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# Environmental and organizational factors in the adoption of open source software in Dutch municipalities

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# 1

## INTRODUCTION

Open source software (OSS) provides many benefits that closed source (proprietary) software does not. Users have the freedom to study, change and redistribute OSS. With these freedoms OSS can not be the exclusive property of a single software vendor and it is often available for no license costs. It is making gains in market share rapidly. A study from 2009 estimated that worldwide revenue from OSS would grow at an annual rate of 22,4% to reach US $8,1 billion by 2013. The economic crisis is an extra stimulus for that growth (International Data Group, 2009).

The advantages of using OSS have not escaped the attention of the public sector. The Center for Strategic and International Studies, a foreign policy think tank based in the USA, tracks government policies on OSS. Their study distinguishes four categories of policies: research, mandates (where the use of open source software is required), preferences (where the use of open source software is given preference, but not mandated), and advisory (where the use of open source software is permitted). It also notes if policies were made at the national, regional and local level and if the policies were under consideration, accepted or rejected. According to their data there were 354 initiatives for open source policies globally from 2000 to 2009, of which 245 were approved. 235 were national policies and only 54 were mandatory. 163 of these initiatives originated from Europe, with Asia taking the second place with 81. Some supranational organizations such as the EU have enacted policies as well (Lewis, 2010).

The Netherlands is no exception to this. In 2002 the Dutch House of Representatives accepted a motion which requested the government to ensure that all software used in the public sector would work with open standards by the year 2006 and to stimulate the use of OSS in the public sector. The arguments given for the motion were the lack of competition in the software market and the high switching costs for choosing a different software vendor (Dutch House of Representatives, 2002). This resulted in several policy programs which were started by the national government since then. Undoubtedly much progress has been made, but there is still large variation in the adoption of OSS in the Netherlands. Government research shows that this is especially true for municipalities (NOiV, 2011c). They are most important because they are the largest branch of government in the Netherlands. They employ more public servants than the national government, provinces and water boards combined: 177.000 versus 124.000, 13.000 and 10.000 respectively (Dutch House of Representatives, 2012).

## 1.1 Research question

This study aims to give more insight in some of the factors which could be the cause of these large differences in the adoption of OSS by municipalities. The adoption of OSS can be seen as the adoption of innovation, which has an entire theory dedicated to its research: the diffusion of innovations theory. Important factors in the organizational adoption of innovation can be categorized as the characteristics of the innovation itself, the characteristics of the adopting organization and environmental influences (Frambach & Schillewaert, 2002). This research is not an innovation adoption study, but it does have some similarity to it. This study focuses on organizational and environmental factors which are interesting from the perspective of public administration and could influence the decisions of municipalities to adopt OSS. These four factors are the presence of boundary spanners, the presence of activist politicians, fiscal pressure on the municipality and the hierarchical fragmentation of the municipality's ICT department. A fifth factor was the the difference between autonomous municipalities and those who are part of a collaborative organization or administrative fusion, but it was not possible to test that factor as a hypothesis due to missing data.

The style of research this study uses is large-N quantitative research. This study is notable as a pioneering work because there is no known existing quantitative research which focuses on the adoption of OSS by municipalities. Cassell (2008) performed an exploratory qualitative study of the motivations of four municipalities to adopt OSS. Ven and Verelst (2008b) executed a large-N quantitative study to investigate factors in the adoption decisions of OSS on a sample of both public and private organizations. While both studies answer a part of puzzle, they do not provide information about the effects of all four factors researched by this study, which is both quantitative and focuses on municipalities.

## 1.2 Justification

Independence from software vendors and financial motives are arguably the most compelling reasons to research the subject. There is plenty of evidence in studies by governmental organizations, scientific studies and media reports of real world migrations to OSS attesting to the financial benefits of the use of OSS. While some evidence disputes the benefits, most of it gives an impression that the advantages are significant.

Due to the nature of OSS there is no single party which has the sole right to offer a specific OSS package on the market. Because anyone can offer it, competition in the software market is greatly stimulated. This was one of the reasons for the House of Representatives to press for the use of OSS in 2002. Because the source code is available freely to anyone, OSS can be acquired without paying license fees as is common for proprietary software.

The latest research on the subject by the Netherlands Court of Audit (2011) (*Algemene Rekenkamer*) was not in favor of OSS. In 2010 the House of Representatives requested the Court to investigate the possibilities, advantages and disadvantages regarding the use of OSS and open standards. The Court only investigated the ministries and not the rest of the public and semi-public sector. It concluded that the potential savings to be made with OSS were very minor. While OSS does not have licensing costs, those constitute a very small part of the ICT budgets of the ministries. The conclusions of the report drew criticism in the ICT media because the

focus on the ministries and license costs without taking into account other layers of government and advantages such as vendor independence was perceived to be very limited (de Rooij, 2011b). The criticism was shared by commissions of the House of Representatives (de Rooij, 2011a).

Other governmental organizations also researched the subject. The Netherlands Bureau for Economic Policy Analysis (*Centraal Planbureau*, CPB) is a research institute which is part of the Dutch ministry of Economic Affairs, Agriculture & Innovation. In 2009 it was asked by the same ministry to investigate the economic effects of stimulating OSS in the light of the government's policy (Bijlsma, de Bijl, & Kocsis, 2009). The CPB argued that both proprietary software and OSS have their advantages if aspects such as welfare and innovation are taken into account and that it depends on the situation which one is favorable. If there is market failure in the form of high dependence on a small amount of vendors and a lack of competition in a specific segment of the software market, government intervention could be justified. While an analysis of such market failure was outside the scope of its report, the Bureau suggested that such market failure might exist in markets for operating systems and office suites.

In 2011 it came to light that the Dutch Ministry of the Interior and Kingdom Relations had investigated how much savings could be made by the national government if it would use open standards and open source software. The report was written by a single public servant and never surpassed the status of an internal, preparatory policy document, but it was sent to the Court of Audit for its aforementioned research report nevertheless. Anonymous government sources informed a member of the House of Representatives of its existence, who then demanded the minister to make the report public. The minister wanted to keep the report secret, but gave in to the pressure with the remark that the quality of the report was inadequate. According to the report € 500 million to € 1 billion could be saved if the government would use open standards and OSS (Bakker, 2011).

Scientific research on the benefits of OSS for the public sector has been limited. Comino and Manenti (2005) investigated the impact on social welfare of government policies supporting OSS. Due to the nature of OSS, which is most often distributed free of charge, its producers have little motivation to advertise. Therefore it is estimated that a large share of mass market consumers is uninformed about the existence of OSS, so there is a market failure. If the government would mandate the adoption of OSS in the public sector or would provide information to consumers social welfare would increase.

Fortunately, the study of Cassell (2008) investigated the advantages of OSS adoption in the real world instead of theory. In his exploratory study of the German municipalities Schwäbisch Hall, Treuchtlingen and Munich and the Austrian municipality of Vienna, Cassell (2008) found that financial reasons were the second most important reason for the municipalities, after becoming independent from software vendors, to migrate to Linux and other OSS applications.

And then there is also the evidence found in the media reports on migrations to OSS. There are a great deal of examples of this. Perhaps one of the most well-known cases is the municipality of Munich. It started its plan to migrate in 2003 (Cassell, 2008) and is now on track to finish the migration of the last 2.500 workstations to meet its goal of 12.000 migrated workstations by the end of this year. The municipality calculated that the current cost of its migration project is € 11,7 million, while an upgrade to a comparable environment based on Microsoft Windows and Office would have cost € 15,52 million. This number excluded € 2,8 million for license fees

for upgrades which would recur every three to four years for a Microsoft infrastructure (von Eitzen, 2012).

Similarly, even larger migrations have been undertaken elsewhere in Europe. The administration of Spain's autonomous region of Extremadura decided this year to migrate to Linux as well. With 40.000 workstations (Hillenius, 2012c) it expects to save € 30 million annually (Hillenius, 2012b). The French national police force decided to migrate to OSS in 2004. This enabled the organization, which had 90.000 workstations in 2004, to save over € 50 million on software licenses, hardware and maintenance since the migration was started (Hillenius, 2009). While concrete numbers for savings are scarce for Dutch municipalities which have migrated, there is information available for the municipality of Groningen. The municipality decided to switch from Microsoft Office to OpenOffice.org and saved € 330.000 annually. This figure was based on the license fee of Microsoft Office for 3.650 PC's (Schaafsma, 2006).

The decision to employ quantitative research gives an extra reason to research municipalities rather than other layers of government. Municipalities are far more numerous: there are 415 municipalities in the Netherlands as of 1 January 2012. By comparison, the current cabinet Rutte has eleven ministries, the Netherlands has twelve provinces and twenty-six water boards. They are simply too few in number to be suitable for quantitative research.

## 1.3   Structure of the thesis

OSS is not frequently studied in the field of public administration. To introduce the audience of this thesis to the concept of OSS a brief history and definition will be given first in the second chapter. That chapter also elaborates on the history of OSS in the Dutch public sector and the use of OSS by Dutch municipalities. In the rest of the chapter a literature review is done to identify the factors influencing OSS adoption which are then constructed into hypotheses. In the third chapter the research design is explained. It discusses the conceptualization and operationalization of the variables, the selection of the respondents for the survey which was used to gather data, how the data gathering proceeded and what the limitations of the research are. The results of the data analysis are discussed in the fourth chapter. The thesis concludes with the fifth chapter which provides a summary of the findings, gives recommendations for policymakers and suggestions for future research. Appendix A contains data on all municipalities which were contacted and lists if they responded, refused to respond or were unable to respond. The survey questions which were used are described in Appendix B.

# 2

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# THEORY

This chapter starts by explaining in the first section how OSS developed through history and clears up the confusion about its definition and terms. Open standards are related to OSS and are covered there as well. The short second section describes how the 2002 motion of the House of Representatives was transformed to policies by the government up to the current state of affairs. How OSS is used in practice by municipalities is discussed in the third section, along with some statistics gathered by the government's research. This is followed by a brief, more general literature review to identify the factors influencing OSS adoption. Each factor is then transformed to a hypothesis in its own section and a rationale is given for it. The last section summarizes the hypotheses which were formulated.

## 2.1 What is open source software?

Wheeler (2007) serves as a good starting point for an introduction to the concept of OSS. While his article may be self-published, it is an authoritative source which has been cited in more than 200 scholarly works according to Google Scholar. He describes how in the early history of computers – approximately from 1945 to 1975 – it was normal practice to share the source code of software. Similar to how dishes or drinks are made with recipes, computer software is made with source code. Source code is any collection of computer instructions written in human-readable computer language. It can be translated by compilers or interpreters to machine code so that computers can execute the code.

This changed, especially in the 1970s en 1980s, when an increasing amount of software developers decided to stop distributing the source code with their software. This development intersected with the commercialization of software; without the source code, users had to pay license fees to be able to use the software. However, this also meant that it became impossible for users to modify the source code and to share their modifications with others.

A researcher at the MIT Artificial Intelligence Lab named Richard Stallman was opposed to this trend. He started the GNU Project in 1984 to develop a Free Software (free as in freedom, not necessarily free as in price) operating system. He founded the Free Software Foundation in 1985 to support the development of Free Software. In 1989 he made another important contribution with the GNU General Public License (GPL) which is one of the most popular licenses for Free Software.

