International Journal of Information Management 37 (2017) 1507–1516

Contents lists available at ScienceDirect

International Journal of Information Management

journal homepage: www.elsevier.com/locate/ijinfomgt

Examining the potential of language technologies in public organizations by means of a business and IT architecture model

Martin Henkel*, Erik Perjons, Eriks Sneiders

Department of Computer and Systems Sciences, Stockholm University, Forum 100, SE-164 40 Kista, Sweden

ARTICLE INFO

Article history:
Received 6 February 2016
Received in revised form 3 April 2016
Accepted 23 April 2016
Available online 25 May 2016

Keywords:
Language technology
Business architecture
IT architecture
Business cases
E-government
Business intelligence

ABSTRACT

New technologies have the potential to improve the quality and efficiency of public organizations. However, it is not always clear what new technologies exists, why they should be introduced, how they can be applied, and how they fit within existing business and IT architectures. In this paper, we examine the potential use of new technologies in the form of language technologies and tools, such as text mining, information extraction, and question and answering systems. We do this examination by introducing a business and IT architecture model. The model contains an overview of IT systems and information traditionally used by public organizations in their interaction with citizens. The model also includes a set of problems facing public organization using traditional IT solutions. More importantly, the paper presents an extension to the model showing how language technologies can be used for supporting operational and strategic processes in public organizations, and addressing the identified problems. The model, its extension and the identified problems are based on and exemplified by cases from Swedish public organizations.

1. Introduction

Public organizations need to be efficient, provide high quality services, manage formal cases in a fair way, be accessible via different channels, and be responsive to new ideas and demands. Therefore, public organizations employ a wide range of means, not at least IT systems. Examples of IT systems used in public organizations are case handling systems for managing formal applications from citizens, workflow systems for efficient routing of documents, web applications and e-services for interaction with citizens, and business intelligence solutions for supporting strategic and operational decisions.

The use of IT systems in public organizations is, however, not optimal. For example, citizens may need to wait for weeks and months for receiving certain services; may need to wait for hours in telephone queues for asking basic questions; and may receive confusing and inconsistent answers from different public officers. Moreover, public organization may need to spend a large amount of resources to manage unstructured information, and, on a strategic level, may need to be reactive instead of proactive.

By properly introducing new technologies in public organization the described problems can be addressed. A promising group of technologies addressing these problems are language technologies. In this paper we define language technology as a technique for processing human language, including semantic techniques (e.g. natural language processing and information extraction), statistical techniques (e.g. text retrieval and text mining), or a combination of these. These technologies are now mature enough to have a significant impact on an organization's business processes and services as well as on their strategies. They can be applied as a new form of IT systems or as part of existing ones, such as a case handling system. Different types of language technologies can also, as mentioned above, be combined in order to provide a more beneficial solution for an organization.

The large number of existing language technologies and solutions – stand-alone, combined, and integrated with other IT systems – makes it hard for both business and IT managers in public organization to understand what language technologies exists; why they should be introduced in public organizations; how they can be applied to support operational and strategic processes; and how they fit within an existing business and IT architecture. In this paper, we present a business and IT architecture model supporting business and IT managers to choose an appropriate mix of language technologies in a public organization. The contributions of the paper are:

* Corresponding author.
E-mail addresses: martinh@dsv.su.se (M. Henkel), perjons@dsv.su.se (E. Perjons), eriks@dsv.su.se (E. Sneiders).

http://dx.doi.org/10.1016/j.ijinfomgt.2016.05.008
0268-4012/

- A number of business cases showing what language technologies exists.
- A list of current problems facing public organizations when they deal with citizen requests given existing IT systems, specifying why language technologies should be used in public organizations.
- A high-level graphical business and IT architecture model of public organizations showing roles, main information flows and IT systems. The model's focus is on describing the interaction with citizens in form of customer services and case handling.
- An extension of the model showing how language technologies fit into the model, and how language technologies can be used to address current problems.

The model and its extension is based on an analysis of customer services and case handling processes in Swedish public organizations. The analysis has been carried out as part of a research project, called IMAN2. The project's goal was to develop innovative e-government solutions for customer service and case handling processes by the use of language technologies, with the aim to simplify and improve the interaction between public organizations and the actors they serve, such as citizens and organizations, both private and public. The project was a collaboration between researchers in language technology at Stockholm university, Sweden, Royal Institute of Technology, Sweden, the business intelligence company Gavagai, the process improvement company Visuera, and the IT consultant company Cybercom. Moreover, the project includes a number of Swedish public organizations on national as well as local level: the Swedish Transport Administration, the Swedish Pension Agency, and a number of local governmental organizations: the municipalities of Klippan, Kungsbacka, Nacka, and Söderhamn. These public organizations need a well-structured way of managing citizen services and case handling processes. They have all seen language technologies as promising solutions. The role of these public organizations in the IMAN2 project was, first, to provide the project with practical challenges within public organizations based on analysis of their citizen services and case handling processes; second, to participate in design of solutions based on language technologies; and, third, to act as test beds for the designed solutions, i.e., implement software prototypes that was develop as part of the project. In this paper, we also include some experiences from a previous research project, IMAIL, in which the Swedish Social Security Agency participated (Cerratto-Pargman, Knutsson, Celikten, Sneiders, & Dalianis, 2011).

The paper is an extension of an initial work presented in (Henkel, Perjons, & Sneiders, 2016). Compared to the initial work, we have in this paper provided descriptions of the problems that public organizations face; included a more detailed view of the business and IT architecture; and presented a more thorough description of the research approach used. Note that a full description of language technologies is not included in this paper, instead a full description of the state-of-art of language technologies was presented in a previous paper, see (Henkel et al., 2014).

The paper is structured as follows: Section 2 and 3 describes the research methodology used and related research. Section 4 presents the business and IT architecture model. Section 5 presents problems that language technology solutions can address. Section 6 and 7 present operational and strategic use of language technology. Finally, Section 8 concludes the paper.

