Reducing redundant functionalities of an application portfolio
– Case study Swedish municipality

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Abstract
Many government organizations consist of complex application portfolios with significant redundant functionalities and in order to run this portfolio, 80% of the IT budget is consumed by maintenance cost. Eliminating redundant functionalities improves efficiency, operational performance and decreases maintenance costs. A midsized Swedish municipality has a complex application portfolio with redundant functionalities, and this study aims to suggest actions for reducing redundant functionalities of citizen related applications.

In order to identify redundant functionalities in a complex organization such as the government, all surrounding complexities need to be identified. Therefore, by performing a literature study, Application Portfolio Rationalization has been selected as an approach for reducing redundant functionalities. An online survey was conducted for gathering data about applications and the total response rate was 46.5%. The collected data was analyzed to identify complexities and applications with similar purpose and functions. Finally, actions were suggested for reducing redundant functionalities of applications by consolidating them with the “best-in-class” application, and implementing a central database for reducing redundant storage of data by the applications.

Keywords
Redundant functionalities, Application Portfolio Rationalization, application consolidation.
1. Introduction

Today many governments have a complex portfolio of applications with significant redundant functionalities. (Fabriek, Brinkkemper, & Dullemen, 2007) The information about these applications is not shared at local or central government level. This leads to a problematic situation where departments start adding, altering and removing applications without planning, which results in having a nestled application landscape (Ebrahim & Irani, 2005). Maintaining the nestled application landscape leads to increased maintenance cost (Fabriek, Brinkkemper, & van Dullemen, 2007; Oracle, 2009).

Information systems in government organizations most often handle sensitive individual data; therefore, departments create and maintain their own databases due to privacy issues. Sharing data between government organizations could reduce redundant usage of data, but due to legal constraints of confidential data, cross departmental sharing of data through applications is not allowed. (Otjacques, Hitelberger, & Feltz, 2007; Ministry of Justice, 2008) These legal constraints and different functionalities of an application such as usability, relevancy, availability, importance and satisfaction are considered as complexities which are involved in reducing redundant functionalities of applications (Hess, 2005; Fabriek, Brinkkemper, & Dullemen, 2007). The group of applications used in an organization is also called an application portfolio (Riempp & Ankel, 2007). Redundant functionality in this context refers to similar functionality supporting a process by two or more applications (Buckl, Ernst, Lankes, Schneider, & Schweda, 2007). The scope of functionality in this study involves data usage as well as purpose of applications (Hess, 2005). By eliminating redundant functionalities, the efficiency of applications increases, maintenance cost decreases and operational performance of governments can be improved (Miranda & Lerner, 1995; Ebrahim & Irani, 2005).

Redundant functionalities of applications can be managed by a centralized system where all IT requests are managed by one agency (Seifert & McLoughlin, 2007). The use of a centralized system involves effective implementation of an IT portfolio where all information related to the portfolio is inventoried into one database (Maizlish & Handler, 2005). However, there are also arguments for a decentralized system which gives a sense of ownership for the administrators and encourages better management of systems (Seifert & McLoughlin, 2007). A decentralized system with a lack of visibility in IT spending can lead to increased maintenance cost and redundant functionalities of applications (Maizlish & Handler, 2005).

The name and employees of the midsized municipality involved in this study is maintained anonymous due to legal constraints (IT-architect, 2011). This municipality has a nestled application landscape where the maintenance costs consume a large percentage of their total IT budget (IT-Manager, 2010). The municipality has a population of around 100,000 and it strives to provide good services for its citizens (The Municipality, 2011). The municipality consists of more than 7000 applications where redundant functionalities exist among these applications (IT-Manager, 2010). The authors were given an opportunity to suggest actions for reducing redundant functionalities of applications. There are a total of 50 citizen related applications in the municipality, and in this study a sample of 30 applications is considered as the application portfolio. The sample applications consist of internal applications, database applications and web applications (IT-architect, 2011).
The aim of this paper is to suggest actions for consolidating redundant functionalities of applications. According to the problem domain, the main research question of this study has been formulated as: How can redundant functionalities of applications be reduced in a midsized Swedish municipality?

1.1 Analysis of research question

The research question has been analyzed and derived into the following questions:
- How can redundant functionalities of applications be identified?
- What complexities are involved in identifying redundant functionalities?
- What actions can be implemented to reduce redundant functionalities?