Many developers joined the effort to develop Free Software. The rise of ARPANET and later the Internet greatly aided collaboration. A very important milestone was the first release of the Linux operating system kernel in 1991 by Linus Torvalds. With the kernel being the main component of most operating systems, all the pieces of the puzzle were now in place for the Free Software operating system. While other Free Software operating systems like the BSD operating systems were developed concurrently with Linux, the latter (sometimes also called GNU/Linux) has become the most popular operating system.

From its inception in the mid-1980s, OSS has become very important on the software market. More than 75% of all web servers run on OSS as of April 2012 (Netcraft, 2012). 52,5% of all smartphones sold to end users globally in the third quarter of 2011 used Google's OSS Android operating system, which is based on Linux (Gartner, 2011a). However, on the operating system market for clients (as opposed to servers) Microsoft is the dominant vendor. It was estimated that of all new PC's shipping in 2011, 94% would ship with Windows 7 and 4,5% with Apple's Mac OS (Gartner, 2011b). The market share for Microsoft Office is also estimated to be over 94% (Fildes, 2010). Not surprisingly, with its dominant position Microsoft's Windows division had a profit margin of almost 60% in 2011 (Garside, 2012).

In 1997 the term open source software was thought up to make the concept of Free Software easier to communicate, as the latter term led to confusion because it is often associated with software that merely has no cost. The Free Software Foundation did not agree to this and continues to use the term Free Software. Both terms have their own definitions and are based on different ideological backgrounds, but in practice most of the software meeting one definition meets the other as well. For example, the Free Software Definition states that software is Free Software if the license of the software permits users the freedom to run the program for any purpose, to study and modify the program and to freely redistribute copies of the original or modified program. In this thesis the term open source software and the abbreviation OSS will be used because it is the more popular term. Other alternative terms are Free and Open Source Software (FOSS) and Free/Libre/Open Source Software (FLOSS).

Additionally, the term open standards is used throughout this thesis. Just like OSS, the definitions of what constitutes an open standard can be different. The Standardisation Board and Forum of the Dutch government defines open standards as standards which have no restrictions on their use. They are maintained by non-profit organizations who include all involved parties in an open decision-making process for the development of the standard, anyone can use them freely and potential owners of intellectual property make their patents available on a royalty-free basis. Like OSS, they are a cornerstone of the Dutch government's policy because they enable interoperability and reduce dependence on single vendors (Standardisation Board and Forum, 2011). They are different from OSS because they can also be implemented in proprietary software. An example of a common open standard is the PDF format, which is used for this thesis and is also recognized by the Standardisation Board and Forum. Because open standards are different, they are not included in the scope of this thesis.

## 2.2   The adoption of open source software in the Dutch public sector

The report of the Netherlands Court of Audit (2011) provides a summary of how the Dutch government's policy on OSS and open standards was developed. In response to the motion accepted by the House in 2002 the cabinet started the program Open

Standards and Open Source Software (OS&OSS). In the following years the cabinet took various measures to increase the knowledge about OSS in the public sector. In 2006 the government established the Standardisation Board and Forum (*Forum Standaardisatie* to execute its policy on open standards. The policy on open source software was continued under a new program called OSOSS. In 2007 several members of the House of Representatives were disappointed in the government's execution of the motion of 2002. They submitted a new motion to request the government to ensure that all software used in the public and semi-public sector would conform to open standards by 2009. The motion was rejected, but later that year a new program called 'The Netherlands in Open Connection' (*Nederland Open in Verbinding*, abbreviated as NOiV) was launched by the government.

As part of the new plan the 'comply-or-explain and commit' (CEC) regime was enacted in 2008 for a selection of open standards determined by the Standardisation Board and Forum. The regime requires that public sector organizations use open standards for ICT projects which are new or are modifications or contract extensions of older projects. If that is not possible the organization is required to explain its choice and must then explain how it intends to commit to open standards in the future. Contrary to the policy on open standards, the policy on OSS was far less demanding. The NOiV program merely stimulated that OSS was considered on an equal level to proprietary software in decision making and asked public organizations to formulate an implementation strategy for OSS. But an instrument for enforcement like the CEC-regime was absent (NOiV, 2011b).

The NOiV program ended in December 2011 and most of its supporting tasks were transferred to other organizations. The Quality Institute Dutch Municipalities (*Kwaliteitsinstituut Nederlandse Gemeenten*, KING) assumed this role for municipalities. The third and final progress report (NOiV, 2011a) of the NOiV program summarizes that the adoption of OSS and open standards is now irreversible and that the action plan has been effective. Yet in some other aspects improvement was inadequate. The progress report mentions that compliance with the CEC-regime was limited. A sample of all tenders written by governmental and public sector organizations revealed that 40% complied with the policy and that the other 60% of the tenders did not ask for open standards to be used. This is allowed as long as an explanation is given for it, but no explanation was found in the annual reports of the organizations not in compliance. This worried the cabinet, which decided to implement a stricter CEC-regime.

One of the measures taken was that the national government's budgeting provisions now require organizations which are part of the national government to explain non-compliance to open standards in their annual reports, starting with those for 2011 (Standardisation Board and Forum, 2012). To increase the compliance of municipalities with the CEC-regime the Ministry of the Interior and Kingdom Relations intends to give more attention to the regime in the accountability agreements it will make with other layers of government (NOiV, 2011a).

## 2.3 The adoption of open source software in Dutch municipalities

During the time it was active, the NOiV program published the NOiV Monitor. The Monitor is a report based on a survey used by NOiV to measure the effectiveness of the government's policy, with the last Monitor for the year 2010 being released in 2011 (NOiV, 2011b). The survey was sent to all ministries, provinces, municipalities and water boards and a few other national governmental organizations of the

|                        | Number of fields | | | | |
| --- | --- | --- | --- | --- | --- |
|                        | 0 | 1 | 2 | 3 | 4 |
| Adoption of OSS in %   | 17 | 12 | 31 | 27 | 13 |
| N = 183 | | | | | |

Table 2.1: Relative frequency table of OSS use by municipality as measured by the NOiV Monitor.

Netherlands. Some of the survey's results were compiled in two rankings to compare the organizations. The normal ranking (NOiV, 2011c) scores the compliance of organizations to the NOiV program's action plan for adopting open standards and OSS. A vanguard ranking (NOiV, 2011e) scores the extra efforts of organizations who do more than merely complying to the action plan.

The rankings show that there is a wide variety in the degree to which municipalities comply with the action plan and their use of OSS. This is evident from the total score which measures adoption of both open standards and OSS and in the score for a single survey question which measures adoption of OSS specifically. There is a relatively small amount of municipalities with high scores and a larger amount of those with low scores. The response rate of municipalities to the survey is 44% with 183 respondents. While not unreasonable, it might not be as representative as desired. The Monitor suggests that non-response to the survey might be linked to familiarity with and support for the action plan and the degree to which the municipality has implemented the plan. In other words, in the real world the share of municipalities who have adopted OSS intensively could be even lower.

To measure the degree of adoption of OSS the Monitor distinguished four fields of applications and provides examples to explain what they could include. Infrastructure includes operating systems, databases, network services, application servers and geographic information systems; system administration includes network management, security, data storage systems and software development; Internet applications include web servers, content management systems, portals and search engines. End user software includes document creation, document management, groupware and CRM. For every field in which OSS is used the municipality scores points. For the purpose of the ranking itself this was translated to four points and a four point bonus for all four fields to get the nicely rounded number of twenty, but the practical range of the scoring system is from zero to four.

Table 2.1 shows the relative distribution of scores on OSS adoption by municipality. This data is not given in the report itself and was compiled manually from the data provided by the rankings. The Monitor does give numbers on the relative use of OSS by field. That data is shown in table 2.2.

The NOiV program's website provides a large amount of example projects detailing which municipalities use OSS, what kind of OSS and how they implemented it (NOiV, 2011d). Dutch ICT news websites have covered the use of OSS by municipalities as well. Some popular OSS software packages which feature prominently in these example projects and news reports are the office suites OpenOffice.org and LibreOffice as replacements for Microsoft Office and the groupware Zarafa as a replacement for Microsoft Exchange. Some municipalities who use the TYPO3 content management system for their websites established a user group for municipalities (TYPO3 Gemeenten, 2012).

| Field | Use in % |
|---|---|
| Infrastructure | 73 |
| System administration | 58 |
| Internet | 51 |
| End user software | 31 |
| N = 183 | |

Table 2.2: Use of OSS by municipalities by field as measured by the NOiV Monitor.

Among many success stories, there are a few reports of failures as well. According to the NOiV Monitor the compatibility, support, implementation, reliability, stability, security, maturity and usability of OSS are factors of concern for governmental organizations. Two reports of failed projects initiated by municipalities reflect the concerns over compatibility. The municipality of Amsterdam, the largest municipality of the Netherlands, held successful pilot projects (de Haes, 2008) for a migration to OSS, but this project was shelved (de Winter, 2011) because of larger ICT issues unrelated to OSS. Even so, a program manager of Amsterdam's OSS project emphasizes the difficulty in maintaining compatibility with the existing software infrastructure of Amsterdam (Visser, 2011). Similarly, the municipality of Heerenveen migrated back to Microsoft Office after its migration to OpenOffice.org in 2006. According to the municipality it was not possible to make OpenOffice.org compatible to several mission-critical applications (de Rooij, 2010).

When asked for his opinion on the cases of Amsterdam and Heerenveen, a public servant who led a successful migration to OSS in the German municipality of Munich answered that it is a matter of perseverance (Editors of Binnenlands Bestuur, 2010). According to him there are solutions for all problems as long as the municipality takes the time, has the budget and political support.

## 2.4 Literature review

The adoption of OSS in the public sector is a *terra incognita* as the subject has not seen much investigation yet. The research of Cassell (2008) is in fact the only research found from the perspective of public administration. His research was an exploratory qualitative study into the motives of the municipalities of Schwäbisch Hall, Treuchtlingen, Munich (Germany) and Vienna (Austria) to adopt OSS. Outside the sphere of public administration, studies on the adoption of OSS with a wider perspective are more numerous. The work of Ven and Verelst (2008b) is notable for being the sole known quantitative study on adoption of OSS. They study adoption from the perspective of business informatics and have authored many other publications on the subject. In their quantitative study they found the presence of boundary spanners on adoption of OSS was the most significant influence of all their independent variables.

It was noted in the introduction that the reason for adopting OSS often boils down to financial motives. This is confirmed by Cassell (2008), who found that financial savings were an important reason to migrate to OSS for the municipalities he investigated. For the smaller municipalities of Schwäbisch Hall and Treuchtlingen their plans were triggered by a drop in tax revenues. A possible factor might be that larger municipalities have greater budgets per inhabitant than smaller ones as is the

case in the Netherlands (Allers, 2011). This could mean they have more incentives to reduce expenditures. Morgan and Finnegan (2007) also identify lower Total Cost of Ownership (TCO) of OSS compared to proprietary software as an important factor for adoption of OSS by companies. However, Fitzgerald (2006) writes that calculating TCO is very complex with its outcome being dependent on the organization, its environment and which costs are taken into account. This makes perceptions of TCO highly variable. The concept is also difficult to investigate as there can be many decision makers in an organization. Instead of investigating the consequences of perceptions of TCO for adoption, we can investigate if adoption increased as a consequence of the 2008–2012 global recession, which is easier to investigate.

