INCREASING THE EFFICIENCY AND QUALITY OF E-MAIL COMMUNICATION IN E-GOVERNMENT USING LANGUAGE TECHNOLOGY

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E-government includes electronic communication between citizens and governmental agencies. In the present on-going research project, we have focused on asynchronous communication that handling officers establish and maintain with citizens through the use of e-mail. In particular, we are designing and developing a language technology-based system to support communication that handling officers carry out at the Swedish Social Insurance Agency (SSIA). The SSIA receives about 10 000 e-mails per week from citizens. The e-mails are handled by handling officers distributed over four customer centers located in different parts of Sweden. The findings so far indicate that very frequent and simple questions can be answered by automatic means, and that text clustering can facilitate the process of semi-automatic answering of citizens' e-mails. Furthermore, we report on the use of interaction design methods applied from the beginning of the software development in the project.

Author Keywords: Language technology, e-mail, user involvement, user-centered design, automation

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1. Introduction

During the last decade, many countries have put a lot of efforts into developing and introducing electronic services in the public sector. Sweden, for example, together with USA and Denmark shared the top of the list of countries having adopted electronic services into the daily communication between citizens and governmental authorities [1]. Indeed, according to the Swedish government, public organizations are considered as precursors in the introduction and propagation of e-services and information into the society. In Sweden, it has been suggested that public authorities should be stimulated to develop "the 24hours authority". That is, the idea that public service and information should be available to the citizens at any time through the use of Information Technology. This vision of e-Government puts high demands on employees in particular. For example, Grundén [2], showed that implementation aspects of e-Government are closely interrelated with the competence and knowledge development of the public servants conducting their work with new electronic tools. Cajander & Ericsson [3] argues that e-Government may make public servants ill-healthy since they cannot affect their working situation since they are captured in the way their computer system are designed and therefore will not able to make creative solutions. Fully aware of these risks, our work intends to provide both, public servants and citizens with usable and quality-based language technology e-services.

Language technology (LT) is the base technology for our system, and LT includes all algorithms and tools that deal with human speech and writing [4]. The technology is based on analysis, filtering or generation of human language, but the applications are far more sophisticated and useful (e.g. machine translation, sentiment analysis, speech interfaces, search engines). LT has a potential not only to support human-machine interaction but also to support human-human interaction. There are several examples of the use of language technology in e-Government including for example e-mail classification for automatic routing to appropriate public servant [5]. A number of useful functions for e-Government using language technology are described in [6]. Further, LT can serve as an aid in rule-making processes [7], and in crime information extraction from narrative reports [8]. Scheffer [9] have analyzed incoming e-mails to an education provider, and he found that 42 percent of the incoming e-mails could be answered with nine different standard answers. In [10] there is a good overview on automatic e-mail answering.

The benefits of automated e-mail answers are several. From the point of view of the citizens, who contact the customer service, the main benefit is an immediate answer. An automated answer is, as a rule, well developed and reasonably complete. Furthermore, the answers are consistent, i.e., similar inquiries get the same answer, rather than each handling officer writes his or her own. Still, the main beneficiary of automated e-mail answering is the organization itself. First of all, computer generated answers to frequent inquiries allow saving manpower or reallocating it to solving more complex issues that do require human action. Further on, a minimized number of repeating trivial inquiries reduces stress and stress-related decrease of productivity among handling officers. Furthermore, automated answers help to channel the citizens who contact the organization to a preferred means of interaction, normally a self-service system. Finally, analysis of user queries reveals users' needs, helps to monitor their interests, and facilitates proactive reacting to the rising demand. The above benefits are common for both commercial and governmental entities. One important difference lies however in the public policies that should grant all social sectors of the society the right to access public information, and have the right to communicate with authorities independent of

any kind of disability. This means that accessibility for all is a specific and central issue when designing e-Government services [11,12].