2. Research approach

The research methodology used in the research presented in this paper was design science, which aims to create innovative artifacts for solving practical problems (Hevner et al., 2014). Example of artifacts are models, methods and IT systems. A design science process has been presented by Peffers, Tuunanen, Rothenberger, and Chatterjee, 2007 describing how an artefact are designed and developed in a research context. The activities in this process, as well as their applications in the IMAN2 project, are described below:

2.1. Identify problems and motivate

The first activity in the design science process presented by Peffers et al. (2007) is to identify a practical problem that needs to be addressed and that motivate why the artifact, in our case the business and IT architecture model and its extension, needs to be designed and developed. In our case the business problem was identified as part of the IMAN2 project. While working in the IMAN 2 project it was evident that the potential of using language technologies in public organizations is high, but that it was difficult for business and IT managers in public organizations to understand what language technologies exist; what problems language technologies address; how they can be applied supporting operational and strategic processes; and, and how they fit within existing business and IT architectures.

2.2. Define objectives of a solution

The second activity defines the objectives of the artefact. In this paper the activity is interpreted as defining the requirements on the artifact in focus. These requirements are based on the identified problem, but specify more precisely in which way the artifact addresses the problem. These requirements guide the design and development of the artifact and form the basis for a future evaluation. For the work presented in this paper, we focus on two requirements presented and motivated below:

- Applicability, i.e., the degree to which the business and IT architecture model and its extension (i.e. the artifact) support the organization that use the model to select appropriate language technologies and solutions
- *Understandability*, i.e., the degree to which the model and its extension are understood or comprehended by the users. The model is an instrument that should support business and IT managers to get a better overview of what language technologies exist; why they should be introduced; how they can be applied; and how they fit within the business and IT architecture of an organization. Therefore, the business and IT architecture model needs to be understood by these managers

The reason for introducing a limited set of requirements on an artifact is that an artifact cannot normally manage all kinds of requirements when addressing a problem. Instead, it needs to focus on a certain number of requirements, which need to be clearly stated.

2.3. Design and develop

The third activity describes how the artifact was designed and developed as well as its final construction and functionality. The artifact presented in this paper is mainly based on actions and discussions carried out within the IMAN2 project, including all participants: researchers, system developers, business and IT consultants and managers within public organizations. An important step in the IMAN2 project was to perform process analysis in the participating public organizations. This uncovered a number of concrete problems in the public organizations case handling processes and customer service. This was an important input to a number of problems that language technology solutions can address. These problems are presented in this paper and related to the business

and IT architecture model. Based on these problems, a set of use cases was constructed describing how the use of language technologies could address the problems. The use case design was performed using workshops involving domain experts from the public organizations and experts in process analysis and improvements from other organizations in the IMAN2 project. The use cases were then generalized, modularized and refined to be applicable to a larger set of organizations. The generalization was performed by removing organizational specific details from the use cases as well as merging cases that were similar. Modularization was performed by splitting large cases that employed a group of language technologies, so that each case was only describing one language technology. Finally, a refinement was done to add details regarding the benefits of each use case. The use cases were also renamed to "business cases".

2.4. Demonstrate

The fourth activity in the design science process aims to demonstrate the feasibility of a designed and developed artifact by showing the use of the artifact in an illustrative or real-life case. In our case, the model and its extension were demonstrated by presenting real case example(s) for each business case. These examples were based on the process analysis and the design of the business cases in the participating public organizations in the IMAN2 project.

2.5. Evaluate

The fifth activity in the design science process is to evaluate if and how the artifact solves the identified problem and fulfills the defined objectives (that is, the defined requirements). In this paper, the evaluation is presented in form a so called informed argument (see Hevner et al., 2014), where the researchers discuss if and how the model solves the identified problem and fulfils the defined requirements (understandability and applicability).

2.6. Communication

The sixth activity in the design science research process is to disseminate the research carried out to both researchers and practitioners, e.g. in the form of academic write-ups, such as this paper.

3. Related research

The work in this paper relates to *models of e-government* and *ICT architectures* for case management in public organizations. Generally, e-government refers to the use of ICT to improve public organizations in the form of several "qualities", such as efficiency, improved interaction with citizens, and transparency (Yildiz, 2007). Models of e-government explain how e-government can be performed and how to improve it. An appropriate architecture of ICT systems helps to fulfill the promises of e-government.

Several theoretical *models for e-government* have been proposed, the most well known being the four stage model proposed by Layne and Lee (2001). The four stage model, and other similar theoretical models, describe how e-government can progress from an initial web presence into an ICT supported interaction between citizens and public organizations (Layne & Lee, 2001). In this progression, ICT is seen an enabler that improves efficiency and administration capabilities (Coursey & Norris, 2008). However, ICT development within e-government programs has been criticized for the use of generic "universal strategies" when trying to reach efficiencies (Cordella & Iannacci, 2010). In this paper, we do not apply a specific prescriptive e-government model, we rather examine and describe the current practices with regards to case handling and citizen services in public organizations. Furthermore, we avoid prescribing universal strategies by instead focusing on problems and means to overcome the problems (that is, means in the form of language technologies). The major contribution of this paper, the business and IT architecture model, can be used as part of an existing e-government model or framework, or as a standalone tool.

Even though there exist numerous commercial systems that especially target case handling system in public organizations, surprisingly little research have been done into how these systems are used in practice. However, some authors have suggested IT architectures that may help public organizations. Dias & Rafael (2007) suggest a division into a front-office and a back-office system, serving the same purpose as we have found in the form of web forms and case handling systems. Another example is Salhofer and Ferbas (2007) that propose an architecture that allow the use of process descriptions that is similar to what existing commercial case handling systems are offering. Moreover, some guidelines exist for governing the utilization of e-government service platforms (Henkel, Perjons, & Zdravkovic, 2007). To the best of our knowledge, there is no previous research describing the business and ICT architecture of Swedish public organizations. Our contribution is to firstly examine what type of IT systems and information are in use, and describing them in form of a business and IT architecture, and what problem exists given existing architecture. Secondly we suggest an extension to this architecture model by suggesting how several problem could be solved introducing language technologies, and how these technologies can fit into the architecture.