Finally, the organization of the ICT services of the municipality is likely to have an important impact on the adoption. The municipality of Munich underestimated the difficulties of migrating to open source software and open standards. Because the municipality had twenty-one independent ICT departments which did not share standardized software the migration took longer than expected (von Eitzen, 2010). The municipality of Zaragoza also experienced difficulties with its migration due to a fragmented organization (NOiV, 2010). The research of Cassell (2008) confirms this, it mentions that organization structure was the most important factor affecting the implementation of the migrations.

Amsterdam's pilot projects faced similar problems. The reason why Amsterdam abandoned its plans with OSS was the ICT chaos in the municipality. It had a huge amount of applications in use, with estimates ranging from ten to fifteen thousand. The municipality uses at least fifty different software packages for e-mail servers and for some other applications the municipality has at least five different versions in use. The total costs for ICT in the municipality, € 128 million, are at least twice as high as in other municipalities (de Winter, 2011; Visser, 2011). Munich experienced similar circumstances and decided to standardize on OSS, Amsterdam decided to stop its OSS project and standardize on proprietary software first.

The theoretical and practical insight provided by this brief literature review led to the formulation of five hypotheses. In the rest of this chapter each hypotheses is formulated and its theoretical base is elaborated on.

## 2.5  Boundary spanners

In their exploratory, qualitative field study of OSS adoption by several companies Morgan and Finnegan (2007) define boundary spanners as 'individuals who connect their organization with external knowledge and can bring the organization in contact with new innovations' based on an earlier study. That study revealed that adoption of OSS is mostly a bottom-up initiative instead of top-down. They mention that in most of the companies they studied, there are some employees who are knowledgeable on OSS and can support its introduction. These individuals are influenced by the technical and business benefits of OSS to become advocates of OSS. In other research the concept of 'OSS champions' is used, but they find this concept is hard to distinguish from the boundary spanner.

Ven and Verelst (2008b) investigated which factors influence the adoption of open source server software in 332 private and public Belgian organizations. They reference Morgan and Finnegan (2007) as a source for existing research on boundary spanners and found some evidence in favor of the hypothesis in their own qualitative research (Ven & Verelst, 2006). Because evidence for the hypothesis based on large-N quantitative studies was missing they tested it in their own research project. They

expected the presence of boundary spanners to be positively related to the adoption of open source server software and negatively related to switching costs. Their reasoning was that organizations with boundary spanners need to invest less time and money in training personnel for the transition to OSS. The results of their research show that the presence of boundary spanners is the most influential independent variable on adoption. In one of their other qualitative studies Ven and Verelst (2008a) found that boundary spanners can sometimes be driven by ideology in their choice for OSS. As such their beliefs can influence adoption decisions in smaller organizations, but the majority of organizations are pragmatic in their decision making.

The authors cited above do not specifically exclude managers, but they do focus on the bottom-up aspect of innovation. According to Damanpour and Schneider (2009) managers with a positive attitude towards innovation will make the adoption of innovation more likely as well. Having this positive attitude might make managers boundary spanners themselves to some extent. At least innovative managers would enhance the presence of boundary spanners in the organization because managers value their opinions. This means the managerial aspect needs to be incorporated in the research design.

## 2.6 Activist politicians

While the adoption of OSS in organizations is frequently a bottom-up process in which personnel promotes the use of OSS, it can also be a top-down process, especially in municipalities. The municipal council and the College of Mayor and Aldermen are respectively the government and executive board of municipalities in the Netherlands. In two of the four municipalities studied by Cassell (2008) the adoption of OSS was initiated by councilors. This also occurred in the municipality of Gouda, where a councilor submitted a motion which resulted in the municipality switching to OpenOffice.org (Klijmij, 2010). In Amsterdam municipal councilors also took the initiative (de Winter, 2011).

Determined politicians could thus play the role of the top-down boundary spanner, but their influence is different. The council might be able to force its will on the public servants with a majority, but public servants can resist. In the case of Amsterdam top public servants did not support the plans to migrate to OSS because they considered them to be unfeasible (de Winter, 2011).

## 2.7 Fiscal stress on the ICT department

According to a report by the Centre for Research on Local Government Economics (*Centrum voor Onderzoek van de Economie van de Lagere Overheden*, COELO) municipalities expected to cut their spending up to 7% in 2010 as a consequence of the 2008–2012 global recession, increasing to 12% in 2012. They plan to include their own organization in the austerity measures (Allers & Hoeben, 2010).

Unfortunately it is difficult to investigate by how much municipalities exactly reduced their spending. Budget cuts in expenditure always intermingle with increases in expenditures on other fronts. These need not be 'true' expenditures, because expenditures can also include write-downs of assets, such as plots. Furthermore, budgets are an estimate of future income and expenditures, the difference with final accounts is often significant. There are no usable statistics to determine the extent of austerity measures, the only way is to gather data provided by municipalities themselves.

From the perspective of the innovation adoption literature Wolman (1986) argues that local governments under fiscal stress are more likely to pursue innovations if they increase efficiency and less likely to pursue those that involve risk and resource commitment. It could be argued that OSS can be placed in both categories depending on the scale of migration projects.

Mone, McKinley, and Barker (1998) study the effect of organizational decline on innovation of private organizations and draw a similar conclusion. Depending on the conditions, decline can stimulate or inhibit innovation: necessity is the mother of either rigidity or invention. Based on reviews of existing research, they make five propositions for moderating variables on the effect of organizational decline on innovation. Highly institutionalized missions, widely diffused power structures and high levels of resource commitment and the attribution of decline to temporary or uncontrollable causes negatively affects innovation in response to decline. Conversely, less institutionalized missions, more concentration of power, high levels of uncommitted (slack) resources and the attribution of decline to permanent or controllable causes positively affect innovation. They add that many public sector organizations have highly institutionalized missions, diffuse power structures, higher levels of committed resources and less slack resources. As a consequence they consider the private sector to have better credentials for innovation. Unlike Wolman (1986), they do not consider the influence of the characteristics of the innovation itself on innovation adoption.

It is difficult to determine in which of these two categories of innovations distinguished by Wolman (1986) OSS fits best. It could be argued that OSS falls in both categories depending on the scale of migration projects, which can vary among municipalities. The German municipalities of Schwäbisch Hall and Treuchtlingen were motivated by a decrease in tax revenue to migrate to OSS. On the other hand the migration to OSS of Munich was not motivated by decreasing tax revenue but did involve a lot of risks and significant commitment of resources (Cassell, 2008). On the contrary, for Munich having an adequate budget to migrate was an important condition (Editors of Binnenlands Bestuur, 2010). In the Netherlands most municipalities take a more evolutionary step-by-step approach, none so far have migrated to OSS (almost) completely like the German municipalities in the study of Cassell (2008). So it is to be expected that their 'style' of innovation is more compatible with the kind of innovation induced by fiscal austerity.

While all municipalities experience fiscal austerity to some degree, there are differences in the wealth of municipalities, their financial management and their priorities for austerity measures. Because fiscal stress on the municipality as a whole does not necessarily translate to the ICT department being subject to fiscal stress, fiscal stress on the ICT department needs to be investigated specifically.

## 2.8  Fragmentalization of the ICT hierarchy

The highly independent departments with their own ICT management in Munich, Zaragoza and Amsterdam can be described as silos or stovepipes. In an analysis of the national Irish public sector Bannister (2001) explains how ICT silos came to evolve in the public sector and why the public sector is more vulnerable to silo development than the private sector. Some of the reasons for this are internal politics in which control of information systems is a key form of power and influence within departments, the relatively uninfluential positions of IS managers in some departments, the absence of central authority and the level of independence of departments. These

characteristics run counter to some success factors of information system implementation given by Nah, Lau, and Kuang (2001), which include having a project leader placed in charge with high-level backing and the collaboration of the departments. As mentioned previously, Mone et al. (1998) also identified diffusion of power in the organization structure as an inhibitor of innovation. It is to be expected then that fragmentation negatively influences adoption.

The three municipalities mentioned as examples are all very large municipalities. Zaragoza had 701.090 inhabitants as of 1 January 2010 and Munich had 1.353.186 inhabitants as of 31 December 2010. The size of municipalities in the Netherlands varies widely. As of 2012 the Netherlands has 415 municipalities (Statistics Netherlands, 2012). Amsterdam is the largest with 790.110 inhabitants and Schiermonnikoog is the smallest with 932 inhabitants. Many small municipalities have just one ICT department. Cassell (2008) describes how the two smaller municipalities of Schwäbisch Hall (37.137 inhabitants as of 31 December 2010) and Treuchtlingen (12.778 inhabitants as of 31 December 2010) migrated to OSS relatively easily. Their ICT departments are very small and they did not have many workplaces to migrate. As municipality size plays an important role it is an important control variable.

## 2.9 Fusions and collaborations between municipalities

As a consequence of increased decentralization of tasks by the national government to local government over the last decennia, municipalities are under pressure. This has resulted in the mergers of some of them to form new municipalities, both voluntary and involuntary. Some municipalities decided to merge their administrative organization with those of others, so that they only remain independent in a political sense with their own Council and College. Some consider administrative fusions as a first step towards a complete merger (Bouwmans, 2011). Other municipalities do not merge but ask other municipalities to deliver ICT services to them. Leeuwarden is an example of this, providing ICT services to several very small municipalities.

Another option is to collaborate with other municipalities on certain fields by setting up a new organization to provide services to the participating municipalities. Research done on twelve collaborative organizations of municipalities by van der Zwan (2011) revealed that collaboration on supporting and executive tasks is popular, which includes fields such as ICT, procurement, personnel and salary administration, taxes and permits. The greatest advantages of collaboration are a better quality of service and reduction of vulnerabilities. In the majority of cases there are no cost savings, in part because collaborating municipalities have a higher level of ambition for the quality of the services they want to deliver. In fact this often demands extra investment, but these extra costs are lower than if they would not collaborate.

It depends on how 'no cost savings' is interpreted. He defines it by comparing the total costs of the collaborative organization with the total costs made by the individual municipalities and concludes that because the collaborative organization spends more there are no cost savings. If the lower extra costs for the collaborative organization are compared with the higher extra costs for the individual municipalities, it could be argued that there are in fact cost savings. Possibly the sample of twelve organizations is not representative because some media reports on collaboration between municipalities place emphasis on the cost savings. An example is Drechtsteden, the largest collaborative organization of the Netherlands consisting of six municipalities. The organization expected that the merger of eight ICT departments into one department would save € 6,5 to € 7,5 million a year (van Heur, 2009).

Another example is the fourth largest collaborative organization Servicepunt 71. In its business plan a figure of € 6 million in cost savings after five years of collaboration is given (Servicepunt 71, 2012).

Before this research was started it was not expected there would be so many municipalities in this category. The NOiV ranking for 2010 (NOiV, 2011c) showed only four of these collaborative organizations. Because it was thought there were so few of them it was intended to exclude them entirely to keep the completely autonomous municipalities easily comparable. While respondents were being invited to respond to the survey it became evident that their numbers were greater and they could not be excluded. Even if the survey was already finished it was possible to adapt the research to include these organizations. The language of the survey was not adapted to them – the survey only refers to municipalities – but the questions could apply to collaborative organizations in a similar way.

