Supporting Workflow and Adaptive Case Management with Language Technologies

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Abstract. Public organizations handle many request from citizens, some are routine requests, while others are more complex. To support the handling of requests workflow management (WfM) systems and Adaptive Case Management (ACM) systems may be used. However, in order to be more efficient both WfM and ACM systems may be augmented with other technologies. In this paper, we examine how the use of language technologies can support WfM and ACM in the public sector. Based on a set of case studies from Swedish public organizations, we have identified a set of language technology use cases. Each use case is describing a potential application of language technologies in public organizations, and how these technologies can be used to support WfM as well as ACM approaches in these organizations.

Keywords: language technologies, public organizations, adaptive case management, workflow management systems.

1 Introduction

Public organizations have used workflow management (WfM) technologies as a way to improve the efficiency and response time managing citizens' request. In order to make use of such technologies, business processes of organizations need to be structured according to a set of workflows. A workflow is here defined as a set of activities structured according to a pre-defined order.

In this paper we are examining the use of language technologies as a novel type of technology for increasing efficiency and quality in public organizations. We define language technology as a collection of techniques for processing human language, including semantic techniques (e.g., natural language processing and information extraction) and statistical techniques (e.g., text retrieval and text mining), as well as a combination of these.

By combining language technology with WfM systems, public organizations can reduce processing time and the amount of manual labor. This is due to the structuring of workflows in the organizations, and the automations of certain activities using language technologies and WfM systems. As a result, resources can be used more efficiently in public organizations.

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However, public organizations also need to handle many requests that are non-standardized and knowledge intensive, meaning that public agents need to interact with each other and with the requesting citizen in order to manage the request. These requests are not well supported by traditional WfM approaches. Instead, adaptive case management (ACM) has been proposed as one way to deal with these kinds of requests [1], [2]. In contrast to WfM, ACM does not focus on following a strictly defined order of activities in a process; the focus is rather to support a knowledge worker to select and perform appropriate activities by providing well-structured information [1], [2]. More precisely, ACM is a management approach aiming at providing the knowledge worker with the required information at the right time, and supports the knowledge worker to continuously re-plan, for example as a result of handling frequent exceptions which is common in knowledge intensive processes. ACM can be characterized by a number of properties that affect how public organizations manage requests, including agents/personnel interaction and way of working, and system support needed. First, it is common that a team of public agents *interacts* to solve request, instead of a single agent carrying out each task, which is often the case in WfM [3], [2]. Second, agents are carrying out tasks on a *case-to case basis* based on the understanding of the situational context of a request, instead of carrying out a standardized set of actions. Third, the role of the citizens will be as a *co-creator* of the final outcome from a case, and not only as an initiator to the case. Thus, citizens can, together with the public agents, identify or design solutions that suites the problem at hand.

There is a need for IT system support for ACM, and such systems exists and are often categorized as ACM systems [4]. ACM systems can be combined with language technologies, especially when unstructured information [3], such as free text and speech, need to be managed.

The problem that we address in this paper is that it is unclear for business and IT managers in public organizations which language technologies exists; and how the use of these technologies may positively affect WfM and ACM.

Is this paper we provide practical examples of how language technologies can be used to support WfM as well as ACM. We structure the description into *use cases*. Each use case represents a type of language technology that public organization can use. To structure the use cases we describe the problem that each case solves, the employed technologies, and their effect on both ACM and WfM. To make the use cases concrete and easy to understand, illustrative real-world examples for each case are presented as well.

The use cases described in this paper are drawn from analysis of case management in Swedish public organizations. The analysis of case management and design of use cases were carried out as part of an ongoing research project, the IMAN2 project, described in next section. A full description of the state-of art regarding the language technologies use cases described in this paper can be found in our previous paper, [5], the novel contribution of this paper is the cases effect on WfC and ACM.

The paper is structured as follows: Section 2 describes the research project that was the base for identifying the use cases as well as the research methodology used. Section 3 presents the use cases. Section 4 contains a summary of the findings and Section 5 concludes the paper.

2 The IMAN2 Project

The use cases presented in this paper is the result of the IMAN2 project. The project is a collaboration between researchers in language technology at Stockholm university, Royal Instituite of Technology, Sweden, the business intelligence company Gavagai, the process improvement companies Visuera, and the IT consultant company Cybercom. Furthermore 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 three local governmental organizations, Kungsbacka, Söderhamns and Klippan municipalities.

The project's goal is to develop innovative e-government solutions for customer service and case management processes by the use of language technology. The public organizations participating in the project all have the need of a well-structured way of managing case management processes as well as general requests from citizens using language technology. In this paper we also include some experiences from a previous research project, IMAIL, in which the Swedish Social Security Agency participated.