4. Public organizations' architecture

A central part of public organizations is the interaction with citizens. Public organizations handle different types of incoming request form the citizens, ranging from small routine request for information to complex cases that require extended interaction. Based on our experience within the IMAN2 project, we have identified two main types of request and a number of supporting IT systems that are used to support the two types of requests.

The two types of requests can be called *general questions* and *formal case requests*.

A *general question* is a request for information about the public organization and its services. For example, a citizen can ask when the public swimming pool is open; which plans exist to build block of apartments or highways in the neighborhoods of the citizen; or how to apply for a driving license.

A *formal case request* is a request for access to certain services that require some form of formal investigation at the public organization. For example, a citizen can request a permission to build a house on a certain property, or request extra support at home for a person that is not able to manage cocking and cleaning. This type of request is regulated by national and/or regional laws and/or rules. This type of request commonly starts a formal case process in which an officer investigates the request and checks if it is compliant with the national and/or regional laws and rules, and then make a decision about the citizen's right to access the service.

These two types of requests need to be managed by public organizations. Fig. 1 describes somewhat simplified how a traditional public organization manages these two types of request. General questions are often managed by a customer service in the public organization. For example, a citizen contacts the customer service via telephone. The service officer at the customer service can answer the question, or make use of domain experts in the public organization if the service officer does not have the skill set to answer the questions. In many organizations, the citizens can also contact the domain expert directly, often via a telephone operator that direct the citizen to the right expert. Some general questions result in a formal case requests, see Fig. 1. The citizens can also

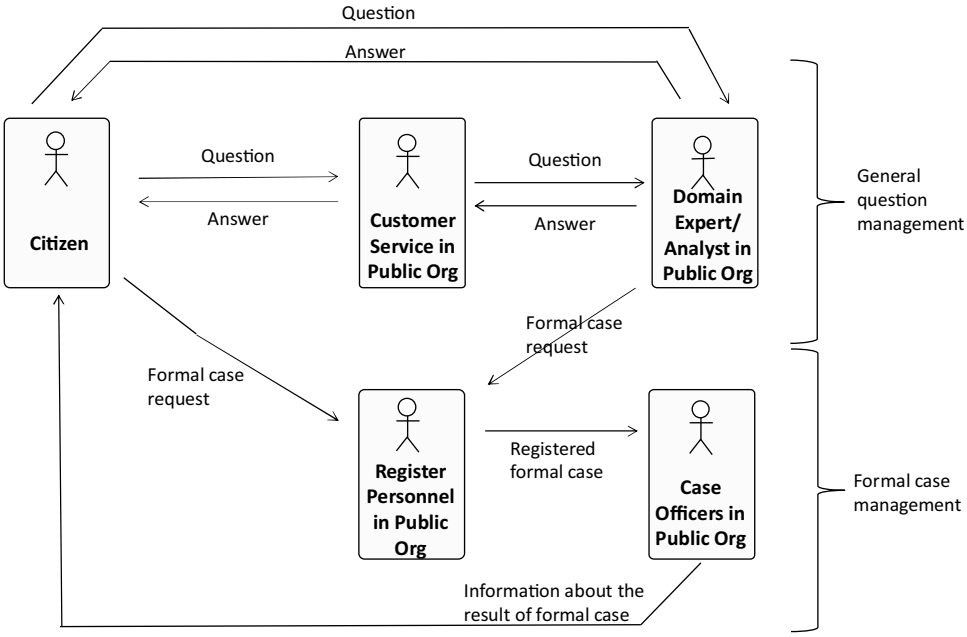

Fig. 1. Overview of the case handling in form of general questions and formal case request.

directly contact the public organization for a formal case request, via phone or mail. Formal case request are registered in a register system of the public organization, and the management of these formal request are usually supported by a case handling systems. Formal cases are often carried out by case officer, a role that can be played by the same person as is playing the role of domain expert, mentioned above. The case officer will also contact the citizen via phone and mail to inform the result of the formal request. The process of managing formal cases is described in Fig. 1 as well.

The management of the two types of requests in a traditional public organization, described above, is often not optimal. Different types of IT solutions have been introduced for a more effective management of the requests, see Fig. 2:

- *Web Info*. A public web site with info of the public organization and its services. For example, the web site can provide the citizens with easy access to answers of often asked questions (i.e., Frequently Asked Questions). An example of a web info system is the extensive information that the Swedish Tax Agency has published on its web site.

- *eMail System*. Questions from citizens can be sent to the customer service via email. These questions via email can be forwarded to a domain expert. For example, the Social Security Agency receives requests on issues related to parental leave and sickness leave via mail.

- *Web forms*. Web forms on a public web site can be used for formal case requests. For example, tax declarations can be filed to the Tax Agency by using their online forms, "forcing" the citizens to provide all necessary information to the Tax Agency.

- *Register system*. This system provide formal registration of all formal case requests. Usually, each case is given a unique case number that is public. All Swedish public organization are required by law to have a registry that contains all the formal cases.

- *Case handling system*. This system supports the handling of the cases, for example by providing workflow and/or content management support. Most Swedish municipalities, such as Klippan and Nacka, have a case handling system that support the operational handling of cases.

- *Routing system*. A routing system can be introduced to integrate the web forms, the register system and the case handling systems, so that a case can automatically be registered in the register system as well as automatically be started in the case handling systems when a citizen post a formal case request via a public web form. This type of system is not commonly used, instead routing is many time done manually. For example the Transport Administration performs manual routing of 2000 request per month. However, in Nacka municipality, a routing system has been introduced to support interaction between different IT systems, although not used in full.

5. Problems identified in public organizations

Many of the IT systems presented in Section 4 support the management of the two types of requests – general question and formal case request – in public organizations. The management of these requests can, however, be carried out even more effectively by using different types of language technologies, which we will describe later in this paper.

In Table 1, a number of problems (P1-P18) have been identified, and they have been related to Fig. 3 (which is a copy of Fig. 2, but with the problems added). The problems have been identified during discussion with public organizations by presenting possible solutions based on language technologies. In this paper, a problem is seen as a gap between a current state and a desirable state of affair for an organization. However, employees and others are not always aware of the gap until someone has suggested the desirable state of affairs, for example, by presenting a new technology. This is what we have done in the IMAN2 project in order to identify business problems to be addressed by language technology solutions.