No data on municipalities who have entered in administrative fusions or participate in collaborative organizations is available, not even from the Association of Netherlands Municipalities. They were expected to be a small minority even if their numbers are increasing. With approximately only ten of these organizations their results are not likely to be representative. Nevertheless it was considered interesting enough to add a hypothesis questioning if these fusions or collaborations have less adoption of OSS, especially if these organizations aim to reduce vulnerabilities according to the theory. A high adoption of OSS is more likely to flourish in a municipality and organizations which allow for taking some risks and experimentation.

## 2.10   Hypotheses in summary

In conclusion, five hypotheses were formulated:

1. The presence of boundary spanners in the municipality is positively related to the adoption of OSS.
2. The presence of activist politicians who push for the use of OSS in the municipal council or the College of Mayor and Aldermen is positively related to the adoption of OSS.
3. Higher fiscal stress on the ICT budget of the municipality is positively related to the adoption of OSS.
4. A fragmented ICT hierarchy is negatively related to the adoption of OSS.
5. Administrative fusions and collaborating municipalities are negatively related to the adoption of OSS.

In the third chapter which covers the research design the conceptualization and operationalization of the hypotheses is elaborated on. In the fourth chapter the hypothesis are tested and the evidence for them will be discussed, followed by the final chapter with the conclusions.

# 3

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# RESEARCH DESIGN

The existing data on the use of OSS collected by the NOiV program was judged to be insufficient and data on the independent variables was simply unavailable. A web survey was designed to gather the required data. Eighty-one Dutch municipalities, fused municipalities and collaborative organizations of municipalities were invited over the phone and e-mail to answer the survey. They were selected both deliberately and randomly.

First the definition and methods of measuring all the variables is explained. This is followed by a section explaining how the municipalities were selected, After that the method which was used to gather data is described, together with the experience of the data gathering process. The chapter finishes with a discussion of the limitations of the research and possible threats to the validity of the results.

## 3.1  Concepts and operationalization

The conception of the dependent variable OSS adoption was borrowed from the NOiV Monitor (NOiV, 2011b). As was explained in the previous chapter, the NOiV survey distinguished four fields of applications for OSS to measure adoption. The survey conducted for this thesis uses the same definition of those fields but uses a different operationalization. The questions in the Monitor ask if the municipality uses at least one OSS software package in a specific field and are answered with 'yes' or 'no', giving a possible maximum score of four. This way of measuring is too imprecise because it does not take into account the large differences which are possible. Whether a municipality uses just one OSS package in every field or uses OSS exclusively, the answer would still be 'yes'.

For this survey the five point Likert scale allowed answers ranging from 'no OSS at all' to 'OSS exclusively' with three values in between those extremes. This gave a minimum score of four and a maximum score of twenty. In theory respondents could be asked to provide an exact percentage of the OSS applications in use relative to all applications, but with many applications in use this would be too time-consuming to determine for respondents. A rough estimate made on a five point Likert scale is less detailed but is quickly made and still adequate. The respondents were requested to exclude OSS for tablets and smartphones from their answers. They should not count because many of these devices ship exclusively with Google's open source Android operating system and do not offer a choice for proprietary operating systems.

Similarly, the first and second survey questions for the measurement of boundary spanner presence were copied from the survey used by Ven and Verelst (2008b). The questions designed for this and the other independent variables started with asking if the lowest common denominator applied to the organization, with later questions asking for conditions which were increasingly more unlikely to occur. For this variable the first question was if there were employees promoting the use of OSS. The second question asked if there were employees who tried to convince the management to adopt more OSS. This could signify more determined boundary spanners than the type of the first question. Because boundary spanners are conceptualized in the literature as individuals with knowledge about innovations the third question asks if there are employees in the organization who could support a migration towards OSS. Boundary spanners might be present in the organization, but it is important if they are taken seriously by managers. That is why the fourth question asks if the opinions of boundary spanners are valued by decision makers. In the theory section it was established by Damanpour and Schneider (2009) that managers have an influence on innovation adoption and can act as boundary spanners like employees. The fifth question incorporates that in the survey by asking if the employees promoting OSS are in fact managers.

While the questions for the dependent variable focused on the current situation, the survey emphasized for the questions on boundary spanners and the other independent variables that the respondent had to be familiar with their municipality for a longer period of time, approximately a year or longer. Boundary spanner presence can be subject change as a consequence of personnel turnover for example, and the questions on fiscal pressure also relate to longer spans of time.

The presence of activist politicians is not something which can be measured in great detail if public servants are the respondents of the survey. They might lack detailed knowledge of the actions of the municipal council or the College of Mayor and Alderman. As a consequence detailed questions would likely lead many respondents to answer that they do not know. To avert this, three questions answered with 'yes' or 'no' asked if specific events had taken place. The first is that questions were asked about the use of OSS by the council. Councilors might be aware of some advantages of OSS and might simply want to inquire about the use of OSS in their municipality. In the second event councilors actively try to get a majority for a motion requesting the municipality to use more OSS, but fail to gather a majority to get it accepted. In the third event they succeed in gaining a majority for their motion or an administrator from the College of Mayor and Aldermen might make a decision.

The questions for the hypothesis of fiscal pressure on the ICT department started with asking if the municipality had to implement austerity measures in general. Following the theory almost every municipality should answer positively (Allers & Hoeben, 2010), but it was important to verify if this was true. In case this was not true no further questions regarding this hypothesis were asked, they were made to be conditional in the survey, Descending from this general question to more specific questions, the following questions asked if the austerity measures also led to lower spending on respectively the ICT budget, the license fees for proprietary software, an investigation of using more OSS as an alternative and a concrete increase in adoption of OSS. Again these questions are answered with 'yes' or 'no'.

The set of questions for the hierarchical fragmentation hypothesis use the five point Likert scale again and asked if some common properties of fragmented organizations established in the theory apply to the municipality or organization. The first question asks if there is no central ICT department and how strongly power is di-

vided between the separate departments. The second question asks if there is not one person who is responsible for decision making on ICT. The final question is a more subjective measurement, asking if respondents experience ICT decision making as difficult and time-consuming.

No questions were asked for the final hypothesis concerning fused or collaborating municipalities. To determine if the municipality has its own ICT department the respondents were asked during the telephone conversation or through e-mail. On other occasions this was determined in advance by searching the Internet. This is something which could have been asked in the survey, but as was mentioned earlier the initial plan was to exclude them from the survey altogether. It was only realized that the number of these fused or collaborating municipalities was much greater and could not be excluded when the survey had already been started.

The answers to the survey questions were converted to numbered answer codes. The answers to the questions related to each hypothesis were then summed and are analyzed in the next chapter. A summary of the survey questions and a detailed explanation on question and answer codes is given in appendix B. The survey design in its current form was established after consulting with public servants at three municipalities. They provided feedback on the design of the survey, as a consequence some modifications were made.

It was decided to use two control variables in the research design. Using municipality size as a control variable is necessary, as differences in size affect personnel and financial resources (third hypothesis) and the organization structure and decision making (fourth hypothesis). Possibly there is a relationship with the chance that boundary spanners (first hypothesis) or activist politicians (second hypothesis) are present as well. If a municipality simply has more public servants and politicians, the chance that they may be present could be higher.

It should be noted however that differences in the amount of public servants per thousand inhabitants for municipalities are quite large. Among municipalities with more than 50.000 inhabitants, Amsterdam has the most public servants, 20 fte (full-time equivalent) per 1.000 inhabitants, Amersfoort and Zeist have the least with 6 fte per 1.000 inhabitants with the average being 7,6 fte. The fact that Amersfoort contracted many services to the private sector partially explains the difference. But more important is that larger municipalities face more problems and challenges, such as more inhabitants receiving welfare, ethnic minorities, homeless people, drug addicts and crime. Large municipalities perform a center function for the region and are disadvantaged by the scale of their policy development, which takes more effort and time. These and several more factors cause them to require more public servants per inhabitant (Bekkers, 2008).

Because of this it might be more desirable to use the fte at the ICT department as a control variable instead of number of inhabitants. Because respondents might not know the fte of their department without taking some time to investigate, it is not a good idea to include such a question in the survey if it needs to be short and attract high response rates. Even if the number of inhabitants is a crude proxy for municipality size, it is usable. There still is a pattern that larger municipalities have more public servants, it is just not a linear pattern.

Another control variable is the debt quote. The financial specialist of the Netherlands Association of Municipalities van der Lei (2011b) writes that the debt quote gives the best description of the financial position of a municipality. It is the net debt as a share of the total income of the municipality. The most recent data (van der Lei, 2011a) was compiled for 31 December 2009, newer data is not yet available.

According to van der Lei (2011c) high debt quotes are not a problem if the municipality has a large stock of plots and loans to third parties. Future revenue from the sale of plots and interest on loans to third parties can offset the cost for financing those plots and loans. In theory it costs the municipality nothing to finance them, but in reality there is a risk that a plot might sell for less than it was purchase price or that third parties default on loans. He defines the stock quote as those plots plus the loans to third parties divided by income before change in reserves. The net debt quote minus the stock quote is the net debt quote after the revenue of the stocks. That value allows for a judgment on the height of the debt quote. After making some assumptions on what the maximum interest rate pressure should be, he concludes that only nine municipalities are in the danger zone.

This control variable is especially useful for the third hypothesis on fiscal pressure. In itself, a high debt quote does not say much about fiscal pressure because policies are different in every municipality and this leads to different solutions for austerity. Asking respondents for about fiscal pressure is therefore more relevant, but the debt quote is an objective measurement. It is interesting to see if there is a relationship between this control variable and other variables.

## 3.2   Case selection

It was not feasible to contact all 415 municipalities in the Netherlands with one person. However, almost half of the total population in the Netherlands[1] lives in just 50 municipalities with more than 70.000 inhabitants. As these municipalities are relatively important it was decided to adopt a dual strategy for case selection as a compromise. All of these 50 large municipalities were contacted, while out of the remaining 365 municipalities with less than 70.000 inhabitants a random sample of 30 were contacted as well. For a detailed overview of which organizations were contacted and which responded, consult appendix A.

A relatively large part of these smaller municipalities turned out to participate in collaborative organizations or were part of administrative fusions (as opposed to merely four municipalities with more than 70.000 inhabitants). When it turned out that response from this category was lacking, several more of these organizations were deliberately sought out and selected. The municipalities of Vianen and Ijsselstein were chosen because their public servants had provided advice for the design of the survey. This made them more likely to respond to the survey, which is why they were selected. Only Woerden was deliberately selected for its high adoption of OSS.

Some municipalities have either applied for or been granted the article 12-status. The status is granted to municipalities with structural financial deficits who are unable to solve the problem on their own. Municipalities receive an extra financial allowance of the government at the cost of financial supervision by the government. The autonomy of the municipality is reduced as it has to request the government permission to make decisions which lead to substantial increases in expenditure or decreases in income. At the moment only the municipalities of Boarnsterhim, Boskoop, Ouderkerk, Millingen aan de Rijn and Loppersum have article 12-status. Formally speaking Lelystad has the status, but practically it is not under supervision (Government of the Netherlands, 2012).

