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Improving telemedicine processes via BPM

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Abstract

BPM is an emerging theme that plays an important role in the global market of Business Processes. An efficient Management of Business Processes is able to ensure the requested development and competitiveness. A company which will be based on Business Process Management will provide a climate favoring the cooperation of its employees; they will be engaged in realizing well-defined tasks leading to an effective achievement of its objectives.
Although telemedicine is an emerging successful field, it still suffers from problems of understanding, lack of techniques and legal texts and huge costs, and is still rarely used especially in Tunisia. Hence, the importance of process modeling and discovery of relevant technological means facilitating their use and automation. In this work, we designed, developed and tested a solution deploying Teleconsulting Process and remote diagnosis through a BPMS (Business Process Management System) that ensures their automation based on BPMN 2.0 models.

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Keywords: Business Process; BPM; BPMN 2.0; Telemedicine; automation;

1. Introduction

Telemedicine is a particularly useful way to optimize the quality of care by rapid medical exchanges for the benefit of patients whose state of health requires an appropriate response, fast, regardless to their geographic location. Telemedicine is likely to be an important factor for improving the performance of our health system.

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Its use in many countries is in fact a response to organizational and technical epidemiological (aging population, increasing number of patients with chronic diseases and polypathologies), demographic (unequal distribution of professionals in the country), and economic challenges (budgetary constraints) facing the health care system today. In this research, we rely on the approach of Business Process Management to show that it is possible in the context of telemedicine to exploit business process automation in the field of health as it has been proven in other areas, in order to maximize customer satisfaction (doctors and patients) with better management of care processes. We suggest a system of Business Process Management which is able to automate the process of care of Telemedicine to better serve actors. The remainder of this paper is organized as follows: In Section 2, we present the importance of Business Process in enterprises. Description of BPM is introduced in section 3. In section 4, we describe telemedicine. Section 5 provides our context of work. In section 6, we describe our proposed approach: the model of care process and the main features of the developed prototype. Section 7 gives an idea on the way in which we have experimented our approach. Finally, we conclude in section 8 and give some future perspectives.

2. Business Processes of the enterprise

Organizations often have to change their processes at higher or lower frequencies, in order to improve and make them more efficient. Business Process Management has become essential in these times because we cannot afford to have heavier and less agile process without losing any competitiveness [1]. The risk increases even more when the processes are common and horizontal to several departments, and this transversality prevents to act quickly and effectively on the problems it causes.
Introducing an application of Business Process Management can be an opportunity to act directly on these processes and to make a radical change. It has as objective, to reposition the stakeholders and to insure monitoring and control relying on indicators integrated into various parts of the existing information system. Man has always sought to reduce his efforts while producing goods or services. Economists and researchers in management focused on specific issues of the company and its output of capital by improving productivity through the transformation of productivity to industrial production [2]. Given the importance of the place of Business Processes in the organization, the implementation of an approach based to Business Process Management becomes a required intervention within organizations.

3. BPM

Business Process Management deals with the engineering cycle of business processes addressing the business issues of effectiveness (or unnecessary redundant steps, uncertain time bottlenecks) control (who controls and is responsible for the process) and transparency (ability to follow processes) [3]. Thus, a broad definition would be "BPM is the discipline that provides all the methods, tools and technologies to improve efficiency, traceability and agility of business processes where there is collaboration between systems, software, people, customers, suppliers and partners ... BPM addresses the engineering cycle process."
BPM suites, as a support for the process, provide the ability to **model** and **design** processes through a modeling environment; **execute** processes via a Framework based on a business rules engine that governs the behavior of the process which is established by users. Interactions with other systems such as web services or databases of the company are also possible. Manual activities can also be included in case it is unable to automate. Thus BPM suites can simultaneously control and **monitor** process performance through statistics and measures rendered as dashboards. These are usually indicators that provide information on the cycle time of the process, the default rate of production and productivity. They also offer the possibility to **analyze** and **optimize** the processes, for example by detecting and eliminating bottlenecks and reducing time while performing tasks [1].
In summary, BPM enables organizations to continuously monitor and offers continuous processes to increase operational efficiency. BPM, by definition, requires that companies review their processes and workflow to manage and deliver continuous improvement in their operations. This improvement is achieved by improving

the coupling of processes and management approaches with tools that automate the management of the implementation process by defining and generating applications of support.
BPM is a new approach supporting technologies that provide operational flexibility and sustainable optimization. The benefits of BPM can be split into five categories:
- First, the understanding of the business transaction and the rules that govern the activity is improved;
- Secondly operational efficiency is improved and costs are reduced;
- Third, consistency of operation and better quality are obtained;
- Fourth, operational flexibility for the rapid and continuous change will provide optimization;
- Finally, performance and reporting are improved.