Table 1 describe the identified problems, which actor the problem hinders (i.e. the public organization, the citizen or both), and what type of problem it is. Based on the SERVQUAL framework (Parasuraman, Zeithaml, & Berry, 1988), we have identified the

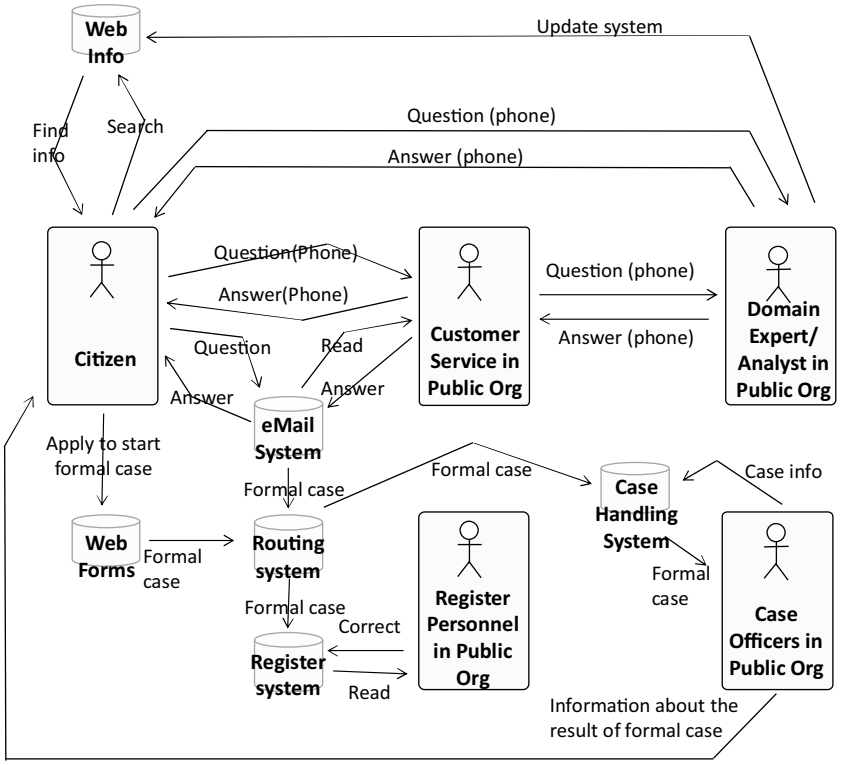

Fig. 2. Overview of the case handling IT support systems.

following quality criteria which helped the identification of problem types:

- *Efficiency*—the degree to which a service is effective without wasting time, effort or expense
- *Responsiveness*—the degree to which a service is provided prompt to the citizens
- *Accuracy*—the degree to which a service is correct
- *Consistency*—the degree to which different services are free from conflicts.
- *Info distribution*—the degree to which an service supports transfer of needed information
- *Customization*—the degree to which a service can be adapted to the specific needs of a local practice or user
- *Product quality adaptation*—the degree to which a service can provide quality adaptations to the organizations quality

6. Operational use of language technologies

This section describes a set of business cases, each business case describing a possible use of language technologies in public organizations. The business cases can be used by business and IT managers in order to better understand what language technologies can be applied in their organizations, why the language

Table 1
Problems identified in public organizations.

ID	Problem description	Perspective	Type of problem
P1	Public organizations use many resources to answer simple telephone questions	Public organization	Low efficiency
P2	Public organizations use many resources to answer simple email questions	Public organization	Low efficiency
P3	Citizens need to wait in telephone queues before getting needed information	Citizen	Low efficiency
P4	Citizens need to wait for email answers after sending an email question	Citizen	Low responsiveness
P5	Citizen cannot get email answers from the public organization in weekends	Citizen	Low efficiency
P6	Citizen cannot ask questions via telephone in weekend	Citizen	Low responsiveness
P7	Public organizations' answers are not always accurate	Citizen & Public organization	Low accuracy
P8	Public organizations' answers for the same type of question among employee can differ, i.e. the answers are not consistent	Citizen & Public organization	Low consistency
P9	Public organizations use many resources to route formal cases to the right case officers	Public organization	Low efficiency
P10	Citizens need to wait for decision about formal cases	Citizen	Low efficiency
P11	Public organizations use many resources to write answers via email after telephone call	Public organization	Low efficiency
P12	Public organizations use many resources to summarize phone call conversations	Public organization	Low efficiency
P13	Citizen do not get text summary of phone call conversations	Citizen	Low info distribution
P14	Public organizations do not analyse phone call conversations to identify new trends	Public organization	Low product adaption
P15	Public organizations do not analyse phone call conversations to identify low service quality	Public organization	Low product adaption
P16	Public organizations do not know in full the mind-set, mood, and attitude of the public opinion in order to identify new trends	Public organization	Low customer adaption
P17	Public organizations do not know in full the mind-set, mood, and attitude of the public opinion in order to identify low service quality	Public organization	Low product adaption
P18	Public organizations do not discover upcoming problems, and are, therefore, not reacting early and provide needed information to citizen.	Public organization	Low info distribution

