research accurately describe reality. Yin (2003, p. 34) gives several aspects for research validity. *Construct validity* is concerned with establishing correct measures for the concepts being studied. *Internal validity* is concerned with establishing causal relationships, where certain conditions are shown to lead to other conditions. *External validity* is concerned with establishing the domain to which study's findings can be generalized.

The above quality control concepts address general reliability and validity concerns in scientific research. Yin (2003, p. 97) gives three general principles which are relevant to address the construct validity and reliability issues: (a) use multiple sources of evidence, (b) create a case study database, and (c) maintain a chain of evidence. In the following, these principles are discussed in the context of this study.

- Järvinen (2004) suggests the principle of triangulation, i.e., to use a combination of various data gathering techniques in the research. Errors and biases are more likely to be detected if several different and independent sources of information form the basis for the study. This research is restricted to an in-depth innovation adoption study in a single organization which leads to somewhat isolated use of information sources. Data gathering techniques applied in this study include acquiring written material and documentation from several sources, log files from computer records, participant observation, pilot project, and computer artifacts. Plenty of the information comes from various sources from the target organization of the study, including administrative documentation (minutes of meetings of the project and the

steering group, progress reports), public diary of the organization, personal field notes, migration reports and publications (evaluations, user handbooks, and engineering documentation), and computer log files (help desk service records and usage records of office documents). Public information external to the organization of the study includes public diaries of the organizations referenced in the study, reports and publications, public presentations, newspaper clippings, and articles. Comparative adoption information has been gathered from multiple sources (literature, news services, other organizations in Finland and abroad). The OpenOffice.org website[42] has been an important source of information. Both Järvinen (2004) and Yin (2003, p. 96) suggest that the technological artifact itself can be an important component in the overall case considering the sources of evidence of the study. In design science research, the artifact is a crucial element of the study. The instantiation of OpenOffice.org in the target organization belongs to the vital sources of evidence in this study.

- In order to increase the reliability of the study, Yin (2003, p. 101) suggests to create a separate case study database containing the raw data of the study. The database could be reviewed and analyzed independently by other investigators. The study data of this research has been retained and is available. The research project has created a migration intranet which is based on the open source Moodle software. Detailed data of the migration has been kept and updated in the intranet. An example screen of the migration intranet is shown in Figure 5-2 in Chapter 5 which also has a more detailed discussion on the contents of the intranet. Also other research study material has been retained and is available (public diaries, public documentation, field notes, help desk service records). However, as noted by Lee (1989), it has to be recognized that a case study is difficult to replicate while maintaining consistency with the operations and results. The circumstances in the target organization of the study are unique considering the structure, functions, personnel and expertise in the organization, the timing of the study, and the IT environment where the innovation is to be deployed. Fichman (2001) has shown that such organizational characteristics can greatly influence innovation diffusion experiences. The dependency from the specific circumstances in the environment is unavoidable in design science research. Following Hevner et al. (2004, p. 85), the business environment establishes the requirements upon which the evaluation of the artifact is based and that the integration of the artifact within the technical infrastructure of the business environment is a crucial element in the the evaluation of the research.
- The principle in maintaining the chain of evidence or audit trail is to allow the reader of the study to follow the derivation of any evidence, ranging from initial research questions to the ultimate conclusions of the study (Yin 2003, p.

42 http://www.openoffice.org/ (cited 11 June 2010)

105). This study has addressed the guideline by grounding the reasoning to the objectives of the research, to the relevant portions of the literature and to the study data. In order to further support this principle, the study has produced several detailed public reports and documentation since 2005 covering crucial subtopics of the migration. These reports form the basis for the study in many important areas, and consistent use of references to the public reports has been maintained to facilitate the transparency of reasoning in the research. Miles and Huberman (1994) have given a set of queries applicable, e.g., to the evaluation of the auditability of the research. In addition to the specification of basic paradigms and constructs of the research, the queries address the description of the researcher's role and the review of peer colleagues. The researcher's role as an active participant who is able to control the events in this study is obvious and clearly specified. Peer review of the research has first taken place in the Scandinavian IRIS30 research seminar (Karjalainen, 2007d) and thereafter also in the seminars of doctoral student colleagues in the University of Tampere. The research process of the study is based on the well-known and open frameworks of Rogers' (2003) innovation adoption model and Hevner et al.'s (2004) design research framework which facilitate the accessibility and reliability of the research process.