The research methodology used in the research presented in this paper is design science research [6], [7]. Design science is carried out to change the state of affairs by designing and using an innovative artifact. Commonly, the design science process consists of several activities that lead to an artifact. We use the activities presented by Peffers et al [7]. To *identify current problems* and the *scope of a solution* we engaged the project participants in process modeling workshops, where existing business practices where discussed and problems identified. The next step in the research project was the *design and development of the solution* in form of use cases. With help from the consulting companies Cybercom and Visuera several use cases representing the problems in the organizations were created and documented [7]. In this paper we extend the use cases by differentiating their effect on WfM and ACM respectively. The result of this activity was the extended use cases as presented in this paper. Next, in order to *demonstrate* the utility of the use cases each case includes examples from the organizations participating in the project, each example illustrating how applying a use case could be carried out. Thus, the use cases are empirically grounded in public organizations, although not yet applied. As a last step, we are currently working on an evaluation of the use cases within the IMAN2 project.

3 Use Cases for Language Technologies

This section describes a set of use cases, each use case describing a possible use of language technologies in public organizations. The use cases can be used by business and IT managers in order to better understand what language technologies can be applied in their organizations, and how they affect WfM and ACM. We describe each case using the following template:

- *Use case & problem* - provides a short definition of the use case and the practical problem that can be solved by applying the use case.

- *Applicable technical solution* - provides a short definition of the applicable language technologies for the case and gives a brief overview of current research within the technology field.
- *Effects on workflow management* - describes the positive effects of the use case when using a WfM approach.
- *Effects on adaptive case management* - describes the positive effects of applying the use case when using an ACM approach.
- *Examples* – provides real-world examples where language technologies can be combined with WfM and ACM respectively. The examples are based on the process analysis and design of use cases carried out in context of the IMAN2 project, but in some cases also from the research project IMAIL.

Each subsequent section is describing a use case. In the end of the paper we present a summary of the use cases and conclusions.

3.1 Use Case A – Automatic Message Answering

Use Case and Problem: Automatic message answering is a use case in which citizens' requests for information are managed automatically by a system creating answers without human involvement. The answers created could be one, or many. The practical problem being tackled by this use case is that public organizations may receive a lot of questions from citizens, and these require a lot of resources to answer. The citizens may expect instant answer of high quality to the stated questions. However, citizens often need to wait one day or more to get an answer via mail, or need to wait in a telephone queue. Furthermore, depending on the skillset of the agent, the quality of the answer may vary.

Applicable Technical Solutions: Automatic message answering is making use of language technologies to lookup pre-specified responses to requests. The response can be either an answer to a question, or contain references to resources that help to manage the request. In domains dealing with a few subjects, automated FAQ retrieval has proved practical. Iwai et al. [8] make an observation that 30-40 % of an email flow addresses often reoccurring topics. FAQ retrieval can consists of statistical techniques, natural language processing and/or ontology-powered FAQ retrieval and template/text-pattern based techniques [9]. In [9] it is furthermore demonstrated that a system in a self-service environment can answer about 70 % of all questions with about 90% accuracy.

Effects on Workflow Management: Efficiency can be increased by swiftly responding to requests without any person being involved. This makes the solution ideal for handling large volumes of queries, which is often the case in WfM.

Effects on Adaptive Case Management: The quality can be increased by creating high-quality answers for the most common request. High-quality answers means legally correct answers and answers independent of individual agents' subjective opinions and level of expertise. The agent could also be presented with a set of pre-defined answers and be able to select among those. Furthermore, the agent can be given the possibility to combine pre-defined answers and/or in other way modify the answer before sending it.

Examples: The Swedish Social Security Agency get a large amount of emails asking questions about compensation for sickness leave, parental leave and so forth. A workflow-based pilot was therefore created. At Kungsbacka municipality the customer services are aiming at improved ACM as part of an initiative to create an improved first-line customer support. One possible solution discussed in the IMAN2 project is to provide the customer support personnel with several templates of pre-defined answers.

3.2 Use Case B – Case Routing

Use Case and Problem: Case routing is a use case in which a case is automatically routed by a system to the agents with the appropriate knowledge to handle the case. For large organizations it can be a problem to find the appropriate person/role to route a request to. This may require extensive knowledge about the organization and its capabilities. The person managing the routing of cases also needs to be informed when changes occur that affect the routing.

Applicable Technical Solution: Automatic case routing is the process of categorizing requests and based on a set of rules route the request to a receiving agent or group of agents. The categories used for classifying incoming request can swiftly be changed if needed. The categorization can both be based on meta-data, such as the field and values in the form used for the request, and on free text contained in the request. Document routing can be viewed as a task of text categorization, where a certain text category is routed to a certain role or employee. Hao et al. demonstrate classification accuracy above 90% for many text categories taken from Reuters-21578 corpus of news stories [10]. Often, however, "off-the-shelf" statistical text categorization methods demonstrate insufficient text categorization accuracy, which leads to a requirement to customize these methods.