As the aim of this study is to suggest actions for consolidating redundant functionalities of applications, the scope of this study is delimited to use a sample of applications from the municipality's application portfolio. Since this study involves applications which contain information about citizens, certain data is protected by the Personal Data Act (1998:204) (Ministry of Justice, 2008). The study has been delimited in aspects such as; access to information, software functionalities and the scope of presenting results due to restrictions by Swedish law and legal departments at the municipality.

2. Method

2.1 Approaches concerning problem domain

There are several approaches which deal with redundant functionalities of applications in an organization and these are described below.

Cloud computing is an upcoming concept which provides software, infrastructure and platform as a service. Software as a Service (SaaS) can eliminate redundant functionalities by aggregation of organizational units and functional modules (Cellary & Strykowski, 2009). However, in a government context, cloud computing has tangible risks such as unavailability and intangible risks such as lack of confidence in technological capabilities. Thus, due to its security issues the use of cloud computing for managing confidential data is not yet trusted by the government (Paquette, Jaeger, & Wilson, 2010).

Enterprise Application Integration (EAI) is an approach which can reduce redundant functionalities in an application portfolio. It is defined as an activity that integrates business applications and processes to provide common and sharable applications. However, the EAI approach is ideal during application development but not suitable for identifying and reducing redundant functionalities in an existing application portfolio (Ruh, Brown, & Maginnis, 2000).

Service oriented design and development methodology is an approach of Service Oriented Architecture (SOA) which handles redundant functionalities through service coupling. Coupling eliminates unnecessary relationships between business processes and services. However, this methodology is specifically suited for applications which leverage web services and developing new applications rather than organizing an existing group of applications. (Papazoglou & Heuvel, 2006)
Application Portfolio Management (APM) is an approach which can reduce complexities of an application portfolio. The use of APM creates an application inventory to identify the importance of each application in the portfolio. (Maryan, 2009) A matrix known as the strategic grid was initially used to identify and assess application portfolios in organizations (McFarlan, Mckenney, & Pyburn, 1983). The strategic grid was later developed to help management in making decisions by identifying key issues (Ward, 1987). Weill and Vitale (1999) developed the health grid which helps in identifying problem areas and wider coverage of business goals. The health grid focuses on use, importance, investment, technical quality and management value of an application. This health grid was later developed by involving categorization of applications and planning of actions (Sarissamis, 2006). Fabriek et al. (2007) developed Application Portfolio Rationalization (APR) approach using the health grid, and it bridges the gap between investment of maintenance and new applications. The APR approach can be used to consolidate overlapping processes which can justify maintenance cost (Greenbaum, 2005).

2.2 Choice of approach
The municipality's application portfolio is built up with different types of applications such as; web applications, database applications and internal applications. These applications are currently being used, which means that they are not under development stages (IT-architect, 2011). SOA and EAI approaches are suitable for applications which are under development, and the SOA approach is specifically for applications which leverage web services (Papazoglou & Heuvel, 2006). However, according to Greenbaum (2005) the APR approach is applicable to all kinds of applications which are either under development or in use.

As government organizations are complex (Séguin, 2008), their application landscape tends to be complex (SUMMIT Government Group, 2009). In order to take decisions for consolidating redundant functionalities of applications, all surrounding complexities needs to be examined (Zachman, 1997). With the APR approach, complexities of an organization’s application portfolio can be identified using different values such as business value, value of use and technical value (Fabriek, Brinkkemper, & Dullemen, 2007). Identification of complexities help in choosing the “best-in-class” application among a group of applications and the criterion for the “best-in-class” application is based on the purpose and functionality of an application (Hess, 2005). APR assists in identifying existing functions and data in each application, (Fabriek, Brinkkemper, & Dullemen, 2007) which helps in highlighting overlapping and redundant functionalities of applications (Hess, 2005; Erradi, Anand, & Kulkarni, 2006). Since the purpose of this study is to suggest actions for consolidating redundant functionalities of applications, APR is chosen as a suitable approach for achieving this.