The characteristics of design science research bring some special considerations for the quality control in the study. In design science research, the investigator is not a passive outside observer but instead an active participant who has considerable control over the events of the study. Additionally, the research is technology-oriented trying to device artifacts to attain specific goals (Simon, 1996). The seven guidelines, established by Hevner et al. (2004) and summarized in Table 3-2 in Section 3.1, define the requirements for effective design science research. Especially the guidelines 3 (design evaluation) and 5 (research rigor) address quality control measures in the research. The evaluation of this study in the light of the seven guidelines of design science research has already been discussed in Section 10.1.

External validity is concerned with the generalization of the study's findings. An important aspect to the generalization of the findings in design science research is the utility of the innovation. As noted by March and Smith (1995, p. 11), we build an artifact to perform a specific task. The basic question is, does it work? Following Hevner et al. (2004, p. 84), artifact instantiation demonstrates feasibility both of the design process and of the designed product. Without instantiation there is no proper basis for the generalization of the findings. This study produced the instantiation of the artifact in a single organization. Studies limited to a single case do not generalize statistically as surveys but instead analytically (Yin, 2003, p. 37). In analytical generalization, the research tries to generalize a particular set of results to a broader theory. The generalizing framework of Lee and Baskerville (2003) has a category for "generalizing from empirical statements to theoretical statements" which shares

the same basis with analytical generalization. In this study, the findings have been analyzed and integrated to the theoretical framework derived from Rogers (2003). As discussed in Section 10.1, the analytical generalization in the study resulted in several findings which included confirmative results with Rogers' framework, suggestions for improvements, and even contradictory evidence in the underlying framework for the organizational innovation process. Following the logic of syllogistic reasoning as presented by Lee and Hubona (2009), the findings from the single case study thus provided results ranging from evidence holding summative validity to the contradictory evidence of modus tollens.

The participatory researcher's view in this study is the view of an implementer and project leader in charge of the adoption of the innovation in the target organization of the study. As a researcher I am aware of the challenges related to the participatory views. As an insider in the organization, I have had access to both public and internal information sources. The participatory researcher's view may be biased and it may be argued that more attention to complementary and competing views, such as those of top management and end-users in the organization would be needed. Buchanan (2003) argues that it is not sufficient to present a single coherent account of organizational change by data triangulation and that exposure to competing and conflicting views is necessary in the research. The study of Bartis and Mitev (2008) provides an example showing how the introduction of a new information system was interpreted differently by the implementers and users within an organization and suggests that what is regarded as a success for one can be seen as failure for another. The low focus on complementary and competing views in this research is acknowledged. However, the current implementation-oriented view was considered the most essential view to serve the utility-oriented goals involved in the design science research. In the discussion of method bias in IS research, Burton-Jones (2009, p. 468) argues that no single study can fully address method bias which he defines consisting of knowledge bias and rating bias. He calls for programmatic research to be carried out by a community of researchers, not just one. The approach applied in this research, to use triangulation to address possible errors and biases in the study, represents current practice in IS research. To overcome self-reporting bias, the research has followed suggestions by Jeyaraj et al. (2006) and Venkatesh et al. (2003) who advice to study also actual system usage which is an objective measure typically obtained from computer logs. Measurements based on actual system usage are objective and address possible concerns related to the self-reporting bias in the research.