Effect on Workflow Management: The use of case routing enables requests to be swiftly sent to the right agent within an organization. When implemented successfully a large set (typically 80 %) of the incoming request can be automatically routed, thus saving resources and lessening the burden on the expert personnel if needed to spend time managing routing of cases. Automation of case routing could lead to faster responses from the citizens' perspective.

Effect on Adaptive Case Management: Case routing allows the system to address a group of agents that can handle a request. For example, a case could be routed to a common shared space accessed by the group and which could be used for gathering information and documenting discussions regarding the case. Commonly the group should be a mix of different domain experts.

Example: The Swedish Transport Administration handles about 2000 written request per month according to a defined workflow. One possible use of automatic case routing would be to sift out the "small" cases that a single agent at the customer service can handle promptly. This would increase the throughput of the workflow.

The Swedish Transport Administration also handles larger projects, such as the creation of a new turnpike. The creation of a new turnpike could cause a lot of questions from the citizens that require the joint work from several experts in order to

be answered. If case routing is used, the questions could be routed to a shared space accessed by a group of agents that collaborate in similar cases.

3.3 Use Case C – Phone Call Summation

Use Case and Problem: Phone call summation is a use case in which a telephone conversation between a public agent and citizens or between employees is automatically transformed into a written summary by a system, thereby providing a documentation of the conversation in text form. The practical problem addressed with this use case is that nothing, or very little, is documented from telephone conversation. This can be an issue if another case officer gets involved, or if the case needs to be reviewed later on.

Applicable Technical Solution: A summation of phone call is providing a written summary of a conversation. The summary could both contain excerpts from the conversation as well as selected keywords. In recent years speech recognition technology has improved to the point where it is reasonable to expect a word error rate (WER) of less than 10% for dictation software out of the box, and around 1-5% after speaker adaptation. However, for call center applications, where the speech data is much noisier and displays a great variability of speaker style, dialect, age, caller's calling equipment, etc., it is reasonable to expect a WER of 33% or even up to 50% [11], [12]. For call summarization, standard text summarization techniques based on sentence selection are not immediately applicable because of the high WER usually obtained from call center speech data. Rather researchers have focused on call segmentation and extraction of topics and important phrases used in the call [13]. Such phrases and topic labels can be used as a succinct summary or classification of a call.

Effect on Workflow Management: By providing an automatic summary it is possible to drastically reduce the time spent documenting a conversation. Since the automatic summary is inexpensive, it is possible to document a large extent of the cases. Phone call summation can be an important part of documenting that certain activities in the workflow have been carried out, for liability issues.

Effects on Adaptive Case Management: Since, compared to a traditional WfM, ACM may not follow a main well-documented workflow it is important to document the conversations being carried out, both between public agents and citizens, and between the agents in joint conversations around the case. An advantage with this is that new public agents can join the group, and catch up on the case by reading the summarized conversations previously held.

Examples: The Swedish Pension Agency handles request via mail, e-mail and phone via a workflow management approach. For example, one type of case that the pension agency handles is applications for housing supplementary allowances. Particularly elderly people are inclined to ask questions via phone. 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 handling the requests. In the health care area it is common to gather different types of experts in a ward round, where the patient is discussed. This is an example of where a form of call summation could be applied and combined with ACM systems.

3.4 Use Case D – Competitive Intelligence Analysis

Use Case and Problem: Competitive intelligence analysis is a use case in which external information that affects an organization's activities is collected. This information is analyzed to make long-term strategic decisions and short-term resource allocations. The practical problem that this use case addresses is that both public and private organizations need to understand their external environment. For example, public organizations need to acquire some sense of what the mindsets, moods, and attitudes of the public opinion are, and to aggregate that information into actionable information for both strategy and immediate actions.

Applicable Technical Solution: Competitive intelligence analysis is the process of gathering external views and events in the environment which affect the activities of an organization. Analysis can be based on sources such as newspapers, TV, and radio channels, and on information from social media. There are numerous technical solutions that have been developed to monitor internet-scale feeds of information. These solutions can be divided into active and passive collection tools [14]. Active collection tools are targeting a specific question for a limited time, whereas passive collection tools target an ongoing information need. Two central technologies are clustering and linkaging [15]. Clustering is the process of grouping text documents into categories, while linkaging is the process to find connections, or links, between texts in different clusters. The result of using these tools can either be a list of relevant documents, or a summary of the frequencies in which certain key words occur.

Effect on Workflow: Competitive intelligence analysis does not fit well with a workflow based approach. The reason is that the purpose of the workflow is to achieve efficiency by standardization. Handling new, changed context is thus not the strength of the workflow approach. However, the output from the intelligence analysis can be used to change the design of a workflow.