In the IMAIL-project we have focused on the work that handling officers carry out at the Swedish Social Insurance Agency (SSIA)[6], and their strive to improve and facilitate e-mail communication between government and citizens. Although increasing efficiency has been one of the principal objectives that we aim at with the development of a prototype of an e-mail system, we acknowledge that the introduction of a new technology into the communication between citizens and governmental authorities is not only a matter of efficiency but also of power, trust, and safety [13]. In this sense, the issue guiding our work is: how can we improve the efficiency and quality of e-mail communication using language technology in an e-mail communication system, and how should this be done? And more in particular: 1) How should such a system be designed to support the handling officers in their work in the best way? 2) How can we use and develop language technology to assist the handling officers to capitalize on (reuse) and update the answers already sent? 3) How large amount of citizen questions can be answered automatically?

2. A Framework for E-mail Communication between Citizens and a Governmental Organization

In order to investigate the project's research questions, we started with a sketch of the e-mail flow integrating the handling officers and the tools based on language technology. Figure 1 shows an overview of the system that is developed in the IMAIL-project. The thick lines describe the current procedure; all incoming e-mails (queries) are answered manually by the handling officers. We introduce the E-mail interceptor to reduce the workload for the handling officers (see Section 4.2), as indicated by the thin lines. When incoming queries are recognized as common they are answered automatically with manually formulated answers, which will be the same for similar queries. The dotted lines represent the off-line part of the system. Handling officers can use text clustering to identify common queries (see Section 4.1). When a common query is identified the handling officers formulate suitable answers that can be sent as automatic responses by the E-mail interceptor. For each common query we also extract features that are used for recognition.

The dashed circle represents the workflow and interactions of the handling officers. In an ordinary setting (the thick lines in the picture) this would correspond to handle the incoming e-mails and formulate manual answers. This is typically achieved through the use of an e-mail client of some sort. In our expanded system it would also include interacting with the off-line part of the system (the dotted lines). This raises question about interaction design (see e.g. [14]), but also questions of the whole workflow combining manual and automatic processing of e-mails. We will explore these questions by user-centered design methods, and by an iterative design process involving the handling officers in every step towards a running demonstrator, which will be the end product of the research project.

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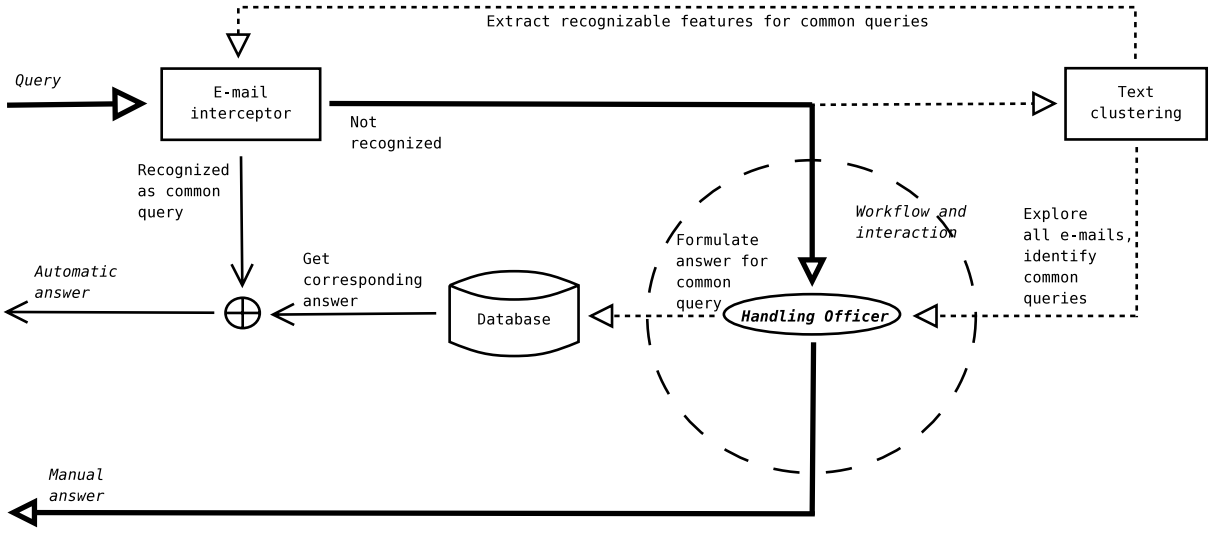