10.4 Limitations of the research and suggestions for further studies

One of the possible limitations of this research is that the adoption study has been conducted in a single organization. No statistical generalization of the results can be provided in a single case research and the representativeness of the results in other environments may be argued. However, the concentration in one organization has brought the benefit of allowing an in-depth insight and a rich description of the OpenOffice.org adoption process. Also the limitation to restrict the study to a Finnish organization and to take comparative cases just from European organizations may limit the representativeness of the results of the study. There is evidence that cultural differences affect the innovation adoption so that the overall validity of results based on study cases taken from the Western cultures may be challenged (Zhou, 2008).

A further organization-related limitation is that the study organization is a public sector one. There could be important differences in the adoption process of open source office suite software in private sector organizations. Furthermore, the concentration in the adoption of OpenOffice.org in a large organization may bring adoption challenges which require less attention in a small organization. It can be argued that the implementation of the adoption in a small organization is more straightforward requiring less attention to software installations, user training, document conversions, and templates.

The study has focused on a mass-market open source desktop application which is highly visible to the end-user and which has a strong market-leading proprietary alternative. It can be argued that the focus of the study brings additional adoption challenges when compared to the adoption of less visible back-office server side open source software like the Linux operating system and the Apache web server. Another software-related limitation comes from the software environment of the target organization of the study. The evaluation of software alternatives in the study was affected by the software packages and specific versions deployed at the time of the evaluation, e.g., OpenOffice.org versions 1 and 2, Microsoft Office 2003, and Lotus SmartSuite Millennium. More recent versions, OpenOffice.org 3 and Microsoft Office 2007 and 2010, have new functionalities thus affecting new evaluations. Especially the situation with two international ISO standards for office document formats, the ODF format ISO/IEC 26300:2006 and the OOXML format ISO/IEC 29500:2008, brings new requirements for the file format support thus affecting the results of new evaluations. The dependence of design science research on the rapid advances in the technology has been noted by Hevner et al. (2004, p. 99) who characterize design science research to be perishable with new technological developments being sometimes able to quickly invalidate earlier results.

One possible limitation of the study concerns the participatory and implementation-oriented research view which was considered essential to serve the utility-orientated goals of the study. As already discussed in Section 10.3, this has

resulted to less attention on complementary and competing views, e.g., the views of top management or end-users.

The possible limitations of the study can be used to identify issues and avenues for further research. The current study's limitation to focus on the implementation-oriented research view suggests further studies which would present additional views focusing, e.g., on end-user experiences in the deployment of OpenOffice.org. The limitation to concentrate on a single Finnish public sector organization in this research calls for further research collecting evidence from multiple organizations representing private and public sectors and organizations of different sizes. The advances in the open source and proprietary office suite software suggest further studies where the office suite adoption issue would be evaluated using the latest releases of the software packages.

The innovation process in this study involved a rather long time period from 2003 to 2010. An interesting subject for further studies would be the investigation of factors and methods affecting the length of the OSS office suite migration process. Both long and short migration times can be noticed in the European large-scale OSS migrations presented in this study as example cases.

This study has applied Rogers' organizational innovation adoption process model which was the first process model for innovation adoption in the organizational context. However, this far Rogers' process model has received little attention among IS researchers. The low attention given to the process model calls for more studies applying and validating the model.

10.5 Concluding remarks

As concluding remarks I summarize some of my experiences after completing the research project. Hopefully the lessons I have learned can provide some guidance for other IS researchers or practitioners considering projects of similar type.

Combining the roles of a practitioner and a researcher has provided me with an enriched environment to carry out the project. The academic perspective and scientific resources have supported the practical work in numerous ways by providing facilities to structure the migration considerations with well-thought and tested approaches. The scientific knowledge-base has helped to prepare thorough analysis and reporting which in turn has reduced uncertainties and increased the credibility of the evaluation and implementation of the migration. Without the academic perspective, the practical considerations would have been based on an ad-hoc analysis with more uncertainties and less credibility. On a personal level, there is no doubt that the academic perspective has improved my professional capabilities in OSS and innovation issues.