The theoretical data collection has been carried out using three online databases; the ACM digital library, IEEE Explorer and Google Scholar. The keywords used during the search process of scientific peer reviewed articles were; application portfolio, application redundancy, IS portfolio, application portfolio rationalization, application portfolio management, enterprise architecture and service oriented architecture. In selection of articles the search process went through an exclusion method (Yakoubsohn, 2005). The process involved reading an article's abstract and conclusion, if it was relevant for this study’s
problem domain it was saved for further reading otherwise excluded. Some articles’ reference lists were used to find relevant material.

Figure 1: Processes involved in this study

Figure 1 illustrates the processes involved in this study. The municipality has a problem of redundant functionalities of applications. In order to find a suitable approach to tackle this problem, a literature study was performed to search for a relevant approach. After a comparison between different approaches, APR was found suitable as it is applicable to existing portfolios. APR approach was used to gather information about the application portfolio which then was analyzed to suggest actions for consolidating redundant functionalities of applications.

2.3 APR approach
The concept application in this paper is defined as logical pieces of software which together can be described as a system of applications (Fabriek, Brinkkemper, & Dullemen, 2007). The application can at least create, read, update and delete data (Maryan, 2009). Rationalization refers to “activities applied to reduce portfolio complexity” (Fabriek, Brinkkemper, & Dullemen, 2007, p. 1).
According to Fabriek et al. (2007) there are three phases involved in APR; assessment, evaluation and planning. The evaluation phase identifies underlying patterns between different departments within the organization; it helps to improve strategic plans which would affect future investments. However, since the purpose of this study is to suggest actions for reducing redundant functionalities of applications, the APR approach has been modified and as a result the evaluation phase has been omitted. Figure 2 illustrates phases included in the modified APR approach; assessment and planning. In the assessment phase the data about applications is gathered and assessed using different values such as business value, technical value and value of use. These values are used to identify redundant functionalities and complexities of the portfolio. The identification of redundant functionalities and complexities was modified in the Assessment phase to suit the purpose of this study. Since the APR approach was applied to a government organization, legal constraints were added to the value of use. In the planning phase, actions are determined which involve decisions about removing/re-developing applications and allocation of resources. Performing APR approach once is not enough; it should be carried out continuously on a regular basis in order to maintain a clear application portfolio. The two phases involved in this study are briefly described below according to Fabriek et al. (2007).

2.3.1 Assessment
In the assessment phase information about the application portfolio is gathered. However, before the actual assessment phase can be carried out, the purpose of applications need to be identified as it
defines the scope of the APR approach (Fabriek et al., 2007). Once the purpose is identified the application portfolio is assessed using following measures of value:

Business value: The applications are procured to achieve certain tasks or goals; this value identifies the application's ability to achieve the business goal.

Technical value: This value identifies the technical quality of the applications. It identifies update procedure, database attributes, type of database, quality, reliability and maintenance of applications.

Value of use: This value identifies the use of application by gathering information about legal constraints, availability, usability, efficiency, satisfaction and importance.

Before performing the planning phase, the data gathered about the application portfolio has to be presented to the practitioner for a review before analyzed.

2.3.2 Planning
The complexities and redundant functionalities identified during the assessment phase are addressed in the planning phase by planning actions. This phase needs to be carried out in consultation with the practitioners. In the scope of this study a practitioner is an employee of the municipality who has a relation to the applications (e.g. a user, system owner etc.).

Determine actions: Plan for actions in form of removing, keeping or redeveloping applications in the portfolio. For instance, if more than 2 applications have similar purposes and functionalities (i.e. providing a user with contact details) the one with higher values identified will be kept as a basis for the other application to consolidate against.

Allocate resources: Resources must be allocated to achieve objectives.

2.4 Framework
Figure 3 illustrates a modified version of the initial APR approach by Fabriek et al. (2007). The assessment phase was performed by conducting a survey as suggested by Weill and Vitale (1999). The questionnaire used in the survey was developed with the use of a document provided by the municipality and field notes gathered from the meetings with an IT-Architect of the municipality. The document was provided with information regarding the application portfolio and it contained information such as; application name, system owner, database type, operating system, client program. The field notes consist of information about the purpose of applications provided by the IT-Architect during meetings. The questionnaire was used to gather information about business value, technical value and value of use for each citizen related application. The information gathered from business value and technical value was used to identify redundant functionalities of applications, and information from technical value and value of use was used to identify complexities involved with the application. After identifying complexities and redundant functionalities of applications, the planning phase was performed in consultation with the IT-Architect. Finally, actions were suggested to consolidate redundant functionalities.
2.5 Data Collection

There are a total of 50 citizen related applications in the municipality and out of the total, a sample of 30 applications was considered as the application portfolio in this study. The sample of applications chosen was based on a systematic selection where the common denominator for the sample group was applications which handled citizens’ data as referred by the municipality. Two meetings were conducted with an IT-Architect at the municipality in order to define the scope of the APR approach. These meetings were documented using field notes (Oates, 2006).