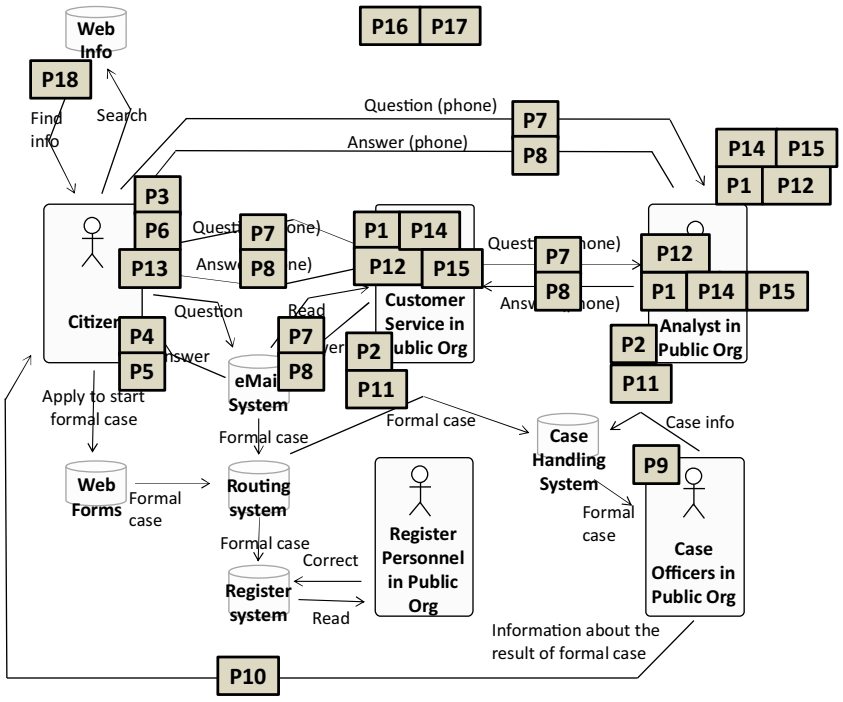

Fig. 3. Problems that can be addressed by language technology solutions.

technologies should be used, that is, what problem the technology address, how to apply the technology, and how to fit the technology in the business and IT architecture. The business cases impact on the business and IT architecture are visualized in Fig. 2.

6.1. Automatic and semi-automatic message answering

6.1.1. Business case description

Automatic message answering is a business case in which citizens' requests for information are managed automatically by a system sending back answers instantaneously without human involvement (see A in Fig. 4). Different types of language technologies, pre-specified answers and rules are used by the system to manage the questions automatically. However, there is a risk that the answers are not adapted to the citizens' need using such a system. Therefore, many times organizations prefer semi-automatic message answering system (see B in Fig. 4). Such a system is a system suggesting one or several pre-specified generic answers (often called templates) to a specific question. The user of the system, for example a customer service agent, can then select one of the templates suggested by the system, and, edit the template to produce an answer that suite the citizen's need (interpreted by the agent based on the way the question is formulated). Note that also domain experts and case officers can use a semi-automatic message answering system (not shown in Fig. 4).

6.1.2. Fit in the business and IT architecture

Modules for automatic and semi-automatic message answering can be connected to the *email* and/or *web forms systems* that public organizations use.

6.1.3. Effects on current problems

Messages answered by the use of automatic and semi-automatic message answering system could lower the amount of resources needed for answering email questions (P2), and if automated, answers can be sent back immediately (P4) to the citizens. (P2 and P4 are IDs of generic problems described in Section 5). By using automatic message answering system, the citizens can both ask questions (P5) and receive answer (P6) when the customer service is closed. Moreover, if citizens find that email can be used to receive answers quickly, many citizens may prefer using email instead of telephone, which will lower the number of resources needed for answering simple telephone questions (P1). Thereby, citizens do not need to wait in telephone queues (P3). Moreover, in an automatic or semi-automatic message answering system, the answers (templates) used will be quality assured, resulting in accurate (P7) and consistent (P8) answers.

6.1.4. Real case example

The Swedish Pension Agency estimates that it on average takes around 10 min to answer an email from a citizen. Today, around 99,000 emails are answered on average per year. This requires 9.5 full time customer service agent positions per year, just to answer email questions. The Swedish Pension Agency wants to decrease the time to answer an email by using templates (pre-specified generic answers). Some customer service agents are already using templates in the existing email system: the agent starts to find an appropriate template in a folder structure and if a template is found, it is adapted given the question from the citizen, and, the answer is sent to the citizen. However, most of the service agents do not use the templates since the number of templates is still low. Moreover, rules to be used by the system to suggest templates automatically given the question have not been developed. In the future, the Swedish Pension Agency considers to use an advanced semi-automated message answering system: a system that will automatically suggest a number of templates given a question, and where the customer service agent selects one of the templates and adapts the pre-specified answer in the template to suite the citizen's need. This require development of both templates and rules. The latter for identifying appropriate templates given a question. The service agents at Swedish Pension Agency estimate that the average time to answer an email using such a system will be 5 min (instead of 10 min) if a template is found. An important part of the semi-automated message answering system is to develop and maintain the templates. Therefore, a structure for handling templates needs to be decided and introduced. An

