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Application of Business Process Management to drive the deployment of a speech recognition system in a healthcare organization

María José GONZÁLEZ SÁNCHEZ[a, 1], José Manuel FRAMIÑÁN TORRES[b,] Carlos Luis PARRA CALDERÓN [a], Juan Antonio DEL RÍO ORTEGA[a], Eduardo VIGIL MARTÍN[a], Jaime NIETO CERVERA[a]
[a] *'Virgen del Rocío' University Hospitals. Seville. Spain.*
[b] *School of Engineering. University of Seville. Seville. Spain*

Abstract. We present a methodology based on Business Process Management to guide the development of a speech recognition system in a hospital in Spain. The methodology eases the deployment of the system by 1) involving the clinical staff in the process, 2) providing the IT professionals with a description of the process and its requirements, 3) assessing advantages and disadvantages of the speech recognition system, as well as its impact in the organisation, and 4) help reorganising the healthcare process before implementing the new technology in order to identify how it can better contribute to the overall objective of the organisation.

Keywords. Human Interfaces, Speech Recognition, User interfaces, User-computer interface.

1. Introduction

It is well-known that healthcare practice produce large amounts of documentation. Researches conducted by the American Medical Industry Transcription Association in 2006 and by the Giga Information Group in 2004 estimate that around 12.000 millions dollars a year are spent in transcription of medical report only in the USA [1;2]. The process of dictating and transcribing these reports and delivering them through the hospital and to patients is a slow and troublesome task. Nowadays, the most generalized way to fill these reports is the following: the doctor records an audio tape that it is transcribed by administrative staff. The doctor, who revises and signs it, then examines the output of this transcription. In this way, it can take several days to

[1] Corresponding address: María José González, Grupo de Investigación y Desarrollo Tecnológico, Hospitales Universitarios "Virgen del Rocío". Avenida Manuel Siurot, s/n. Edificio Documentación Clínica Avanzada. CP: 41013. Sevilla. España; E-mail: mjose.gonzalez.exts@juntadeandalucia.es

complete the medical reports, which may delay patients' treatment. This problem is becoming more critical due to several factors, including the following:

- The aging of the population, since a bigger amount of reports, tests and treatments are required[3] , and
- the increasing need of having electronic documentation that can be shared [3]. Medical practitioners need to get the patient information in an immediate and exact way to ensure optimal results [2].

To solve this problem, speech recognition systems have been proposed as a new technology able to automate the capture of the information, thus allowing its distribution in a nearly immediate way. Speech recognition systems can eliminate problems derived from transcriptions, the verbal communication, or communication through manuscript notes between professionals [1-12].

The implementation of speech recognition systems may imply an important reorganization of the resources in the hospital, as it serves to reduce or eliminate subcontracting external services and to release the internal administrative staff of the tedious tasks of typing [2; 11]. To carry out this implementation, a description on the way that doctors conduct their work and their technical needs is required in order to adapt the technology to their environment. Every Medical Unit may work in a different way and every doctor acts according to his/her experience, knowledge and habits, therefore the elicitation of these processes is very difficult, particularly for the non-medical staff in charge of the deployment of the speech recognition system.

To overcome these difficulties, in this paper we propose the application of Business Process Management (BPM) techniques. BPM aims to improving the efficiency of a system by means of modelling, automating, to integrating, and optimizing business processes in a continuous manner. There are several goals behind BPM, including creating new and better processes, understanding what is done well or badly, process automation, and creating and supporting value chains [13; 14; 15].

The first step in BPM is modelling the processes, i.e. developing a formal description of a system and the activities carried out (the so-called 'as-is' process). By modelling the process, the existing interrelationships among different activities, events, stakeholders and resources are depicted so existing problems can be identified and possible improvements can be suggested. Next, a model incorporating these improvements (the so-called 'to-be' model) is built. The construction of the 'to-be' model allows analysing its potential advantages with respect to the 'as-is' model by means of discussions with stakeholders in the process, discrete-event simulation, etc. so an 'a priori' evaluation of the model can be conducted [16].

In industry, BPM is regarded as a very efficient tool, ensuring the success in a high percentage of the companies and organizations where it has been used [17]. BPM capabilities will enable care delivery organizations to improve efficiency and reduce medical errors [16]. Although not very known in the health care domain prior to 2001 [18], nowadays there are well-documented applications, such as e.g. the choice by the Veterans Health Administration (VHA) of a BPM platform as its technology solution for Case Management of VHA Benefits Eligibility.

This paper describes the experience of the application of BPM within the development of the VOZENEC (*VOZ EN Estación Clínica* – Voice in a Clinical Station) project. This project consists on the deployment and integration of a speech recognition system to convert speech to text within the Hospitales Universitarios 'Virgen del Rocío', the largest hospital in Andalusia, Spain. Several pilot Units were

selected for the project, i.e. Radiology and Pathological Anatomy, Respiratory Diseases Unit, Plastic and Reconstructive Surgery Unit, and Endocrinology and Nutrition Unit.

The rest of the paper is organised as follows: next we summarize the methodology and describe the output of our experience, focusing on the benefits gained by the application of the BPM methodology. We conclude presenting areas for future work.