Complex behaviors can be measured using questionnaires where the results would be reliable and generalizable (Matveev, 2002). Interviews can also be conducted for gathering information; however, conducting 30 interviews for 30 applications would be time consuming. Therefore the use of questionnaires was selected instead of interviews. The primary source for collecting data about applications has been by sending questionnaires to corresponding system owners who manage these applications (Weill & Vitale, 1999), see Appendix A.
The semi-structured questionnaire was developed using information gathered from the document and field notes from meetings. The questionnaire consists of 27 questions with both open ended questions and verbal scales as response categories. The aim of the questionnaire was to gather information about different values such as business value, value of use and technical value for each application (Fabriek, Brinkkemper, & Dullemen, 2007). The verbal scales help in gathering respondent’s views about different functionalities of applications (Leadership factor, 2006). However, it was not possible to ensure that all respondents would interpret the questions in the same way which is a drawback for using a quantitative method such as questionnaires (Lanthier, 2002). Therefore, the questionnaire was first tested by four system owners and appropriate changes were made to avoid misinterpretations (Gillham, 2000). The survey was created online with a tool provided by surveymonkey.com and the questionnaire was made available online through a link. The website “surveymonkey.com” maintains the anonymity of the respondents and uses an encrypted connection which is one of the reasons to choose this website (SurveyMonkey, 2008). In order to further maintain anonymity questions such as name and age were excluded. (Oates, 2006).

The online questionnaire was sent to an IT-Architect of the municipality, who sent the questionnaire to corresponding system owners. The questionnaire was available for the system owners for a period of 12 days and the respondents were reminded several times about the survey during this 12 day period. However, only 14 responses out of 30 were received, which lead to a low response rate of 46.5%. The results are reviewed by an IT-Architect of the municipality as suggested by Fabriek et al., (2001). The questions in the questionnaire were written in Swedish as it is the official language in the municipality of Sweden (Ministry of Culture, 2009), however an English version of the questionnaire can be found in Appendix A.

2.6 Method for Analysis
The responses received were presented using tables and graphs and these are compared with one another to identify redundant functionalities. The complexities were considered before suggestions in plan for actions could be made. For instance, consider two applications with similar purpose; if one of these applications isn’t allowed to share data due to legal constraints, it is not possible to consolidate redundant functionalities between these applications. Consider another example where two applications have similar purpose which by law aren’t prohibited to share data, then in order to be able to select the best of these two applications which will serve as the basis to consolidate other applications against, different functionalities of these applications need to be identified. The identification of redundant functionalities and complexities will not be significant if each application is analyzed independently (Hess, 2005). Therefore, the results present responses of the entire group of applications; for instance, if there are 2 or more applications related to storing records about citizen’s health they construct a group and this signifies the number of applications with redundant functionalities. A frequency analysis method has been applied separately on the multiple choice questions; this involves counting frequencies of responses in order to identify any emerging patterns (Hosking & Wallis, 1993). The open ended questions were interpreted before grouping them, based on identical terms (Williams, 2011). For instance, if two system owners mentioned the purpose of two applications to be telecommunication then they were grouped in the same category. Since the
questionnaire consists of different response categories, an item response theory was applied in order to discover insights in underlying data. It involves a comparison between a respondent’s answer on two or more similar questions with different response scales (Edelen & Reeve, 2007).

The responses received from questions of business value and technical value were analyzed to identify redundant functionalities, and responses received from questions of technical value and value of use were analyzed to identify complexities. The identified redundant functionalities and complexities were presented to the IT-Architect of the municipality and relevant actions addressing the problem were discussed (Fabriek, Brinkkemper, & Dullemen, 2007). Finally, after consultation with the IT-Architect, the authors suggested actions for reducing redundant functionalities.