Effect on Adaptive Case Management: By using competitive intelligence analysis, it is possible to get a constant feed of information concerning external views and events. Thereby, it is possible to discover upcoming problems, and to react early. For example, a group of experts that can deal with a problem could be gathered in order to act pro-actively.

Examples: The customer support at the Swedish Pensions Agency is highly dependent on its environment in the form of traditional and social media. For example, if a minister makes an announcement about desired changes in the pension system, the customer support will immediately get a lot of phone calls about how this will affect the individual pensioner. By the use of an environment 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 allocate the necessary group of experts in order to explain and communicate a certain message to the audience, for example via the web site of via traditional press and social media.

3.5 Use Case E – Sentiment Analysis

Use Case and Problem: Sentiment analysis is a use case in which customers' or citizens' views and sentiments are collected during the interaction with customers or citizens. The practical problem addressed by this use case is that traditional categorization using pre-defined categories, first, easily miss how, i.e. in which way, customers or citizens express values and opinions about offered services, and, secondly, easily miss important details in the cases that are not pre-categorized.

Applicable Technical Solution: Sentiment analysis is the process of identifying values and details in a customer interaction. These values and details are usually not considered using an ordinary case management system. The analysis can be performed automatically, for example based on mail, or manually. Sentiment analysis utilizes the same techniques as competitive intelligence analysis. Furthermore, sentiment analysis can make use of telephone call summation as it creates data for sentiment analysis. Note that existing technologies can support sentiment extraction from text that is aimed at expressing an opinion, such as reviews, but also from a more general text that is not focused on expressing an opinion, but still might do [16].

Effect for Workflow Management: Sentiment analysis does not fit well with a workflow based approach. However, by applying sentiment analysis, it is possible to get information about how customers view the organization and its products. Thereby, the organization and its case handling workflows can be adapted to become more customer oriented. Sentiment analysis is thus an instrument for business improvement, rather than aiming at improving a single case.

Effect for Adaptive Case Management: By using sentiment analysis combined with ACM it is possible to react and adapt the handling of the case as it progresses. Thus, sentiment analysis can strengthen the core of ACM by providing input to the adaptation during ongoing case.

Example: Klippan municipality is looking into how to further extract opinions from different forms of communication with the citizens to improve their workflows. Sentiments could also be used in the future to affects ongoing cases. For example, exploitation planning is adaptive in the sense that it is taking sentiments from many different parties into consideration. For example, some citizens can express anxiety when their surroundings drastically change.

4 Summary

Each of the presented use cases provides a possible use of language technologies and its impact on WfM and ACM. In Table 1, the use cases, and their effect on WfM and ACM approaches are summarized.

As stated in the introduction, traditional *WfM* focuses on a pre-defined order or activities. The use of language technologies can improve traditional WfM by increasing the efficiency and thereby throughput (use case A, B and C). Simply put the technologies can replace routine tasks. Language technologies can also be used to collect feedback into the re-design of traditional workflows (use case D & E).

In comparison to traditional WfM, *ACM* focuses on a number of experts that collaborate in a dynamic way to solve non-routine tasks involving the customer/citizen. ACM can be viewed as a process that takes place in "peoples head or through collaboration" [17], making it seemingly less structured. The role of language technologies in ACM is to provide grounds for starting a collaboration (use case A, B, D), support collaboration (use case C) and providing feedback on an ongoing case (case D).

Table 1. Language technology use case summary

Use case name	Effect on workflow	Effect on adaptive case management
A. Automatic Message Answering	Increase efficiency by swiftly and automatically responding to common, standardised, requests	Present an agent with a set of pre-defined answers that the agent can choose among, combine and/or modify
B. Case Routing	Increase efficiency by routing requests swiftly and automatically to the right agent that can start to handle the case	Select a group of agents that can start collaborate to solve a request
C. Phone Call Summation	Reduce the time spent on documenting the communication with citizens via phone by automatically summarize the communication	Document a summary of the interaction and joint work that case agents, as well as co-creating citizens, are contributing to the case
D. Competitive Intelligence Analysis	Use as a way of improving the *workflow design*	Discover upcoming problems for a public organiszation in order to pro-actively address the problems
E. Sentiment Analysis	Use as a way of improving the *workflow design*	Can be useful as a mean to react and adapt the handling of the case as it progresses, i.e., during *execution*

5 Conclusions

Public organizations are constantly trying to improve the way they work towards the citizens. While WfM systems provide excellent support for structured, standardized procedures, public organization also need to handle advanced requests that cannot be solved by following a strict workflow. ACM has been put forward as a solution to handling these requests. In this paper we have examined how both WfM and ACM can be supported by the use of language technologies. To make it easy for public organizations to discern how the use of language technologies can help them, we present a set of use cases. Each use case describes a certain language technology, what problem it solves, and how it can be applied to support both ACM and a more traditional WfM approach.

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