2. Methods

The methodology adopted for process modelling is taken from ARIS (ARchitecture of Integrated Systems). The choice of the ARIS methodology has been based on a previous analysis of the existing methodologies for business process modelling, being this one the methodology that more closely feels the needs presented in the healthcare processes. Among them, it is worth to note the fact that it allows the description of both the processes that specify each activity and the underlying processes structure, the flow of objects and its relations [21].

The core of the methodology consists on the following phases:

1. Process definition: In this phase, the healthcare processes to be studied are established together with a definition of its limits, inputs and outputs, Units involved in the execution of the processes, selection of the staff in charge of assisting during the modelling process and in the validation of the models.
2. Building static 'as-is' models: The output of the phase is a detailed graphical representation of the process in terms of a formal modelling language named Event-driven Process Chains or EPCs. In our case, it refers to the processes before the implementation of the speech recognition. The 'as-is' models were obtained through an iterative process of design and verification until their validation by the staff in the different Units.
3. Building dynamic 'as-is' models: By extracting data from the Hospital Information systems data as well as data provided by the staff in the different Units, discrete-event simulation models of the 'as-is' processes have been built. The results of the simulations have been analysed and validated by the staff.
4. Building 'to-be' models: In our case, it consists on the expected final state after the implementation of the speech recognition system. These models can be simulated so the impact of the technology in the process can be evaluated, thus allowing detection of potential problems, estimation of benefits and disadvantages, identification of new activities that should be improved in the future, etc.

3. Results

Several advantages have been identified by driving the deployment of the speech recognition system by the BPM methodology discussed in the previous section. We group them into three types:

- Development of the to-be model. By involving the key staff within the units in the modelling processes (see steps 2 and 3 in the previous section), they have now a clear picture of all relevant processes in the unit, not only of those under their direct responsibility. As a result, they gained a bigger knowledge of the clinical practice in their units and they were able to detect points for

future improvements they were not aware previously. This is a widely-discussed characteristic of BPM of particular interest in the healthcare sector, as the strong specialization of the clinical staff has lead to the fragmentation of the healthcare processes into small areas of responsibility where (local) improvements may not be reflected in the (global) process. As a result, some practices have changed in view of the implementation of the speech recognition system. For instance, in the Pathological Anatomy Service, the macroscopic report used to be sent to the pathologist's consulting room while waiting for the laboratory's results. In the new process, the report is sent to the laboratory together with the specimens. When the results are obtained from the laboratory, then both the report and the results are sent to the corresponding pathologist for diagnosis. With this organizational change, administrative (non-value added) time has been saved with respect to the previous situation. Also, by means of the study and modeling of Macroscopic processes in the Service of Pathological Anatomy it is chosen to use digital tape recorders instead of using microphones connected to PCs, as the hands of the staff were occupied for most of the time.

- A priori evaluation of the new technology. The BPM methodology employed here has served to make an a priori assessment of the technology to be implemented regarding both time and cost. By simulating the processes and analyzing the output, important time reductions regarding document generation have been anticipated. For instance, the time reduction in document generation was estimated to be about 89% with respect to the previous situation in the Endocrinology and Nutrition Unit. These estimations proved to be fairly accurate when the technology was implemented, as well as the costs reductions estimated by the simulation of the processes.
- Finally, process modeling has eased the deployment of the speech recognition system in the different Units, as the documentation and analysis of the process gained through process modeling have made the IT professionals in charge of the implementation of the speech recognition system to exactly know the requirements and daily practices of the medical practitioners, thus reducing both the time for deployment and its degree of success. Also, a number of documents and templates have been obtained, being the most relevant a reference model of the BPM methodology so its different phases are described, as well as the participants implied in the different stages. Finally, a glossary of terms has been developed. Both the reference model and the glossary have been validated and tested through practice, so they constitute useful tools to help deploying more efficiently the speech recognition system in the rest of the units in the hospital

4. Conclusions

A speech recognition system allows reducing the time devoted to transcribing the reports, and thus the time to complete the whole healthcare process from the patient's viewpoint may be accelerated. It also serves to automate and to centralize the process of documentary generation [1; 2; 4-8; 11; 12; 16; 17], which in turns facilitate the use of Electronic Clinical Records. On the other hand, a speech recognition system involves the introduction of a new technology in an organization, which it turn may

imply an important reorganization of the resources in the hospital, as it serves to reduce or eliminate subcontracting external services and to release the internal administrative staff of the tedious tasks of typing [2; 11]. In order to efficiently cope with the organisational change required by the implementation of such a system, we suggest a methodology based on BPM. The proposed methodology is general in the sense that it can be employed for evaluating and driving the deployment of any kind of Information Technology. The results show that the application of this methodology has been useful and beneficial, and we have been able to fulfil the aforementioned needs. In addition, we must highlight the satisfaction of the clinical staff in the Units, who have gained a comprehensive knowledge of their units via their involvement in helping to model the processes.

The experience and positive results obtained in this project have revealed a number of issues worth of further research. One of the most prominent is the possibility of applying this technology to facilitate the procedure of codification of the Electronic Patient Records, i.e. to develop a system that could codify automatically the clinical information that is generated from the interface of the speech of Clinical Station. The BPM proposed methodology could be used then to identify the requirements posed by the different actors in the process.

5. References

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