My original impulse to embark on the research project was generated by the shortage of publicly available information when commencing the analysis of office

software alternatives in the study organization. Now, seven years later, the situation has improved. Guidelines and case studies addressing OSS office suite migrations are available, though not in abundance but anyway there is more information available for anyone interested enough to find and explore it. Compared with purely commercial software, open source is a grass-roots effort which also means that more user effort is needed in order to evaluate the suitability of OSS solutions. The information does not come to the possible OSS adopter as the result of sales and marketing efforts by commercial vendors. Individual users, user organizations, and projects funded by public institutions are more involved in providing the information on OSS solutions. This was also experienced in this research. Valuable research resources were obtained through the IS research community, but also by getting involved with the activities of the OpenOffice.org user community and with organizations having experience with or considering the adoption of OSS solutions.

The 7-year length of the innovation process in this study was a personal surprise. There were times when I felt frustrated to the slow progress. I finally had to accept the slow pace as the result of the study organization's multitude of other projects and activities having effects to the priority and timing of the OpenOffice.org innovation process. The long duration of the process creates several risks. Organizational restructuring together with changes in personnel and in the duties of staff members are more likely during a long process. Considering the staff members involved in the implementation of the OpenOffice.org migration, there were only short time periods when full-time concentration on the migration was possible. Concerns of lack of trust and commitment are likely to appear in a long process which also involves time periods with only minor activities. There were times when my own trust on the study organization's commitment was weak, especially in the beginning during the agenda-setting and matching stages of the study.

The long duration of the research process clearly demonstrated the effects of the rapid advances in technology. Considering office suite products, the specific features provided by the product versions in the beginning of the process in 2003 have undergone important changes with several new software versions which have been released during the years 2003-2010. The value of the office suite evaluations conducted a few years ago thus soon diminishes suggesting that new OSS migration considerations start afresh from unique situations.

Long-lasting values in OSS migration considerations are not likely to come from the specific features of short-lived software releases but instead from concepts, models, methods, and frameworks addressing the migration process. As a researcher I was fascinated with the simplicity, generalizations, and adaptability of Everett Rogers' innovation adoption and diffusion framework which has survived the tests of time and numerous studies since its first introduction in 1960's. The application of Rogers' framework in this study required some interpretation to address the adoption of an OSS innovation. The benefit of the practical and simultaneously ongoing OpenOffice.org migration process allowed the interpretation and the application of

the complementary resources to appear very obvious to me during the course of the study. Rogers' innovation framework is strongly represented in the structure and in the contents of the study, but I also want to emphasize Herbert Simon's classic work on the sciences of the artificial on my thinking in this research. Like Rogers' framework, also Simon's work provides a holistic approach, originally not associated with IS research. Simon's notion of the artificial sciences, i.e. problem solving by creating artifacts, was originally discussed in other contexts, like economics, engineering, and architecture. Subsequent studies then anchored Simon's work also to IS research. In retrospect, combining these two holistic and discipline-neutral approaches as the building blocks for the research of OpenOffice.org migration seems like too much of an adventure just to provide safe sailing to a doctoral thesis. However, I was determined that the combination provided the ingredients I felt necessary in addressing the research questions of the study. I am still confident that the double-lens approach has given the benefit to discuss the migration from a richer perspective than by just concentrating, e.g., on the design research approach which could also have provided a possible and fully realistic research avenue.

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Appendix. OpenOffice.org questions presented by users

General topics

(1) How do I install OpenOffice.org on a Windows computer?
(2) How do I upgrade to a newer OpenOffice.org version?
(3) Does OpenOffice.org require a Java run-time environment?
(4) What are good OpenOffice.org user settings?
(5) How much RAM does OpenOffice.org require?
(6) Does OpenOffice.org increase the size of the Windows profile?
(7) How do I install and activate Finnish spelling and hyphenation?
(8) How can I get a Swedish user interface for OpenOffice.org?
(9) What are the XML file formats used by OpenOffice.org?
(10) Can I assign Microsoft Office file formats as the default save formats?
(11) How can I set the default application for Microsoft Office files?
(12) What are the shortcut keys of OpenOffice.org?
(13) How can I enable/disable the OpenOffice.org Quickstarter?
(14) How can I use document templates?
(15) How can I assign my own document template as the default document template?
(16) How do I find the style settings of a document?
(17) Can I transform a Microsoft Office file to pdf format?
(18) Does Acrobat Reader display the pdf files generated by OpenOffice.org?