Figure 1. A system sketch. The thick lines describe all incoming e-mails (queries) answered manually by the handling officers. The thinner lines indicate the introduction of the E-mail interceptor, which reduces the work-load for the handling officers by automatically answering common queries. To find common queries and learn how to recognize them we use text clustering in the off-line part of the system, as indicated by the dotted lines. The dashed circle represents the workflow of the handling officers interacting with different modules of the system. See also Section 2.

3. User-Centered Design of the E-mail Communication System

User-centered design (see e.g. [15]) was the approach chosen for the development of the prototype of the e-mail communication system. This choice responds to our interest in developing and designing a language technology system based on handling officers' needs and wants, working routines, rules and specific legal aspects involved in the communication with citizens [16]. The approach of user-centered design consists of different methods that can be applied in design processes requiring different levels of user engagement. In this project we have so far involved the users, the handling officers, through three design workshops [17].

3.1 User-Centered Workshops at the Swedish Social Insurance Agency

We have focused on the work conducted by the handling officers working at the customer center of SSIA. This center receives 10 000 e-mails per week as well as many phone calls that are handled by more than 500 handling officers who are distributed over the country[7]. The handling officers have a large knowledge and expertise concerning what and how to answer citizens' questions. Nevertheless, they are in need of assistance to cope with the great amount of e-mails they receive daily, to allocate and coordinate their work better and, to capitalize and update their competence and knowledge on the domain of social insurance.

With the intention to study how to facilitate the handling officers' work in relation to their electronic communication with the citizens, we conducted three user-centered design workshops with four handling officers, one project leader and one language consultant at the SSIA. The objective of the workshops was to find out how language technology based services might support handling officers in their daily tasks.

[7] The handling officers also communicate with citizens face-to-face, via chat and paper mail.

The first workshop was a so-called future workshop [18]. Handling officers were invited to brainstorm on the design of a future system for e-mail communication at SSIA. The data collected during the workshop were analyzed and resulted into eight different design proposals. The design proposals were based on the handling officers' problems experienced with their current e-mail system, and on their expectations in relation with the integration of a system capable of providing automatic and semi-automatic answers to the citizens.

The second workshop aimed at producing paper-based prototypes of the e-mail system. In this sense, we provided the handling officers with the eight design proposal created after the first workshop so as they created their own sketches of the user interface, storyboards as well as scenarios of use of the e-mail system. Through the use of scenarios, storyboards and sketches, the handling officers working in pairs produced six different low-fidelity prototypes (i.e. paper-based user interfaces) representing the different design proposals.

The third workshop consisted of demonstrating the high-fidelity prototypes (see e.g. [14]) that, we, the research team had created from the low-fidelity prototypes produced by the handling officers. The purpose of the third workshop was to show the first steps of a digital design of the e-mail system, the first prototype of the E-mail interceptor (see 4.2), and introduce the handling officers to the use of text clustering techniques (see 4.1), which will be the theme of the forthcoming workshop.

Overall, the workshops confirmed the hypothesis that handling officers definitely need a system helping them to answer citizens' e-mails. More in particular, we found out that the handling officers need help finding correct answer templates, and support for creating and updating the collection of answer templates. They also welcome the idea of getting rid of frequent "short and easy" questions. In particular, these types of questions have answers that are either possible to retrieve from the website of the SSIA or have an uncontroversial answer. Although handling officers welcome the integration of an e-mail handling system, they expressed their concern about how the answers to the citizens should be designed and formulated. All the handling officers participating in the workshops agreed that messages sent by an automated e-mail answer service should clearly indicate that the information in such an e-mail has been sent by a machine. The automatic answers should also include a disclaimer and always provide citizens with a reference pointing at how to get in contact with a human.