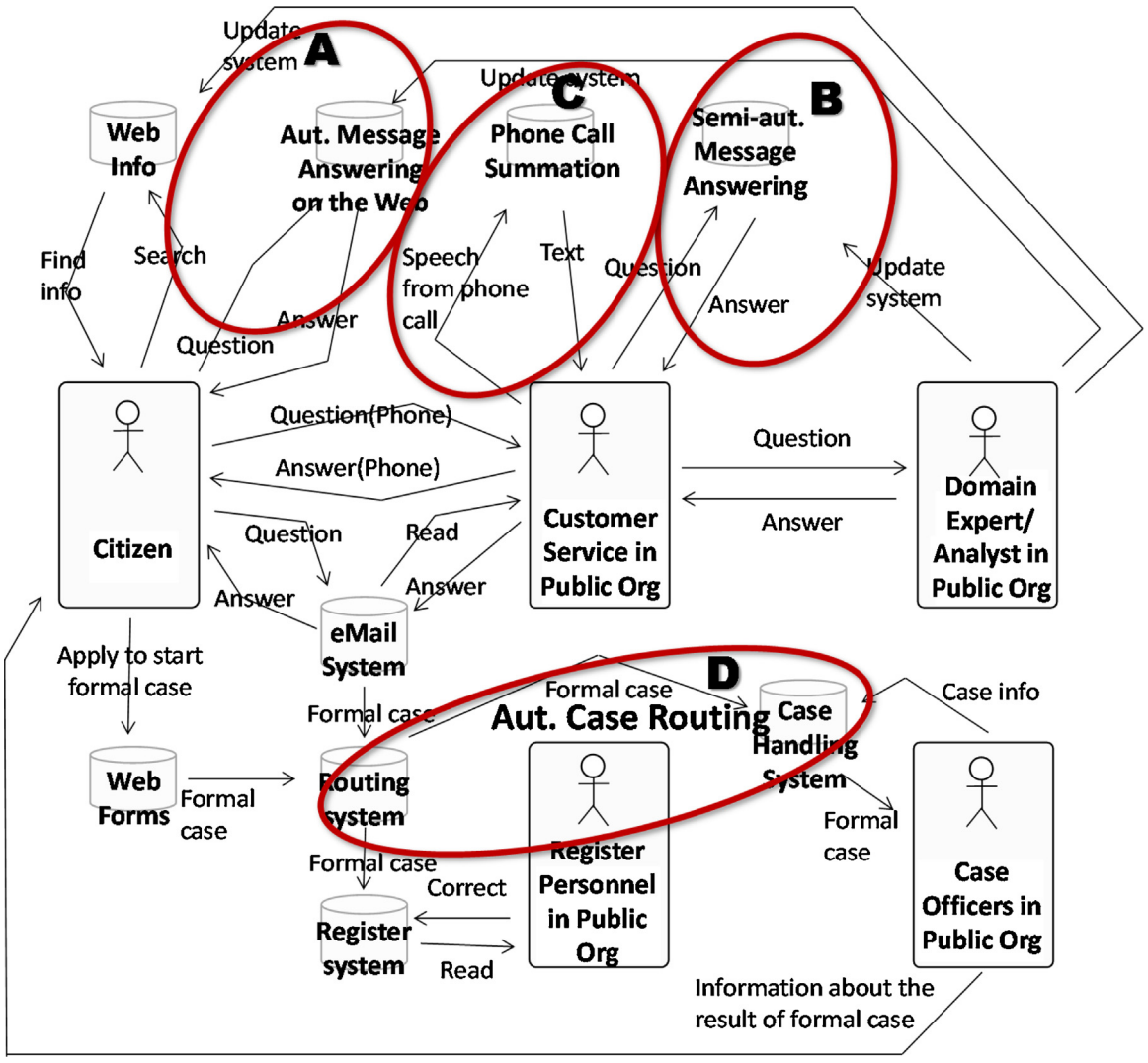

Fig. 4. Language technology businesses cases, positioned in the architecture.

important argument for introducing a system using templates at Swedish Pension Agency is the introduction of quality assured templates. Today, the citizens may receive different, and sometimes, inconsistent answers, from the customer service agents. Another important part is to develop the rules for identifying the templates automatically. Different approaches for developing such rules has been discussed in the IMAN2 project, see Henkel et al. (2014) for a description of the different approaches.

6.2. Phone call summation

Business case description: Phone call summation is a business case in which a telephone conversation between, for example, a customer service agent and a citizen is automatically transformed into a written summary by a system, thereby providing a documentation of the conversation in text form (see C in Fig. 4). Note that also domain experts and case officers can use phone call summation (not shown in Fig. 4).

6.2.1. Fit in the business and IT architecture

A natural point for integration of a call summation system would be to integrate it with the system being used while a public agent has a conversation with a citizen. For example, for customer service agent, the telephone system could be used, and for a case officer, a call summation system would fit well with a *case handling system*.

6.2.2. Effects on current problems

Phone call summation could lower the amount of resources needed for manually write a summary of the phone call (P11, P12) for documenting the conversation. The summary could also be sent to the citizen which might forget important parts of the answer (P13). The call summaries could also be used as a first step to identify new ideas and trends identified by citizens (P13) and low service quality (P14), see Section 7.1 for the following steps.

6.2.3. Real case example

The Swedish Pension Agency handles request via telephone. With the use of call summation it would be possible to extract structured information from the phone call and use that before, while and after the requests. For example, one type of case that the pension agency handles is applications for housing supplementary allowances. While in contact with a case officer, the system could aid the case officer to document what is being said. Today this kind of documentation is done manually and partially after the conversation has ended. With support for text summation it would be possible to perform the documentation automatically, allowing the case officer to focus on the conversation. The documentation could

be sent to the citizen, but also be used by the case officer as documentation of the conversation. The Swedish Pension Agency might implement such a solution in the future. *Klippan municipality* wants to better make use of ideas and trends identified and expressed by citizens, for example, during telephone conversations. A useful mean for identifying such ideas and trends is to analyse a number of conversations with citizens using text summations of the calls.

6.3. Case routing

Business case description: Case routing is a business case in which a case is automatically routed by a system to an expert with the right knowledge to handle the case (see D in Fig. 4). The categorization can both be based on *meta*-data, such as the form used for the request, and on free text contained in the request.

6.3.1. Fit in the business and IT architecture

Language technology based case routing provides the means to build, or extend an existing *routing system,* but could also be used by extend existing *case handling* systems which such a functionality.

6.3.2. Effects on current problems

Language technology based case routing could lower the amount of resources used for routing formal cases to the right case officers (P9). Thereby, the waiting time for the citizens may bet lowered as well (P10).

6.3.3. Real Case Example

The Swedish Transport Administration handles about 2 000 written request per month. Some of the requests are formal case requests and others are general questions. The customer service handles general questions that often can be quickly resolved, for example, requests regarding the current highway status, temporary road routes and so on. The case officers handles formal cases concerned with a number of sub-categories: railway, highways, ferries, transport logistics and large projects. One possible use of automatic case routing would be to first sift out the "small" commonly occurring cases that the customer service can handle promptly. The remaining cases could then be routed to a case officer. An automatic categorization must be updated to cover new experts and projects as they are planned. An example of a project in the domain of the transport administration is the creation of a new turnpike. The creation of a new turnpike could cause a lot of questions from the citizens.

7. Strategic use of language technology

The interest of business intelligence (BI) among public organizations has been high in Sweden for at least the last five years. This is based on the observation that the Swedish newspapers have contained many articles about how to introduce and get benefits out of BI projects, and that presentations and conferences about BI for public organizations have received many participants.

BI can be defined as an "umbrella term that is commonly used to describe the technologies, applications, and processes for gathering, storing, accessing, and analyzing data to help users make better decisions" (Wixom, Watson, Marjanovic, & Ariyachandra, 2010).

Modern organizations, whether public bodies or commercial entities, are highly dependent on understanding their external business environments in order to be pro-active and enhance strategic decision making.