3. Result

The total number of respondents was 14 which represent 46.5% of the sample group selected. Some of the questions are merged according to the purpose.

Figure 4 illustrates the rate of applications belonging to different departments.
Figure 5 illustrates the rate of applications achieving their goals, 93% of the applications achieve their goal.

![Figure 5. Applications achieving goals](image)

Table 1 categorizes the type of information which can be shared among the departments. 35% of the applications can share certain citizen specific information. Citizen specific data contains details about citizens while application specific data is specific to the department and the purpose. All applications consist of these two types of data.

<table>
<thead>
<tr>
<th>Type of Information</th>
<th>Example</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citizen specific information</td>
<td>Name, Address and other contact details, etc.</td>
<td>35%</td>
</tr>
<tr>
<td>Application specific information</td>
<td>Voice information, substitute schedules etc.</td>
<td>57%</td>
</tr>
<tr>
<td>Both</td>
<td>Everything.</td>
<td>7%</td>
</tr>
</tbody>
</table>

Figure 6 illustrates the type of database used by applications, 92% of the applications retrieve their data from a separate database.

![Figure 6. The source of information](image)
Figure 7 illustrates the rate of data which legally can be shared with other departments. According to the respondents, 71% of the applications can share certain information between departments.

![Bar chart showing the rate of data sharing.]

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>No, it is not allowed</td>
<td>29%</td>
</tr>
<tr>
<td>Yes, certain information can be shared</td>
<td>71%</td>
</tr>
</tbody>
</table>

*Figure 7. Sharing information with other departments*

Table 2 categorizes type of information which is classified, where 25% of citizen and applications specific information is classified.

<table>
<thead>
<tr>
<th>Type of Information</th>
<th>Example</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citizen specific information</td>
<td>Health conditions, contact details.</td>
<td>25%</td>
</tr>
<tr>
<td>Application specific information</td>
<td>Citizen information with protection by government.</td>
<td>25%</td>
</tr>
<tr>
<td>Both</td>
<td>All information in the application.</td>
<td>50%</td>
</tr>
</tbody>
</table>

*Table 2. Classified information*

Table 3 categorizes the applications based on restrictions and technical functionality, 42% of the applications have common functionalities with restrictions by laws.

<table>
<thead>
<tr>
<th>Category</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common functionality restricted by laws</td>
<td>42%</td>
</tr>
<tr>
<td>Common functionality without restrictions of laws</td>
<td>25%</td>
</tr>
<tr>
<td>Shared functionality between departments</td>
<td>25%</td>
</tr>
<tr>
<td>Shared database within the department</td>
<td>0%</td>
</tr>
<tr>
<td>Shared database with other departments</td>
<td>8%</td>
</tr>
<tr>
<td>Other</td>
<td>0%</td>
</tr>
</tbody>
</table>

*Table 3. Categorization of application*
Figure 8 illustrates the process of information being updated in the applications, 59% of the applications have a manual procedure for updating information in their database.

![Figure 8. Update process of applications](image)

Figure 9 illustrates the frequency on update procedure of the information in the application.

![Figure 9. Update frequency of information in an application](image)
Figure 10 illustrates the level of functionality, availability, relevancy, efficiency and meeting requirements.

Figure 10. Level of satisfaction

Figure 11 illustrates the frequencies of planned and unplanned maintenance of applications.

Figure 11. Frequencies of planned and unplanned maintenance
Figure 12 illustrates rate of the application in promoting self-learning. 58% of the applications are perceived as being neither hard nor easy to learn and understand the application.

![Usability of the application](image)

Figure 12. Usability of the application

Figure 13 illustrates the usage rate of an application. 64% of the applications are used on a daily basis.

![Use of applications](image)

Figure 13. Use of applications

### 4. Analysis

According to the respondents, all applications contain both citizen specific information and application specific information. A majority of the applications serve different purposes. However, three of the applications have similar purpose where they use the same type of information which legally can be shared, such as; telephone number, name, address and e-mail. These three applications are used in different departments which illuminates the lack of coordination between departments while procuring applications. The three applications are perceived as equally satisfactory except in usability, where one of the applications is perceived as less usable and very difficult to learn. The majority of the respondents
did however perceive availability, relevancy, usability and efficiency of their application as “Good”. In contrast, only 7% of the applications were “very poor” in meeting the requirements. The respondents selected were system owners who manage these applications, and involving only one stakeholder group has resulted in a majority of positive responses, this might have made the responses biased (Moody, 2001; Wood-Harper, Ibrahim, & Ithnin, 2004; Misuraca, 2009).