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[1]7.458.178 inhabitants according to the author's calculation, out of a total population of 16.736.736

The article 12-status is the safety net of last resort. Before the article 12-status looms the a municipality will be put under supervision by its province. The executive body (Gedeputeerde Staten) of the province can impose preventive financial supervision on the municipality if it deems the municipality's budget to be imbalanced and if multiannual estimates show no signs of a return to a balanced budget in following years. In that case the budget of the municipality needs to be approved by the province, but the municipality does not receive financial aid as with the article-12 status (Overheid.nl, 2011). Eight municipalities were placed under provincial supervision as of February 2012 (Seegers, 2012).

There is no reason to exclude municipalities which have been placed under supervision from the selection, as the debt quote can account for financial situation. Besides that, as was discussed earlier OSS can cut costs instead of requiring extra expenditure, depending on the context. If it does not require significant extra expenditure it is likely the municipality does not need to ask for permission. And if a short-term extra expenditure is necessary for the implementation of OSS in exchange for long term savings, the supervisor could be convinced of the merits of such a decision.

## 3.3   Data gathering

Out of 180 organizations which were contacted 64 responded. This is a response rate of 35,56%. Only eight of the organizations who responded are fused or collaborating municipalities. Such a low number of responses from that category makes the result unrepresentative. While it is still interesting for simple descriptive statistics, it is unsuitable for statistical analysis in the context of large-N research. As a consequence the variable is not included in the inferential statistical analysis.

Preference was given to ICT managers to be respondents because it was expected they would have the best 'helicopter view' of their organization, but these could often not be contacted as they are quite busy. The majority of the survey responses were probably given by personnel lower in the hierarchy. Some municipalities have a policy not to put people through and asked for the survey invitation to be sent to the generic e-mail address for questions from the public. Because these e-mail addresses are available on the municipalities' websites this meant the phone call had no added value. When contacting smaller municipalities the chance was much greater to be put through to a person responsible for ICT.

To attain a high response rate it was an important consideration during the design of the survey to keep it short. The number and nature of the hypotheses facilitated this and it was estimated that the survey would take ten minutes to answer. According to comments by a few respondents even five minutes were enough.

A large share of the municipalities who had not answered the survey were contacted again after a few weeks to request them again to respond. While this was very time-consuming, it was a very effective method to increase the response rate. Rather than unwillingness being the cause of non-response, municipalities often did not respond because the invitation somehow escaped their attention.

Because the amount of response was still deemed unsatisfactory, an extra random sample of hundred municipalities with less than 70.000 inhabitants were contacted later during the research. Because time was in short supply the invitations for the survey were only sent to the generic e-mail address which was advertised on the websites of the municipalities. No extra effort was made to coax these municipalities into replying to the survey with extra phone calls or e-mails. It was no surprise

that this led to a lower response rate: nineteen out of these hundred municipalities replied, two of them turned out to be part of an administrative fusion.

Four municipalities were unable to answer because personnel capable of responding to the survey was on holiday. A very small number of municipalities refused to take part in the survey because they receive too many invitations for surveys. When some of the municipalities which had not responded were contacted a second time to inquire what had been done with the request, telephone operators assumed there was no interest in responding and refused to bring it under the attention of the relevant personnel again. One very curious case of refusal was the municipality of Purmerend. During a telephone conversation a public servant told that the municipality's security policy forbade divulging any information on which software is used by the organization. Not only is such a security policy downright paranoid, such a refusal would be unlikely to hold up if the Dutch freedom of information legislation, the *Wet openbaarheid bestuur* (Wob), would be invoked.

What was most disappointing was not the response rate or refusal to respond, but the fact that many invitations to take the survey disappeared in a black hole. Many municipalities asked to send an e-mail with the request but never replied. As a researcher I can live with that, but as a citizen of the Netherlands the least I expect of Dutch public institutions is that they give an answer that they can not or do not wish to respond to the survey.

## 3.4  Limitations

Similar to the NOiV Monitor, this design might be vulnerable to correlation between the dependent variable and response to the survey. Municipalities who adopted OSS intensively might be proud of their achievement and eager to respond to a survey investigating the subject. Municipalities who barely use OSS and have no interest in it might be much more indifferent to the survey and less likely to reply. This is prevented to some degree by contacting the fifty largest municipalities and a random sample of forty of the remaining municipalities. In addition, municipalities who use OSS intensively are a minority. As long as enough municipalities who barely use OSS respond their limited numbers will probably not be sufficient to distort the findings in a significant way, even if they are more likely to respond. The phone calls and e-mails to contact responsible personnel directly and emphasizing in the survey that response of non-adopters of OSS is much valued should alleviate the problem further.

Even if eighty municipalities, fused municipalities and collaborative organizations were contacted, the latter two might constitute a small minority if the response rate is limited. This is a problem for the fifth hypothesis concerning that category as a very limited number of responses will not provide reliable inferences. Similarly, the amount of large municipalities with more than 100.000 inhabitants number no more than twenty-three in the Netherlands. If 500.000 is used as a criterion, it barely amounts to three municipalities. If response from these categories is limited this would prevent making reliable inferences for the fourth hypothesis on hierarchical fragmentation, which is most likely to occur in large municipalities.

It is not impossible that there might be endogeneity bias in the case of boundary spanners. Boundary spanners in favor of OSS might be more likely to work for municipalities who have intensively adopted OSS. Municipalities might deliberately recruit those boundary spanners because they have invested a lot of effort in OSS. In that case the dependent variable is the cause of independent variable, instead of

the other way around. However, this possibility is also limited by employment opportunities and recruitment considerations for municipalities. The survey questions also guard against this to some degree by inquiring for different aspects of boundary spanner presence. In retrospect an additional question might have been added to ask if OSS adoption influenced the recruitment policy for ICT personnel, but this would add to the length of the survey and could be outside the bounds of knowledge for a single respondent.

Finally, more than half the questions in the survey ask for a more subjective judgment of the respondent instead of easily observable facts. Depending on the function of the respondent and differences between individuals answers could be different, but there is absolutely no way to fix this problem. First, the ICT managers who might be most desirable as a respondent for their helicopter view might not be able to respond due to a lack of time or knowledge. In a smaller municipalities the organization, hierarchy and associated functions of the ICT department might be quite different from larger municipalities. In an ideal world all ICT personnel of a municipality could be asked to answer the relevant questions and then the medians of all answers could be used as a more reliable result, but the amount of work for that would of course be prohibitive. This research design relies on an accurate perception of the respondent.

A final limitation following from the previous one is that the boundary spanners themselves are likely to fill in the survey, which might be another source of bias. This is not something which can be avoided unless multiple people in the organization are asked to fill in the survey, which is too much work for both the researcher and the municipality. Again the research design relies on the ability of the respondent to take some distance from his or her own potential role as a boundary spanner.

# 4

# RESULTS

The results of the survey are analyzed in two different ways. In the first section the results are examined with descriptive statistics. The dependent variable is subject to univariate analysis first, after which bivariate analysis is used to show relationships between the dependent variable and each independent and control variable with scatter plots. Additionally a correlation matrix shows the relationships between all possible pairs of variables.

Descriptive statistics alone are not enough because they are just a simple presentation of the facts. They do not use models employing probability theory to test the hypotheses. Inferential statistics do provide the possibility to do so and are used in the second section for that purpose. There two multivariate models, the simple linear regression model and the ordered logit model, are utilized to analyze the data and draw conclusions about its scientific inferences.

For the sake of transparency it is desirable that the data used for scientific research is accessible. The file *oss_survey.csv* that is attached to this PDF document contains the survey data used for the statistical analysis.

## 4.1   Descriptive statistics

Frequencies of the values of the dependent variable are useful for assessing if the dependent variable might be affected by biased measurement. A histogram can be a more convenient way to display frequencies than a table. Figure 4.1 shows the distribution of frequencies on the dependent variable OSS adoption. The theoretical maximum value for OSS adoption is twenty (five multiplied by four fields of application), in which case the municipality or organization would use OSS exclusively in all four fields. As was expected this theoretical maximum does not occur in reality, in practice the maximum value is sixteen and was observed only twice. Four respondents score the theoretical lowest value of four and do not use any OSS at all. This data is not directly comparable with the data of the NOiV survey shown in table 2.1 because it uses a different scoring system. The only data which is comparable is that of municipalities who do not use OSS at all. Those municipalities have a share of 16,9% in the sample in the NOiV survey. For this survey it is 6,3% of the sample.

The histogram shows that the vast majority of the respondents do not use more OSS than proprietary software if the score of twelve – which could occur if the respondent would choose answer code three, 'half', for every field – is used as a guideline. The average is 8,7. The low average and the very small amount of scores higher
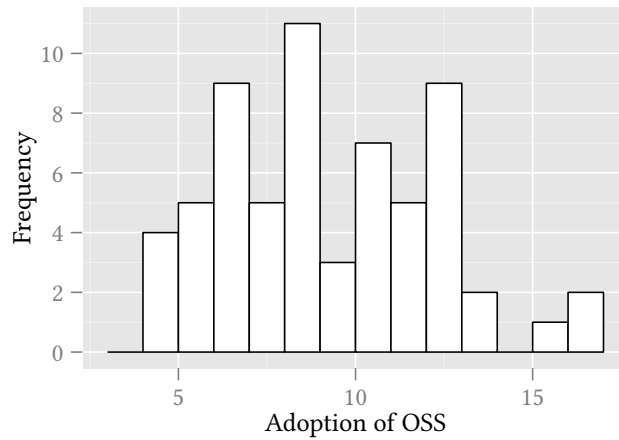
Figure 4.1: Histogram of OSS adoption.

than twelve show that most respondents do not use OSS much, so there does not seem to be correlation between the dependent variable and response to the survey.

Yet the scores of six, eight, ten and twelve occur quite frequently compared to their neighboring scores. This could be caused by the relatively small sample size. If more responses would have been submitted the frequencies for those four scores would have likely been relatively lower. It could also be attributed to central tendency bias and proximity bias, well-known problems of measurement with Likert scales. Respondents can be reluctant to give extreme scores and might give similar answers for similar items (Albaum, 1997).

Table 4.1 is a relative frequency table for the questions on the adoption of OSS which describes how much OSS is used for each field. It shows the distribution of answer codes for every field in percentages. As expected, end user software is used least. It scores highest on answer code one and two, respectively 'no OSS at all' and 'some OSS', most likely because it is more involving to train end users to use different software. OSS is used much more for infrastructure and system administration. These fields are mostly or exclusively dealt with by ICT personnel, who are likely to be more knowledgeable on OSS and more flexible. When it comes to Internet communication, OSS is most popular in the highest tiers of adoption, with three municipalities even reporting they use OSS exclusively in that field. This is slightly different from the results of the NOiV survey displayed in table 2.2, which showed infrastructure was the most popular field of application.