Text processing – OpenOffice.org Writer

(4) Is OpenOffice.org compatible with Lotus SmartSuite WordPro?
(5) Is OpenOffice.org compatible with Microsoft Word?
(6) What file formats does Writer read?
(7) What file formats does Writer save?
(8) How do I copy text from elsewhere to a Writer document?
(9) How can I create a document template from a text document?
(10) Can I use text abbreviations?
(11) What are the shortcut keys of text processing?
(12) How do I set my own shortcut keys?
(13) How do I find out the differences between two documents?
(14) How do I use spelling in Finnish?
(15) How do I hyphenate the Finnish text?
(16) How do I use spelling and hyphenation in foreign languages?
(17) How can I prevent a line break between two words?
(18) How do I insert non-breaking hyphens?
(19) How can I disable the display of conditional hyphens?

(20) How can I make tab stops and return characters visible?
(21) How do I set tab stops and indents?
(22) How do I define a hanging indent as specified in the Finnish standard?
(23) How do I use bullets and numbering?
(24) How do I create headers and footers and insert date and page number fields?
(25) How do I make a different layout for the first page?
(26) How do I apply heading styles and generate a table of contents?
(27) How can I add empty space between the numbers and titles in the table of contents?
(28) How can I create watermark background for each page?
(29) How can I prevent automatic formatting of the text?
(30) How can I prevent automatic word completion?
(31) How do I restore text back to default format?
(32) How can I display/hide line numbers in the document?
(33) How do I remove in Word the highlight marking of text made in OpenOffice.org?
(34) How can I disable the display of background colour in page number and date fields?

Spreadsheets – OpenOffice.org Calc

(1) Is OpenOffice.org compatible with Lotus SmartSuite 1-2-3?
(2) Is OpenOffice.org compatible with Microsoft Excel?
(3) What file formats does Calc read?
(4) What file formats does Calc write?
(5) How do I open and save text files in Calc?
(6) How do I refer to cells and cell areas in Calc?
(7) How do I use the cell of another table (sheet) in a formula?
(8) How can I automatically generate series in consequent cells?
(9) How do I calculate the sum, number and average of cells?
(10) How do I use the Function Wizard?
(11) How do I transform the information in a table into a chart?
(12) How do I format the dates of the cells?
(13) How do I assign the border line settings of the cells?
(14) How do I assign the background colour of the cells?
(15) How do I create headers and footers for tables?
(16) How do I use spelling in a spresdsheet?
(17) How do I control line breaks in the cells of a table?
(18) How do I print only a selected table (sheet)?
(19) How can I print a table in the landscape format?
(20) How can I adjust the height and width of printing?
(21) How can I insert and remove page breaks?

(22) How do I lock the rows and columns of a table?
(23) Why isn't the number representation of date 1.1.1900 the same in Calc and Excel?

Slide presentations – OpenOffice.org Impress

(1) Is OpenOffice.org compatible with Lotus SmartSuite Freelance Graphics?
(2) Is OpenOffice.org compatible with Microsoft PowerPoint?
(3) What file formats does Impress read?
(4) What file formats does Impress write?
(5) How do I add new slides to the presentation?
(6) How do I add slides from another presentation?
(7) How do I hide slides from the presentation?
(8) How do I create slide headers and footers with date and page numbering fields?
(9) How do I show the presentation without page numbers and dates?
(10) How do I set the background of the slides?
(11) How can I create a presentation template from a slide presentation?
(12) How do I use spelling in a presentation?
(13) How do I hyphenate the text of the presentation?
(14) How do I adjust the slide contents to fit the print paper size?
(15) How do I print several slides on one sheet?