According to the respondents, even though 71% of the applications legally can share data, it is not shared between the departments, and 92% of the applications use individual databases for handling information which again indicates the lack of coordination between departments. Even though there are 42% of the applications which have legal constraints, 59% of the applications update their information manually. This indicates a lack of standardized procedure, as information which is updated manually involves a certain degree of risk in exposing confidential data (Frolick, 2003).

According to the respondents, 64% of applications are used on a daily basis which indicates that information has to be up-to-date for these applications. However, 14.3% of applications do not have an update procedure, 21.4% of applications update when they believe it is required and 28.6% of the applications are updated once a week.

4.1 Plan for Actions

If several applications have same or similar goal and functionalities, the “best-in-class” application can be selected as a base for consolidation (Hess, 2005). In case of the three applications which have similar purposes, they should be consolidated with the best one of them as a basis. The “best-in-class” application is the one which has highest overall rate when measuring satisfaction. The redundant application functionalities can be consolidated into one application. However, since the responses received might have been biased, the actions suggested might not consider the whole complexity of these applications.

The use of a central database was suggested for all applications which would decrease the redundant storage of data. This was due to the fact that all applications involved deal with citizen specific information, and 92% of these applications use an individual database for retrieving data which legally can be shared. At least 71% of the applications can share certain data between departments and thus, implementing a central database would reduce redundant storage of data. However, we cannot exclude the fact that in some cases redundant information will be present due to legal constraints. For instance, 29% of the applications are not allowed by the Data Protection Law to share any information which the application handles, i.e. another application cannot retrieve information which belongs to the restricted application. There are not only legal constraints which might affect the idea of a central database; the choice of implementing centralized database involves economic and political aspects of a government (Seifert & McLoughlin, 2007). Due to restrictions provided by legal constraints, patterns for redundant functionalities are identified among applications which do not have any legal constraints. In most cases with confidential data, information is protected by the Data Protection Law and data will not be allowed outside the application’s premises.
In order to maintain confidentiality of sensitive data in a central database, a security module can be implemented for authenticating an application and authorize access to desired type of information (Patentstorm, 1997). Cloud computing is an approach for implementing a centralized database which can be used over the Internet, however, usage of this technology involves a certain degree of tangible and intangible risk which should be considered (Paquette, Jaeger, & Wilson, 2010).

In order to ensure security during transfer of data between departments SHS (Spridnings och Hämtnings System) can be implemented. SHS is a standard and a regulative framework for public and private sectors, the aim is to retrieve and send data between departments through secure lines. As of today, many municipalities have adopted this approach. (Logica Sverige AB, 2010)

5. Discussion

The aim of this study is to identify redundant functionalities of applications which use citizen data. A literature study was performed in order to find a relevant approach suitable for the problem domain. APR was eventually selected for suggesting actions to consolidate redundant functionalities of applications.

The discussion with the practitioner for planning actions helped in suggesting practical solutions for reducing redundant functionalities. The complexities identified restrictions and functionalities of applications which helped in consolidating redundant functionalities of applications. The identification of redundant functionalities of applications in the assessment phase helped to suggest actions for the municipality.

Weill and Vitale (1999) suggested the use of questionnaires for gathering data regarding applications. The data was collected to construct an overall picture of the application portfolio. According to Matveev (2002) complex behaviors can be measured using quantitative approaches, which is partly true in this study. Few responses for the open ended questions were vague which is a drawback in the data collection process (Lanthier, 2002). An online survey was conducted for the convenience of the respondents. However, the respondents were not motivated in answering the questionnaire which yielded in a low response rate of 46.5%. Despite the low response rate, the use of APR helped in identifying redundant functionalities and complexities involved with the applications. The Data Protection law restricted gathering of information about the logical design of the database. Therefore, actions suggested in this study are based on the data collected through the survey and additional complexities might have been missed.