On the following pages scatter plots visualize the relationship between the dependent variable and the independent and control variables for each respondent, along with linear regression lines. Figure 4.2 indicates that one of the strongest relationships probably exists between the presence of boundary spanners and adoption of OSS. There also is a clear relationship between activist politicians and adoption seen in figure 4.3, but it is slightly weaker. In figure 4.4 the relationship between fiscal pressure and adoption looks strong as well. If the data file itself is consulted it is seen that almost every municipality or organization answered positively to the question asking if they implemented austerity measures. One collaborative organization and three municipalities were exceptions, for one municipality the absence of

| Field | Degree of use in % | | | | |
|---|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 |
| Infrastructure | 20 | 42 | 33 | 3 |  |
| System administration | 22 | 38 | 28 | 9 |  |
| End user software | 30 | 53 | 12 | 3 |  |
| Internet | 23 | 36 | 16 | 19 | 5 |
| N = 64 | | | | | |

Table 4.1: Relative frequency table of OSS use by field.

austerity is consistent with its unusually low debt quote of -62%. As was expected the relationship between hierarchical fragmentation and adoption seen in figure 4.5 is negative, but it is not very strong. In figure 4.6 it can be seen that municipality size is barely related to adoption of OSS according to the flat linear regression line.

A scatter plot for the debt quote and for fused or collaborating municipalities are not shown. The former shows a regression line which is very flat, just like the one in the scatter plot for municipality size. The latter is not interesting because it is a binary variable (a municipality is either autonomous or fused/collaborating) and because the number of eight observations in this category is not representative. An average of the score on the dependent variable is more useful information. The average of adoption for autonomous municipalities is 9 compared to 7 for fused municipalities and collaborative organizations.

The correlation matrix shown in figure 4.7 confirms the impressions given by the scatter plots. Additionally, the correlation matrix also shows correlations between the independent and control variables. The correlation between boundary spanners and activist politicians or fiscal pressure is difficult to explain as it is hard to find a logical cause.

The strong correlation between the presence of activist politicians and municipality size can be explained with more certainty. Larger municipalities have larger municipal councils, Amsterdam for example has forty-five seats while Schiermonnikoog only has nine. In larger municipalities councilors are also more likely to receive support from their party on policy making because those have more members in larger municipalities. This allows councilors of larger municipalities to specialize themselves more and possibly spend more attention on OSS. By contrast councilors of small municipalities need to behave more like generalists.

A strong correlation between fiscal pressure and the debt quote was also expected as both variables are related to the financial health of the municipality. The absence of correlation could mean that a high debt quote is not necessarily reflected in fiscal pressure on the ICT department because municipalities choose other options for austerity instead of budget reductions for ICT.

In summary the regression lines and correlation matrix create the expectation that that all four independent variables will have some effect on the dependent variable. This is especially the case for boundary spanners, activist politicians and fiscal pressure. Much more certain is the information provided about the direction of the effects. As expected all independent variables except fragmentation point to positive relationships with the dependent variable. If these expectations are confirmed by inferential statistical analysis and if the effects are statistically significant is explained in the following section.
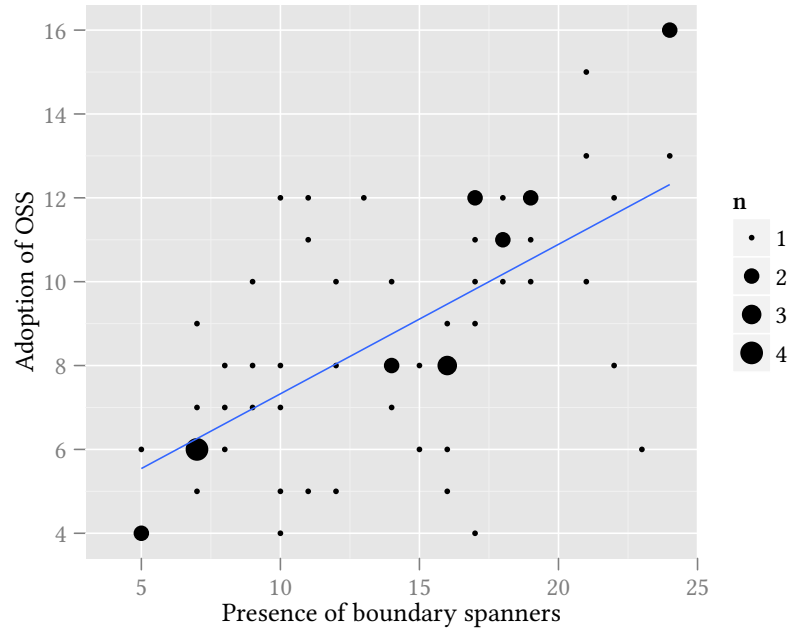
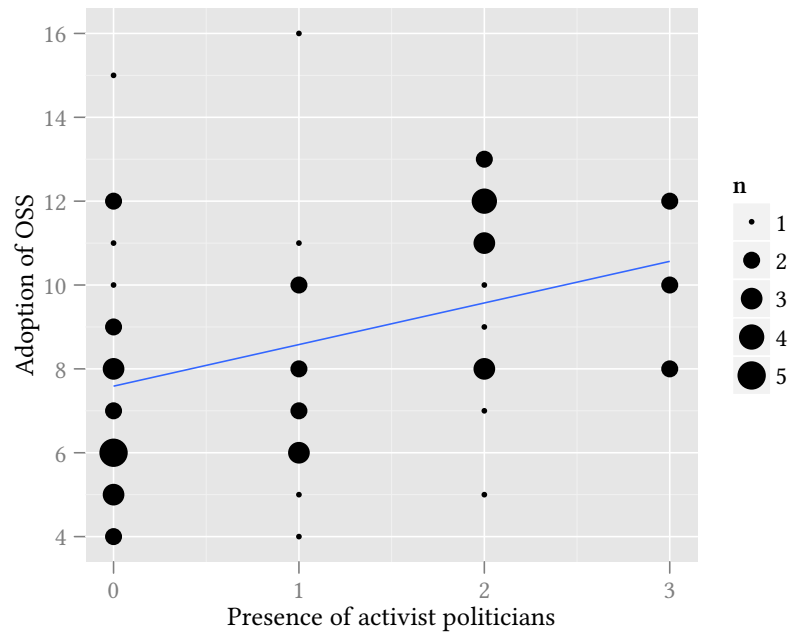Figure 4.2: Scatter plot of boundary spanner presence.



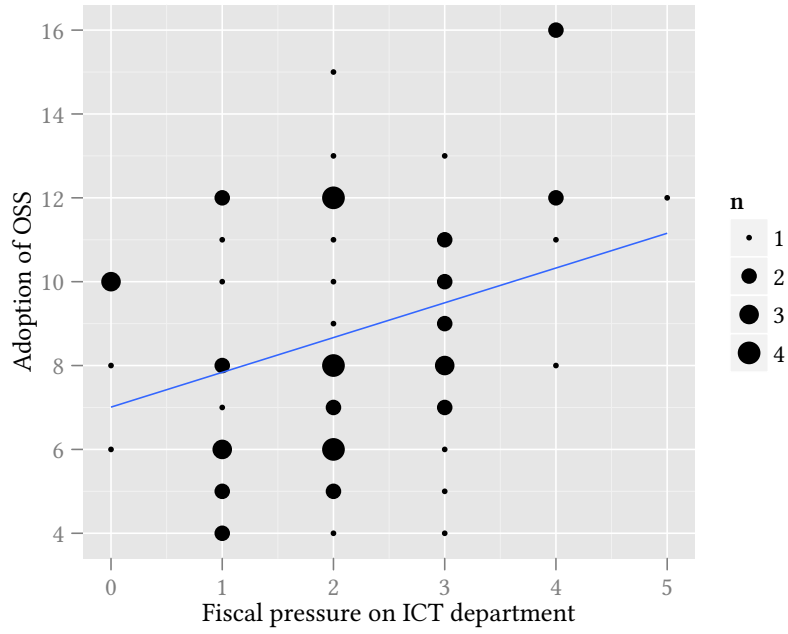Figure 4.3: Scatter plot of activist politician presence.
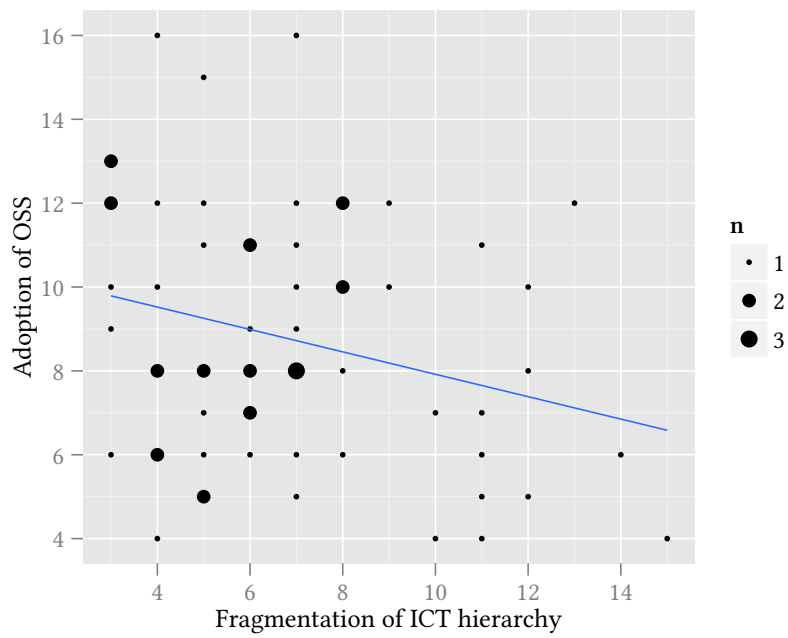
Figure 4.4: Scatter plot of fiscal pressure.



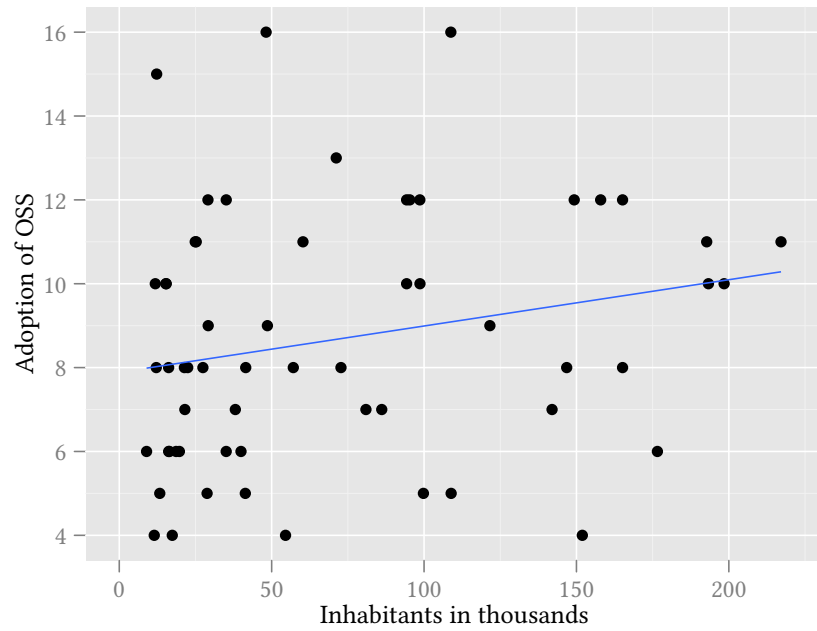Figure 4.5: Scatter plot of hierarchical fragmentation.