Public organizations act on behalf of the general public with a charter broadly defined by the needs of society, which the actions of the public organization in question influences and affects. To perform their duties appropriately, public organizations need to acquire some sense of what the mind-set, mood, and attitude of the public opinion is, and to aggregate that information into actionable information for both strategy and immediate operational action.

In the IMAN 2 project, two business cases for BI have been identified, and are presented below, as visualized in Fig. 5.

7.1. Citizen intelligence analysis

Business case description: Citizen intelligence analysis is a business case in which external information that affects an organizations activities are collected. This information is analyzed to make long-term strategic decision and short-term resource reallocations. Analysis can be based on sources such as newspapers, TV and radio channels, and on information from social media. Moreover, citizens' requests via email and conversations on phone could be used as well. First, Fig. 5 shows how information is gathered via the public agents' interaction with the citizens during telephone calls (see call summation in C in Fig. 5), to be analyzed in a business intelligence system (see A in Fig. 5). Text summation is a useful tool for supporting the analysis, since telephone calls can be easily analyzed when transformed into text. Moreover, analyzing the public use of automatic question answering system (see usage info in D in Fig. 5) can also be used for better understanding the interests and needs of citizens. Finally, social media (see social media info in B in Fig. 5) can be used to identify trends that can influence the public organization both long term and short term.

7.1.1. Fit in the business and IT architecture

Intelligence analysis is not a focus of the language technologies used in the IMAN2 project since most of the IMAN2 technologies are focused on supporting the operational perspective, that is, supporting day-to-day activities. However, as shown in the business case description, different business cases presented in Section 6 can be used for collecting data to be used by software for intelligence analysis, which would fit well within a business intelligence system, see A in Fig. 5.

7.1.2. Effects on current problems

Analysis of phone call conversations could be used for identifying new trends (P14) or low service quality (P15). Also upcoming debates and issues could be discovered early by analyzing traditional and social media, thereby being proactive and provide the needed information to citizens (P18) on the organization's web site before the citizens start calling.

7.1.3. Real case example

The customer support at the *Swedish Pension Agency* is highly dependent on its environment in the form of traditional and social media. For example if a minister make an announcement in traditional media about desired changes in the pension system, the customer support will immediately get a lot of phone calls about how this affect the individual retiree. In the same way, a discussion could start in social media and grow rapidly before entering traditional media, resulting in a number of phone calls from citizens. By the use of citizen intelligence analysis it is possible to monitor traditional press and social media to early discover if a debate is rising. This would allow the pension agency to proactively allocate the necessary resources to their customer support.

7.2. Sentiment analysis

7.2.1. Business case description

Ordinary categorization of cases provides a structured way of sorting and analyzing data based on what the cases contain. However, when using traditional categorization it is easy to miss how customers express values and opinions about offered services. Secondly, by using pre-defined categories it might also be easy to miss

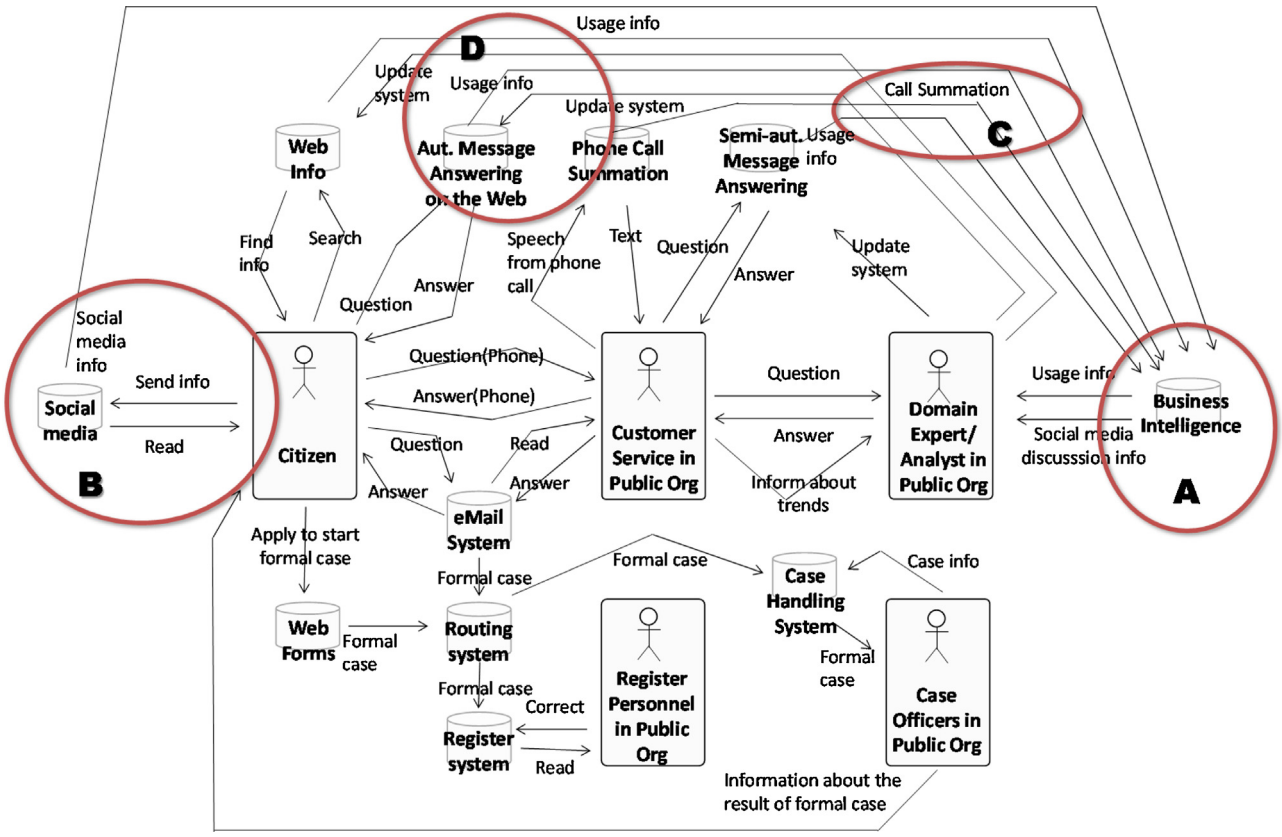

Fig. 5. Language technology strategic businesses cases, positioned in the architecture.

details in the cases. Sentiment analysis is a business case in which customer views and sentiments are collected during the interaction with customers (see social media info in B and call summation in C in Fig. 5). Existing language technologies can support sentiment extraction from text that is aimed at expressing an opinion. The text could be reviews and opinions stated in traditional and social media (such as Facebook, Twitter). Language technologies can also be used to extract sentiment from a more general text that is not focused on expressing an opinion, but still might do (Pang & Lee, 2008). For example, customer views and sentiments can be collected from email systems and case handling systems.