Another backdrop in the data collection procedure was involvement of only one stakeholder group, which might have lead to biased results. In order to perform a critical evaluation of the results, stakeholder based evaluation approaches, such as utilization-focused evaluation, could be used in selecting “intended users” of the applications. The APR approach lacks in support for selecting respondents for the assessment phase, and thus the approach should be complemented with utilization focused processes as potential benefits and risks involved can be identified. (Patton, 2008)
There is not much scientific research performed on APR (Fabriek, Brinkkemper, & Dullemen, 2007). Therefore, for future studies, it would be interesting to perform APR in different cases by making adjustments to the selection of respondents and data collection procedures.

6. Conclusion

The main research question:
How can redundant functionalities of applications be reduced in a midsized Swedish municipality?
The APR approach is suitable for reducing redundant functionalities of applications. Data about applications in the portfolio was gathered through a survey, and complexities and redundant functionalities are identified by comparing the responses with each other. The complexities involved with applications help in identifying restrictions and different functionalities of applications. Finally, with consultation of a practitioner actions were suggested to reduce redundant functionalities.

Derived research questions:
How can redundant functionalities of applications be identified?
Any data collecting method can be used; in this case an online survey is conducted to gather information about the application portfolio. The redundant functionalities are identified by analyzing patterns between purposes and functionalities of different applications.

What complexities are involved in identifying redundant functionalities?
Legal constraints and different functionalities of an application; usability, relevancy, availability, importance and efficiency are considered as complexities which are involved in reducing redundant functionalities of applications. These complexities are involved with each and every application and they are considered before suggesting actions for reducing redundant functionalities.

What actions can be implemented to reduce redundant functionalities?
The applications with similar goal and functions are suggested to consolidate with the “best-in-class” application and redundant storage of similar data is reduced by implementing a central database.

Summarized conclusion
A literature study was performed in order to identify different approaches which deal with redundant functionalities, APR was found most suitable for this study due to its flexibility in handling different applications under different stages. The APR approach assists in identifying redundant functionalities and complexities of applications by analyzing business value, technical value and value of use. In consultation with a practitioner practical solutions for consolidating redundant functionalities were suggested. The applications which have similar purposes and functions are consolidated with the “best-in-class” application and redundant storage of data is reduced by implementing a central database.
7. References


IT-architect. (2011, 03 02). A midsized Swedish municipality. (V. P. Paidi, Interviewer)


Appendix A

Inventory of applications in a midsized Swedish municipality – Questionnaire

You are one of many system owners or administrators who have received this survey since you are responsible for one or several applications that manage information regarding the citizens in your municipality. We would appreciate if you could write down name of the applications on the question 1 below, and then proceed to answer the questions in relation to the given application as detailed as possible. If you are responsible for several applications you have been asked to answer the questionnaire for each application by starting this very survey again.

The result of this survey will be a part of a study conducted by two master students at Örebro University. The aim of this study is to serve as an example for the municipality to reduce redundant functionalities of applications. Your answers will be presented confidentially.

*1. Following questions are related to the application (provide name of the application).

Business value

A. Which department does your application belong to?
   - Department of Education and Childcare
   - Department of Culture and Recreation Management
   - Department of Environmental and Emergency Management
   - Department of City Planning
   - Department of Adult Administration
   - Department of Urban Management
   - Department of Municipal Administration
   - Others, Please specify ____________________________________________________________

B. How many individuals are registered in the database of this application?
   (E.g. if the application manages information about the municipalities pupils, write the number of pupils registered in the database.)
   No of pupils: ___________________

C. What is the goal by using this application?
   (E.g. what do you want to achieve when using this application?)
   ______________________________________________________________________________
   ______________________________________________________________________________
D. Would you say that the application is fulfilling its goal?
   o Yes
   o No (Please specify why)
   _________________________________________________________________
   _________________________________________________________________
   o Don’t know

E. Is the application usable for gathering information for further processing in a workflow? (E.g. retrieve necessary information to handle a case or perform another task)
   o Not useful       o Less useful       o Useful       o Very useful
   o Don’t know

F. Is the application useful for coordination? (E.g. are technical possibilities in this application which allows other application to collect information to achieve a different goal, ignore restrictions in laws)
   o Not useful       o Less useful       o Useful       o Very useful
   o Don’t know