Figure 4.6: Scatter plot of municipality size. To make the plot more presentable Utrecht, Den Haag and Amsterdam were excluded as outliers.
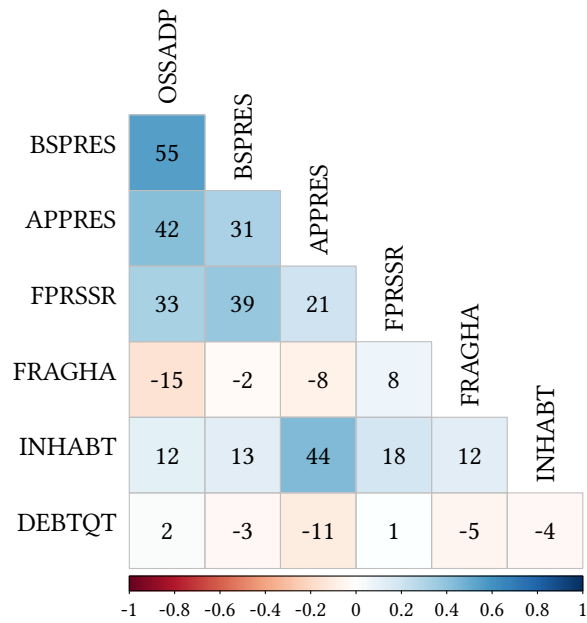


Figure 4.7: Correlation matrix of all variables.

## 4.2  Inferential statistics

With regression analysis the relationships between the dependent variable and all other variables can be analyzed simultaneously. Depending on the nature of the variables different models for regression are used. The dependent variable measured by the survey is an ordinal variable. This is also the case for the independent variables measured with answers on the Likert scale. The questions answered with yes or no are binary variables, but their sum (which is used in our analysis of the data) could be considered an ordinal variable. The numbers in an ordinal scale provide information about a rank order in scores, but do not come in equal interval metrics. For example, the exact difference between using 'none' or 'some' OSS is interpreted slightly different by every person, while the difference between one second and two seconds is the same for everyone. A variable such as time in seconds would belong to the ratio scale because of its non-arbitrary absolute zero point.

Linear regression models are often used for regression analysis, but they are more suited for dependent variables on the interval or ratio scale. It would give misleading answers if it would be used to analyze dependent variables on the ordinal scale. For these an ordinal regression model such as the ordered logit model or ordered probit are more suitable for analysis. Both models are very similar and give results with minimal differences (Long, 1997).

However, there are arguments in favor of analyzing the dependent variable as both an interval and an ordinal variable. The method of answering the questions for the dependent variable, described in chapter B, shows that with the five point Likert scale the possible answers were 'none, some, half, a lot and only OSS'. These answers could be interpreted as 0%, 25%, 50%, 75% and 100%. These are equal intervals, which makes the variable an interval variable. However, while such an interpretation makes perfect sense for first, third and fifth answers, this is not the case for the second and the fourth. The interpretation for 'some' could have a bandwidth between 10% to 40% or more. These imprecise wordings for the answers were chosen deliberately because it was thought that asking respondents to give precise estimates of the share of OSS in use by their organization would be a burden. With the intervals being unequal for these answers, the variable could be considered ordinal.

Because of this hybrid nature of the dependent variable it was analyzed with both simple linear regression and the ordered logit model. Analyzing the data with the ordered logit model proved to be more complicated. The model refused to calculate if the control variables inhabitants and debt quote were included. To fix this, these variables were transformed to ordinal variables with six categories according to the coding scheme in table 4.2. This allowed for a successful analysis of all variables with the ordered logit model. The ordinal versions of the control variables are named INHABC and DEBTQC in the attached data file. The results of the analysis with both models is shown in table 4.3.

The results confirm that the decision to use both simple linear regression and the ordered logit model was right because the results of both models do not differ

| Variables | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Inhabitants (×1000) | 0−30 | 30−60 | 60−100 | 100−150 | 150−200 | > 200 |
| Debt quote (in %) | < −50 | −50−0 | 0−50 | 50−100 | 100−150 | > 150 |

Table 4.2: Categories used for re-coding the control variables.

| Model | Variables | Value | Std. err. | T-value |
|---|---|---|---|---|
| Linear regression | Boundary spanners | 0,274 | 0,071 | 3,198 |
| | Activist politicians | 0,776 | 0,360 | 2,155 |
| | Fiscal pressure | 0,305 | 0,306 | 0,997 |
| | Fragmentation | −0,199 | 0,119 | −1,009 |
| | Inhabitants | −0,001 | 0,001 | −0,548 |
| | Debt quote | 0,003 | 0,007 | 0,455 |
| Ordered logit | Boundary spanners | 0,190 | 0,062 | 3,048 |
| | Activist politicians | 0,662 | 0,312 | 2,124 |
| | Fiscal pressure | 0,270 | 0,240 | 1,128 |
| | Fragmentation | −0,143 | 0,091 | −1,574 |
| (Categorized) | Inhabitants | −0,032 | 0,188 | −0,169 |
| (Categorized) | Debt quote | 0,213 | 0,248 | 0,857 |
| N = 64, linear regression adjusted $R^2$ = 0,327 | | | | |

Table 4.3: Results of data analysis with simple linear regression and the ordered logit model.

much. Especially the first three variables show very similar results, but the last three variables show more difference. For the control variables that can be attributed to their re-coding to analyze them with the ordered logit model.

As expected, the first three variables have positive relationships with the dependent variable while fragmentation has a negative relationship. Municipality size and debt quote have insignificant relationships with practically no effect, which are respectively negative and positive. The ordered logit model shows a much more substantial negative relationship for the debt quote. That result is probably not as reliable as the result obtained with linear regression, because the debt quote was categorized for the ordered logit model.

Only boundary spanners, activist politicians and fiscal pressure have notable effect sizes. In these results political activism supersedes the other variables by a large margin and is the most important variable. Boundary spanners and fiscal pressure share a second place. It is somewhat surprising that boundary spanners have such a small effect because Ven and Verelst (2008b) found in their research that they were the independent variable which had the largest effect by far. Fragmentation is the independent variable with the smallest effect. Again it should be noted that the nature of the sample possibly introduces bias in the test of this hypothesis. It was expected that hierarchical fragmentation would play a role only in very large municipalities. There are merely six municipalities with more than 200.000 inhabitants in the Netherlands, of which four responded.

The t-value is the criterion to determine if a variable is statistically significant or not, if the observations reflect a pattern rather than chance. The convention which is often used to determine statistical significance is that a hypothesis should be true with 95% probability. This corresponds with a p-value of 0,05 and a t-value greater than 1,96 or smaller than −1,96. In both models boundary spanners are even more significant than that with a t-value over 2.576, which converts to a p-value of 0.01 for 99% probability. Activist politicians are significant at a p-value of 0.05. The other variables do not come close to significance, especially the control variables are quite insignificant.

| Model | Variables | Value | Std. err. | T-value |
|---|---|---|---|---|
| Linear regression | Boundary spanners | 0,161 | 0,074 | 2,190 |
| | Activist politicians | 2,673 | 0,782 | 3,417 |
| | Fiscal pressure | 0,285 | 0,287 | 0,993 |
| | Fragmentation | −0,126 | 0,110 | −1,140 |
| | Inhabitants | −0,001 | 0,001 | −0,670 |
| | Debt quote | 0,003 | 0,006 | 0,465 |
| Ordered logit | Boundary spanners | 0,137 | 0,068 | 2,021 |
| | Activist politicians | 2.366 | 0,777 | 3,043 |
| | Fiscal pressure | 0,302 | 0,245 | 1,230 |
| | Fragmentation | −0,157 | 0,092 | −1,712 |
| (Categorized) | Inhabitants | −0,019 | 0,179 | −0,107 |
| (Categorized) | Debt quote | 0,143 | 0,258 | 0,554 |
| N = 64, linear regression adjusted $R^2$ = 0,4286 | | | | |

Table 4.4: Alternative results of data analysis with simple linear regression and the ordered logit model with different measurement of political activism.

To gain more insight in the variable of political activism an alternative approach was taken to its conceptualization. As shown in appendix B, the score of the variable is the sum (APPRES) of three questions: did politicians or administrators ask questions about the use of OSS (APQUES); where they vocal in their support of OSS and did they push the municipality to adopt OSS (APPUSH); did they actually make decisions to adopt OSS (APACCP). It could be argued that only definite decisions by the council or the college are what ultimately matters. The data shows that for twenty organizations such decisions were actually made. To see if this would lead to a change in the results the analysis was done again, but this time with the variable APPRES instead of APACCP. This revealed results which were quite different.

The effect of political activism more than triples in size, and the tables are turned for the t-values of boundary spanners and activist politicians. Now the former is significant at a p-value of 0.05 and the latter is very convincingly significant at a p-value of 0.01 according to both models. The other variables did not change notably. Based on the increase of the adjusted $R^2$ statistic this alternative conceptualization should be given preference because the results of the statistical analysis now explain 43% of variance compared with 33% before.

This much greater effect of political activism does come with twice the amount of standard error as well. Standard error decreases as the sample size increases. The high standard error is likely caused by the smaller amount of twenty organizations which had made decisions, as opposed to the greater variation in the variable APPRES for all 64 organizations. Adding to that is the fact that the total sample size of 64 respondents is still relatively small. In such cases changing the variables which are analyzed can lead to significant changes.

# 5

# CONCLUSION

Out of five hypotheses which were tested in this thesis, there is evidence in favor of the boundary spanner and political activism hypotheses. A confirmation of the boundary spanner hypothesis is not surprising in the least, because the strong evidence which already existed for the hypothesis was the reason to test the hypothesis in this context. What did surprise was the very small effect size of the boundary spanner variable because the existing research suggested that the effect was much greater. The political activism variable has the largest effect of all, three times the size of the boundary spanner variable. With a different conceptualization of the variable the effect more than triples in size, but while it is statistically quite significant it is measured with a high standard error. This uncertainty prevents a conclusion that political activism is really such relatively huge influence. But even with the standard conceptualization the effect size is quite notable.

The variables fiscal pressure and hierarchical fragmentation have effect sizes which are respectively slightly larger and slightly smaller than the boundary spanner variable, but are not statistically significant. A few respondents to the survey thought the survey assumed that OSS was cheaper and criticized that notion. As the hypothesis investigated a potential positive relationship between OSS adoption and fiscal pressure rather than lower cost of OSS, these respondents might be reassured by the findings of this research to some degree. The insignificance of the hierarchical fragmentation hypothesis was expected because it was thought more likely to occur in large municipalities. Large municipalities are not numerous in the Netherlands. The collaboration hypothesis was not tested because there was not enough response from fused municipalities and collaborative organizations. Even if their sample of eight respondents is unrepresentative, their average score on adoption of OSS is a bit lower than the independent municipalities. This could suggest that there is indeed a negative relationship between collaboration and adoption of OSS.

A relatively small sample size is the Achilles heel of this research. Even if there is enough evidence to confirm two of the hypotheses, it would have been very interesting to see what the results would have been like if the Netherlands would have many more large municipalities and if there would have been more response from fused municipalities and collaborative organizations. As a rule of thumb, obtaining more observations means the inferences will be more accurate (King, Keohane, & Verba, 1994). A large sample size would also be very helpful in reducing the large standard error in the measurement of the alternative conceptualization of political activism.