4. Language Technology for E-mail Processing

The SSIA has kindly allowed us access to about 9 000 e-mails from citizen-government communications, on which we develop and evaluate our language technology tools. The language technology tools applied to these e-mails benefit from certain linguistic preprocessing, such as lemmatization, which we will not go into here. The most important preprocessing in this context is, however, brought about by ethical considerations. The e-mails from the citizens are very sensitive, containing information they may not want to be distributed outside the SSIA. We constructed a de-identification program, based on named entity tagging [4], which identify person names, phone numbers, locations etc. The SSIA applied this program to the e-mails before they handed them over to us.

4.1 Identifying Common Queries

Common queries in the incoming e-mails to SSIA could be identified by manual analysis. However, this is a time consuming process and considering that the types of common queries

may well change over time, it is thus a never-ending work. Automatic help in this is potentially very useful. Text clustering is a language technology method that extracts groups (clusters) of similar texts from a large set of texts (see e.g. [19]). It does not use any predefined categories. Cutting et. al. [20] describes text clustering used as an interactive exploration tool. A text set is clustered and presented to the user/explorer as a dynamic table of contents. For each cluster some important words and texts are shown to give the user a gist of its content. Interesting clusters can be re-clustered to give more fine-grained clusters. We propose using this on the incoming e-mails in order to help the handling officers to identify common queries. Exploration of the e-mails by means of text clustering is done off-line. It does not effect the usual query-response loop (with both manual and automatic answers), see Figure 1. It could be applied to any set of e-mails, such as all ever received, or only the most recent incoming. The later allows exploration of recent trends in the questions. If we remove the questions already handled by the E-mail interceptor other common/interesting queries may be found.

Apart from identifying sets of common queries suitable for automatic answers text clustering also provides an overview of the incoming questions that can be valuable in many respects. The individual handling officer may gain insights and the organization may find where resources are best put to use. It may also indicate where the other channels of communication (i.e. web pages) fail to serve the public. So far, we have done the clustering our selves, but we hope to include the handling officers in a future study, and investigate how useful they find it.

We have clustered the e-mails to several different numbers of clusters using the clustering tool Infomat[8], which allows for user interaction. In the process we sometimes excluded some of the e-mails that regarded certain topics to get a more detailed view. We also clustered them based on different parts of the e-mail threads [21]. We identified a number of common queries, or categories of questions that recurred several times: 1) When have you decided on my housing allowance? 2) I want a prognosis for my future pension. 3) I want to change the taxation on my pension. (To avoid tax residual). 4) When do I get the money? 5) How many days of parental benefits remain for my child? 6) Questions concerning child allowances. 7) Want a form (application form or otherwise). 8) Want a beneficiary certificate (used to get discounts). 9) Want a EU-card (entitles the holder to medical care in the EU). 10) A question in any language other than Swedish.

Text clustering generates groups of similar texts, in our case e-mails. The similarities may be on many different levels. The common questions/categories above indicate this. The E-mail interceptor may handle some of these, while others are harder. While categories 1 through 3 are rather precise, category 4 is precise in the question but not the subject (the reasons for getting money are many). Category 5 shares a problem with most of them: in order to answer it the automatic system needs access to private information, which is not acceptable as a rule. As the citizens can log on to the SSIA using an electronic identification system, a suitable answer to some of these are to urge them to do that, and get back if it does not answer their question. E-mails in category 6 are all related to child allowances but the actual questions vary a lot. Categories 7 through 9 are rather straightforward. Questions in foreign languages (10) are easily separated from the others and may be dealt with manually. To evaluate the other parts of our system we have manually annotated a part of the e-mails (see below), i.e. assigned them to one or several of these categories.