7.2.2. Effects on IT system types

Sentiment analysis software can be interconnected with systems that store opinions about offered services formulated in somewhat free form by citizens, such as social media and readers' comments to traditional media published on the web. Moreover, *email* systems, and *case handling systems* are appropriate sources for analysis if they contain the requests as formulated by the citizens.

7.2.3. Effects on current problems

Sentiment analysis software can be used for providing public organizations information about the mind-set, mood, and attitude of the citizens in order to identifying new trends (P16) and low service quality (P17).

7.2.4. Real case example

The *municipality of Kungsbacka* is interested in identifying ongoing discussions in social media about services provided by Kungsbacka municipality, especially the citizens' value and expectation about the services, in order to become a more proactive municipality. A first prototype of such a solution has been presented to Kungsbacka.

8. Conclusions

In this paper we examine the potential of using language technologies to improve operational and strategic processes in public organizations by introducing a business and IT architecture model. The model includes an overview of the roles, IT systems and information commonly used in public organizations to interact with citizens. Related to the model is a number of problems that can be addressed by language technologies. The model is also extended to show what, why and how language technologies can be used for supporting operational and strategic processes in public organizations. Both the model, its extension, and the identified problems have been grounded in Swedish public organizations via the IMAN2 project.

The business and IT architecture model, including its extension and related problems, has been designed and developed as part of a design science research project carried out and presented in this paper. According to the design science process described by Peffers et al. (2007), the designed and developed artefact (in this case the business and IT architecture model and its extension) needs to evaluated. In this paper, we will use an informed argument as the evaluation (Hevner et al., 2014). An informed argument is a weak form of evaluation since the researchers themselves argue for the fulfilments of the requirements on the artefact. Therefore, informed argument are often used as a type of evaluation when a new artefact is presented, as in our case.

The model, including its extension and the identified problems, is generic and aims to be applied to explain and analyze the impact of language technology in public organizations. The requirements defined for the artifact are that it needs to be understandable and applicable. Introducing two common requests types (general and formal), as well as a set of roles and typical IT systems, make it easy to discuss and describe a public organizations current way

of working. The problems related to the model makes it easy to understand why the presented business cases based on language technologies should be introduced. The extended model describes how language technologies can be used to fit a current business and IT architecture of a public organization. Thereby, the model can help public organizations to decide if they should apply language technologies or not.

For further research, we aim to use the model to survey the current business and IT architecture in public organizations in Sweden, and their interest for introducing language technologies, including identifying barriers for such an introduction. However, our first task is to evaluate the model in a more structured way, introducing it to both practitioners and researchers.

Acknowledgements

The IMAN2 project is partially funded by the Swedish Innovation Agency (Vinnova). The authors would like to thank the participants of the IMAN2 project, in particular the participating public organizations.

References

Cerratto-Pargman, T., Knutsson, O., Celikten, E., Sneiders, E., & Dalianis, E. (2011). *User centered development of automatic e-mail answering for the public sector. In new horizons in creative open software, multimedia, human factors and software engineering*. Springer, Berlin: LNCS.

Cordella, A., & Iannacci, F. (2010). Information systems in the public sector: the e-government enactment framework. *The Journal of Strategic Information Systems*, *19*(1), 52–66.

Coursey, D., & Norris, D. F. (2008). Models of e-government: are they correct? An empirical assessment. *Public Administration Review*, *68*(3), 523–536.

Dias, G. P., & Rafael, J. A. (2007). A simple model and a distributed architecture for realizing one-stop e-government. *Electronic Commerce Research and Applications*, *6*(1), 81–90.

Henkel, M., Perjons, E., & Zdravkovic, J. (2007). Towards guidelines for the evolution of E-service environments. *International Journal of Public Information Systems*, *3*, 183–200.

Henkel, M., Perjons, E., Sneiders, E., Karlgren, J., Boye, J., & Thelemyr, A. (2014). *Language technology for e-government – business cases*. pp. 83–95. *In new perspectives in information systems and technologies* (1) Springer International Publishing.

Henkel, M., Perjons, E., & Sneiders, E. (2016). A business and IT architecture model supporting public organizations introducing language technologies. In *Proceedings of the world conference on information systems and technologies (WorldCIST'16)*.

Hevner, A. R., March, S. T., & Park, J. (2014). Design science in information systems research. *MIS Q.*, *28*(1), 75–105.

Layne, K., & Lee, J. (2001). Developing fully functional E-government: a four stage model. *Government Information Quarterly*, *18*(2), 122–136.

Pang, B., & Lee, L. (2008). Opinion mining and sentiment analysis. *Foundations and Trends in Information Retrieval*, *2*(1–2), 1–135.

Parasuraman, V., Zeithaml, A., & Berry, L. (1988). SERVQUAL: a multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, *64*(1), 12–40.

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems*, *24*(3), 45–77.

Salhofer, P., & Ferbas, D. (2007). A pragmatic approach to the introduction of e-government. In *Proceedings of the 8th annual international conference on digital government research: bridging disciplines & domains* (pp. 183–189).

Wixom, B., Watson, H., Marjanovic, O., & Ariyachandra, T. (2010). Educating the next generation BI workforce. *International Journal of Business Intelligence*, *15*(3), 26–31.

Yildiz, M. (2007). E-government research: reviewing the literature, limitations, and ways forward. *Government Information Quarterly*, *24*(3), 646–665.