## 5.1   Policy recommendations

Little can be done to increase the amount of activist politicians, their presence is a matter of chance. In theory voters could exert influence on it. A more practical and easily implemented recommendation for municipalities would be to adjust their recruitment policy to more deliberately recruit personnel which is capable of boundary spanning regarding OSS. Boundary spanners possess more motivation to implement innovations, they continue where others stop. In that sense it is good to reflect on what was written earlier in this thesis, that it is a matter of perseverance because implementing OSS can be a difficult task depending on the situation. The problem is that not all municipalities have similar preferences for OSS and would not adjust their recruitment policy. Also, boundary spanners can be hard to find. According a news report (Bakker, 2009) OSS simply does not receive as much attention in vocational education programs in the Netherlands compared to proprietary software. To increase the adoption of OSS merely increasing the effort to recruit boundary spanners is not enough, the problem needs to be attacked on a larger scale.

The national government's policy to improve the adoption of of open standards and OSS certainly had success, but the NOiV program's progress reports stated that there was still more work needed to make more progress. Considering this it is unfortunate that the NOiV program was ended and not continued in a similar program. Like the NOiV's own research, the results of this survey revealed vast differences in the adoption of OSS. With all the advantages of OSS, there is no reason these huge differences should exist. Adoption should not be left to depend on boundary spanners or activist politicians being present, or possibly other factors which have escaped research so far. The House of Representatives has shown that it values open standards and OSS in the past, if it still does it has a reason to demand the government to follow up the discontinuance of the NOiV program with a new policy.

A concrete example for such a policy could be derived from the policy for open standards, the CEC-regime. This policy features not only recommended but also compulsory open standards. Adopting certain OSS packages could be made compulsory as well. Municipalities often complain that OSS is difficult for them because vendors do not offer it (NOiV, 2011b), but with the backing of the national government vendors could be more effectively persuaded to change. At the same time this would also provide an advantage in the sense of standardization of software and economies of scale. Municipalities are already doing this on a smaller scale with collaborative organizations. Collaboration on ICT, standardization of software and the associated economies of scale are often if not always a goal. Why should this not be done nationally for all municipalities? While municipalities might have different requirements according to their size, all of them need basics like office suites, document management systems and web servers.

This is an idea which is in fact not so far from reality because Iceland is an example (Hillenius, 2012a). Earlier this year the national government of Iceland started a migration project to OSS for all its public institutions, after many of them had already been migrating to OSS over the last four years at a slower pace (before the country was affected by the financial crisis). These include all of its ten ministries, the city of Reykjavik, the National Hospital and schools. Such a migration is apparently understood as entirely moving to OSS. The news report mentions that during the 2011–2012 school year two new secondary schools moved their systems completely to OSS, bringing the count up to five out of thirty-two schools. The newly founded Media Commission also runs entirely on OSS.

The migration project started with a series of five letters addressed to the heads of all public institutions which recommended the use of open standards and OSS. At this point the project is not different from the Dutch government's NOiV program, but Iceland does more. The project also entails setting up a common infrastructure for migrations to foster collaboration. A group of specialists was formed to monitor the project. In the next phase the project aims to ensure that the national curricula of its public schools do not restrict the use of OSS and to work on a call for tender to purchase services based on OSS.

The million dollar question is how the national government of Iceland managed to get the public organizations to adopt OSS so comprehensively, does its policy have a compulsory character or is participation voluntary? This question is difficult to answer because there is not enough (English) information available on the Internet. The available information seems to indicate that there is no compulsion involved, but that is a well executed policy of intensive stimulus.

In another news report more can be read about the motivations of the government of Iceland to adopt the policy (Clark, 2012). These are similar to those of other municipalities and public institutions which have been mentioned previously, namely gaining independence from vendors and cost savings.

It is important to note that Iceland is a very small nation with 320.160 inhabitants as of the second quarter in 2012 (Statistics Iceland, 2012). This is less than half the amount of inhabitants of Amsterdam, the largest city in the Netherlands. Undoubtedly the small size of the country has made it easier to implement their policy, but that does not mean it is unthinkable that other nations such as the Netherlands can draw inspiration from Iceland as a best practice.

## 5.2 Future research

This thesis shows a disadvantage of quantitative research: it is less flexible than qualitative research. The right questions need to be asked immediately as it is impossible to modify the survey after it is started. If there is plenty of existing research this should be no problem and you can stand on the shoulders of giants. In this case quantitative research was more complicated. Research on this topic is still in an embryonic phase and stands on the shoulders of gnomes. Care was taken to ensure that the right questions were asked by evaluating the survey design with three potential respondents, but some more time might have been invested in this to receive more feedback.

While there are good reasons to assume that OSS is adopted at least partially for financial reasons, there is no evidence that fiscal pressure is factor for Dutch municipalities. The theory warns that calculations of Total Cost of Ownership (TCO) are highly variable as everyone includes different factors in the calculation. Even so, investigating the similar but slightly different question if the lower cost of OSS is a reason for adopting OSS would have been interesting. The difference is meaningful because a municipality might want to save money even in the absence of fiscal pressure. A respondent suggested that in addition to that question, it would have been interesting to research if OSS had actually led to cost savings, and if so, by how much.

Another respondent mentioned in a comment that his municipality did not use much OSS at the moment, but that it had plans to adopt more OSS in the future. Just like Rome was not built in a day, software projects are not completed overnight. Such a question could also have been included to determine adoption of OSS.

The fragmentation hypothesis deserves a more ambitious research project. It would be more viable if the sample would not be restricted to the Netherlands and consisted of much more large municipalities. Of course the dependent variable of the hypothesis need not be restricted to OSS adoption because hierarchical fragmentation can affect ICT and innovations in general as well.

Even if it probably did not distort the results of the survey, it was unfortunate that the survey was not adapted properly to fused or collaborative organizations of municipalities. I was simply not aware of how many of them existed because there was no information available about them. To my surprise, even a policy adviser who works for such an organization asked me to name the other collaborative organizations I had encountered because he did not know them all either. Here lies a task for the Association of Netherlands Municipalities. The Association should compile a list of all these organizations to assist them with exchanging knowledge and best practices.

# A

## Contacted municipalities

The file *contacted_municipalities.csv* that is attached to this PDF document contains the data on which municipalities and collaborative organizations were contacted for this research and if they responded.

Leeuwaarden, Grootegast and De Marne are 'center' municipalities who provide ICT services to other municipalities. The municipalities who have outsourced their ICT services to them are listed as dependent municipalities. The combined total number of inhabitants of these municipalities and the debt quote of the center municipality were used in the statistical analysis. These three municipalities are distinct from the collaborative organizations in the sense that they have founded a formal collaborative organization to institutionalize their cooperative efforts.

Collaborative organizations (including administrative fusions) are grouped separately and also have their dependent municipalities listed. The total number of inhabitants of the participating municipalities was used in the statistical analysis. The debt quote control variable was not used for this group.

Leiden, Dordrecht, Súdwest Fryslân and Roosendaal are among the municipalities with more than 70.000 inhabitants but participate in collaborative organizations. As such they are grouped with those organizations.

All statistics for inhabitants were provided by Statistics Netherlands, dated at 1 January 2012. Debt quotes of the municipalities were provided by van der Lei (2011a), dated at 31 December 2009.

# B

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## Survey questions

The questions below are translated from Dutch, the language of the survey. The survey was created with LimeSurvey[1]. The question and answer codes are described below here as well.

*Use of OSS*

Could you give an estimate of the share of OSS used in the follow fields?

1. OSSINF: In your organisation, is OSS used for infrastructure?
2. OSSADM: In your organisation, is OSS used for system administration?
3. OSSUSR: In your organisation, is OSS used by end users?
4. OSSWEB: In your organisation, is OSS used for communication over the Internet?

Answered with a five point Likert scale: none/some/half/a lot/only OSS or don't know. These answers were coded from 1 to 5 in that order. 'Don't know' was coded as 'NA' like in all other questions. The sum of the answers to these questions is OSSADP (OSS adoption).

*Presence of boundary spanners*

To which degree do these statements apply to your municipality?

1. BSPROM: There are one or more employees in the municipality who promote the usage of OSS.
2. BSCONV: There are one or more employees in the municipality who make an effort to convince management to adopt (more) OSS.
3. BSKNOW: There are one or more employees in the municipality who possess adequate knowledge to support a migration towards OSS.
4. BSREPU: The decision makers value the opinions of those employees who press for the use of OSS and take their opinions into account.
5. BSMNGR: One or more of the employees in the municipality who promote the usage of OSS are part of the management.

Answered with a five point Likert scale: disagree/somewhat disagree/neutral/somewhat agree/agree or don't know. These answers were coded from 1 to 5 in that order. The sum of the answers to these questions is BSPRES (boundary spanner presence).

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[1]http://www.limesurvey.org/

*Presence of activist politicians*

To which degree do these statements apply to your municipality?

1. APQUES: Members of the municipal council or the College of Mayor and Aldermen have asked questions about the use of OSS.
2. APPUSH: Members of the municipal council or the College of Mayor and Aldermen have been vocal in their support for OSS and have pushed the municipality to adopt OSS, but failed to get the support of a majority.
3. APACCP: The municipal council or the College of Mayor and Aldermen have accepted motions or made decisions to make the municipality use more OSS.

Answered with yes/no or don't know. 'Yes' was coded as 1, 'no' was coded as 0. The sum of the answers to these questions is APPRES (activist politician presence).

*Fiscal pressure on the ICT department*

To which degree do these statements apply to your municipality?

1. FPAUST: Our municipality had to implement austerity measures.
2. FPICTB: As a consequence of the austerity measures the ICT budget was reduced.
3. FPLFEE: As a consequence of the austerity measures we spent less budget on license fees (for the right to use the software) for proprietary software during this period.
4. FPIOSS: As a consequence of the austerity measures increasing the use of OSS was investigated.
5. FPMOSS: As a consequence of the austerity measures we increased our use of OSS.

Answered with yes/no or don't know. These answers were coded from 1 to 5 in that order. The sum of the answers to these questions is FPRSSR (fiscal pressure). The second to the fifth questions were conditional, they were only asked in case the answer to first question was positive.

*Fragmentation of the ICT hierarchy*

To which degree do these statements apply to your municipality?

1. FHAUTH: Authority over ICT matters is divided over different departments. There is no central ICT department.
2. FHPERS: There is no single person who has the final say in decisions related to ICT affairs.
3. FHDIFF: It is very difficult and time-consuming to make decisions on ICT affairs.

Answered with a five point Likert scale: disagree/somewhat disagree/neutral/somewhat agree/agree or don't know. These answers were coded from 1 to 5 in that order. The sum of the answers to these questions is FRAGHA (fragmentation of hierarchy).

With the municipality's name given by the respondents, data on inhabitants (INHABT) and debt quote (DEBTQT) were added to the data file. Fused or collaborating municipalities (FOCMUN) are coded as 1, municipalities with an autonomous ICT depertment as 0.

*End*

At this point the respondents had the option to provide their name and e-mail address if they wanted to have the finished master thesis e-mailed to them. They were also given the option to write comments on the survey.

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