**Technical value**

G. In what way is the information in the application's database updated? (E.g. is it updated manually through a CD)
   _________________________________________________________________
   _________________________________________________________________

H. What would you say about the quality of information that is produced in form of relevancy when you use the application?
   o Very poor
   o Poor
   o Neither nor
   o Good
   o Very good

   If you answered Very Poor or Poor please specify why:
   _________________________________________________________________
   _________________________________________________________________
I. How often does planned maintenance of the application take place?
   o Never          o Once a year          o Once a month          o Once a day          o Several times a day

J. How often does unplanned maintenance of the application take place? (E.g. this could be due to bugs/errors etc)
   o Never          o Once a year          o Once a month          o Once a day          o Several times a day

K. What type of information does the application’s database contain?
   (E.g. an application about the municipality’s pupils can contain information such as addresses, names and relations to parents etc.)
   ____________________________________________________________________________
   ____________________________________________________________________________

L. From where is the application’s database retrieving its information?
   o A common database. If possible please provide with a name of another application that you know uses the same database.
   ____________________________________________________________________________
   o A separate individual database.

M. Categorization of the application
   o Common functionality restricted by laws (E.g. used within the own department with restrictions)
   o Common functionality without restrictions of laws (E.g. used within the own department with no restrictions)
   o Shared functionality between departments (E.g. several departments are depended of this application)
   o Shared database within the department (E.g. application shares database with other applications within the own department)
   o Shared database with other departments (E.g. application shares one database with other applications in other departments)
   Other, please specify or comment ____________________________________________________________________________
   ____________________________________________________________________________

Value of Use
   N. Is the application restricted by any law?
(E.g. other departments within the municipality are not allowed to retrieve common information from this application.)

- No, this application is not restricted by any law and the information can be retrieved by any department.

- No, this application is not restricted by any law but the information is still not retrieved by any other department.

- Yes (Please specify in what way)

   __________________________________________________________

O. Would you legally be able to share certain information with other departments?

- Yes, only certain information in the application is restricted to a law. (Please specify the kind of information that can be shared among different departments)

- No (Please specify why)

   __________________________________________________________

P. Is the information in the application protected/classified?

- Yes (Please specify the type of information which is protected/classified)

   __________________________________________________________

- No

- Don’t know

Q. Do you see a potential need for purchasing a new application due to the present applications inability of meeting new legal aspects?

- Yes (Please specify why)

   __________________________________________________________

- No

- Don’t know

R. How often is it desirable to have information about the citizens in the application’s database updated?
S. How often is the information about the citizens in the application’s database updated?
- Once a year
- Once a month
- Once a week
- Once a day
- Don’t know

T. What would you say about the functionality of the application? (E.g. does it according to you provide the necessary functionality or not, and why)

______________________________________________________________________________

______________________________________________________________________________

U. What would you say about the application’s availability?
(E.g. Very good if the application’s response time and functionality doesn’t create unnecessary disturbance in the workflow)
- Very Poor
- Poor
- Neither nor
- Good
- Very good

V. How easy would you say that it is for a new user to adapt and learn the use of this application? (E.g. does the application use relevant terms and does it provide help sections and other relevant documentation to promote self-learning)
- Very hard
- Hard
- Neither nor
- Easy
- Very easy

W. How efficient would you say that the work is done with the help of this application?
(E.g. the application is efficient if it doesn’t involve in unnecessary clicks, change of views and other disturbances in the workflow)
- Very bad
- Bad
- Neither nor
- Good
- Very good

X. How does the application satisfy the department’s needs?
(E.g. are the requirements of the application perform a certain task met by the application)
- Very bad
- Bad
- Neither nor
- Good
- Very good

Y. How important is the application in the daily work of your department?
(E.g. Very important if the application was unavailable for a day and work had to be put aside till the application was up and running)
- Very unimportant
- Unimportant
- Neither nor
- Important
- Very important
Z. What type of users does this application have? (E.g. pupils, teachers, administrators, supervisors, medical staff)

______________________________________________________________________________
______________________________________________________________________________

AA. How often does an employee use this application on a yearly basis?

○ Never ○ Once a year ○ Once a month ○ Once a day ○ Several times a day

○ Other, Please specify or comment

______________________________________________________________________________