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[8] http://www.csc.kth.se/tcs/projects/infomat/infomat/

4.2 Automated E-mail Answering

As it is written in the previous section, SSIA's e-mail flow has clusters of messages with repeating inquiries, several of which can be answered similarly. Finding a predefined answer, if it exists, is a task that a computer can do. Answering a generic question (e.g., "How long does it take to process an application?") would be easy. More specific requests (e.g., "How much will my pension be if I retire in two years?") are less trivial. Fortunately, SSIA has a self-service system where a person can log in and interact with SSIA without any mediation of a handling officer. Hence, an automated answer can advise using the self-service system, where appropriate. During 1990s, plenty of research was carried out in case-based reasoning for help desk applications [22] as well as about private use of e-mail [23]. Automation of the e-mail answering process is still a largely unexplored area, but some recent research has been carried out [24, 25, 26].

From the users' point of view, we distinguish three approaches of how to implement automated e-mail answering. First, the system can scan the messages in the inbox of the handling officers, and attempt to answer them. If an answer is found, the system sends a reply message automatically without any human intervention. Second, the system can create a draft reply message that is reviewed and edited, if necessary, by a handling officer before it is sent out. Third, if the message is being sent through a web form as opposed to an e-mail client, the system can take up the initial dialogue with the citizen in order to answer the question or solve the problem without sending any message to the handling officer. We have developed a prototype for SSIA applying this third approach.

A citizen can contact a handling officer through a contact form on the SSIA's website. After the citizen submits the message, the system first tries to identify the questions and problem statements in the message and find standard answers, applying the technique in [25]. If the system cannot find any answer, it sends the message to manual processing by a handling officer. If, however, the system finds one or several answers, it displays them to the citizen and does not send the message any further. If the citizen is satisfied with the automated answers, the problem is solved immediately; the citizen saves time, and SSIA saves manpower that can be redirected to solving more difficult problems. If, however, the citizen is not satisfied with the automated reply, he or she has an opportunity to specify details in the original message and resubmit it. A resubmitted message is always sent to manual processing by a handling officer. Because the citizen has had an opportunity to specify details before resubmission, handling officers have more input for a more qualified answer.

5. Discussion and Future Research

The principal objectives in the development of our system were to automatically answer a large part of simple questions in the incoming e-mail flow, to improve the quality of the semi-automatic answers (i.e. answer templates), and finally, to change the workload for the handling officers. Our tentative results showed that the handling officers are willing to accept the system in their practice. Although these preliminary results are positive, we need to find out if the handling officers will really gain time using the new system once it is fully developed and integrated into their working practices. Another question that remains open is what types of citizens' requests that will be intercepted by the system and get an automatic or semiautomatic answer and finally, the broader question of how we should balance efficiency and quality when developing e-services based on language technology for the e-Government?

With the huge amount of e-mails arriving to SSIA every day, automatic methods are strongly needed in order to get overview and efficiency of the agency's e-mail communication. We have used text clustering to automatically find relevant groups of questions. Preliminary discussions with employees of the SSIA have led us to believe that the groups of e-mails with similar questions are in fact very representative. In the next step we will involve the handling officers in the interaction with the clustering tool. Through workshops we will study how they interact with it, and whether they benefit from it, or not. That is, if they can find common questions, formulate answers for these, and, generally, if they gain from the clustering as an overview. We have also manually annotated 3 500 e-mails of the 9 000 e-mails we have access to with regard to its contents into the ten types of common query categories (see above). This annotation work makes it possible for us to evaluate our developed system but also to use machine learning techniques to automatically classify e-mails. We would like to know how well the e-mails would be classified, and the results of these future experiments will hopefully be very useful in the next version of our system. We will also evaluate the prototype E-mail interceptor on our manually annotated e-mails in order to find out the amount of e-mails from the total e-mail flow that can be answered automatically.

So far, there has been very little research carried out on how semi-automated answers can help handling officers working at customer centers. More studies from the perspectives of human-computer interaction and knowledge management will certainly benefit the study of the implementation of semi-automated answers in e-Government settings. Furthermore, we need to investigate how the receivers of automated answers perceive these answers; do they find them helpful (quick response) or discouraging (standard answers or references to self-service). We have so far only involved the governmental side of the e-mail communication flow, but of course the receivers of the automatic and semi-automatic answers are also very important for the design of the whole system.

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