4. Telemedicine

In recent years, there has been rapid growth of the use of IT in the health sector. These technologies were introduced to support major restructurings of health system in the world. They concerned changes in the process of care and care services offered to the population. The term Telemedicine was introduced by Thomas BIRD in the 70s and designated "A delivery of healthcare and exchange of healthcare information in a distant way" [4]. Telemedicine is the remote provision of health care services through information technology and communication in situations where the healthcare professional and the patient (or two health professionals) are not physically present at the same place.
Telemedicine provides an important improvement in the supervision of patients. Moreover, it represents the contribution of a new technology that combines a sharing of knowledge between health professionals, sharing of biological radiological and ultrasound data. It prevents the transportation of patients between hospitals and allows their monitoring without moving them, promotes dialogue between practitioners in charge of these patients in their health problem [5].

5. Context

Given the competitiveness, rapid advancement and especially the expansion of communication techniques and new technologies in all areas of life as well as the effectiveness of BPM tools to automate and better manage business processes of organizations, we are interested specifically in this work in the health field, since there was no work until now that has applied BPM in this field. Health care is a vital area that affects everyone. The number of health institutions increases and the competition among institutions is growing at a very fast speed. This is why the introduction of a change is needed to give better satisfaction to customers, patients, doctors and health workers. We will try to confirm the contribution of BPM in the field of health by improving the various corresponding business processes.
Indeed, health care facilities are now required to change their processes to better satisfy their customers and offer them more efficient and better services and to integrate the benefits of ICT which are imposed in all areas [6]. Today we talk about telehealth [7], patient E_dossier [8], telemedicine and medical informatics in general [6]. Telemedicine is thus, a new field of medicine enabling to improve medicine by using information and communication technologies. It is an emerging technology in the field of health care, and it is a technology which has enormous potential to help health systems to meet the challenges of today which are: the demands of an aging population, increased long-term illnesses such as diabetes, lack of health professionals, and health care costs which are becoming higher and higher. An effort to modeling telemedicine process was made in earlier work [9] and [6].
On one hand the importance of BPM as an effective means for management and automation of business processes, and on the other hand the major challenges must now answer telemedicine, that’s why we try to answer the following questions: Which means are adapted for the automation of telemedicine? What would be the benefits of adopting the BPM process in the case of telemedicine? And what specific processes for telemedicine and how do they influence the corresponding BPM? Moreover, in our work, we aim to improve the implementation of telemedicine processes: Teleconsulting process and diagnostics process, etc...

6. Proposed approach

Given the benefits offered by BPM in automation and better management of the heart of any organization, it's used in several areas as already mentioned before, except health field particularly telemedicine. This is why the introduction of a change is needed to give better satisfaction to patients, doctors and health workers.
In fact, the approach proposed in this paper consists in adopting the BPM approach for managing telemedicine processes. More precisely, our approach: First takes into consideration the modeling of telemedicine processes with BPMN notation. Then these models are deployed with the use of a BPMS (Business Process Management System), in order to obtain executable telemedicine processes.
Health care need the ability to respond quickly to evolving customer demands or environmental threats with new products and services and to enable planned changes to their business strategies quickly. In this context, BPM can be a business agility enabler and a BPM implementation may include the following capabilities: modeling, business rules, business data, business analytics, collaboration, human interfaces, business events, business activity monitoring, content, compliance, security, and system integration.
By adopting such an approach, our processes will be automated and will involve all the concerned actors. We have succeeded to modeling, deploying and running two care processes: Teleconsulting process and Teleradiology process. In current work, we resent only the adopting of BPM to Teleconsulting process. In next sections, we will present more details about our proposed approach.

6.1 Modeling of care processes

The modeling activity is primarily an activity of the brain [10]. The meta-models, frameworks and methods are defined in this spirit. A process modeling tool, is software which allows to representing and organizing the Business Processes of a company. It has a graphical part to represent the diagram and a textual part to describe the graph and the associated data. The objective is to ensure that general tasks are described in one way and it is reused in multiple locations in order to facilitate updates. In our work, we choose to model in BPMN 2.0 Business Process Modeling Notation Version 2.0.
While business processes are, by definition, focused on activities, a process model in BPMN 2.0 can represent the data exchanged and the interactions between the various actors etc...We have chosen to model the processes of care in BPMN 2.0. In addition, the BPMN 2.0 models are now used to be directly deployed and runned. There are five main applications of telemedicine: Teleconsulting, telemonitoring, distance learning, Telestaff and Teleradiology (remote diagnostics and tele-expertise).
In this work, we are interested in Teleconsulting and Teleradiology (the case of diagnosis). The BPMS which is selected is Activiti from Alfresco. This BPMS provides models by using Eclipse Indigo with plug-in Activiti Designer BPMN 2.0. The modeling of these processes of care is described in the following two paragraphs.

6.2 Modeling of the Teleconsulting process

Teleconsulting process consists in examining a patient or analyzing data about a patient without direct physical interaction via a distant system. Its indications are varied: advice request, diagnosis or therapeutic advice to a colleague, organization of emergency management with guidance and transfer of the patient to the appropriate service, primary care in a place where there is no doctor (ships, aircraft).
The expected product of Teleconsulting is an improvement of medical decision making process and, consequently, the quality of health care offered to patients. In figure 1, we present the modeling of the Teleconsulting process according to the BPMN 2.0 notation:

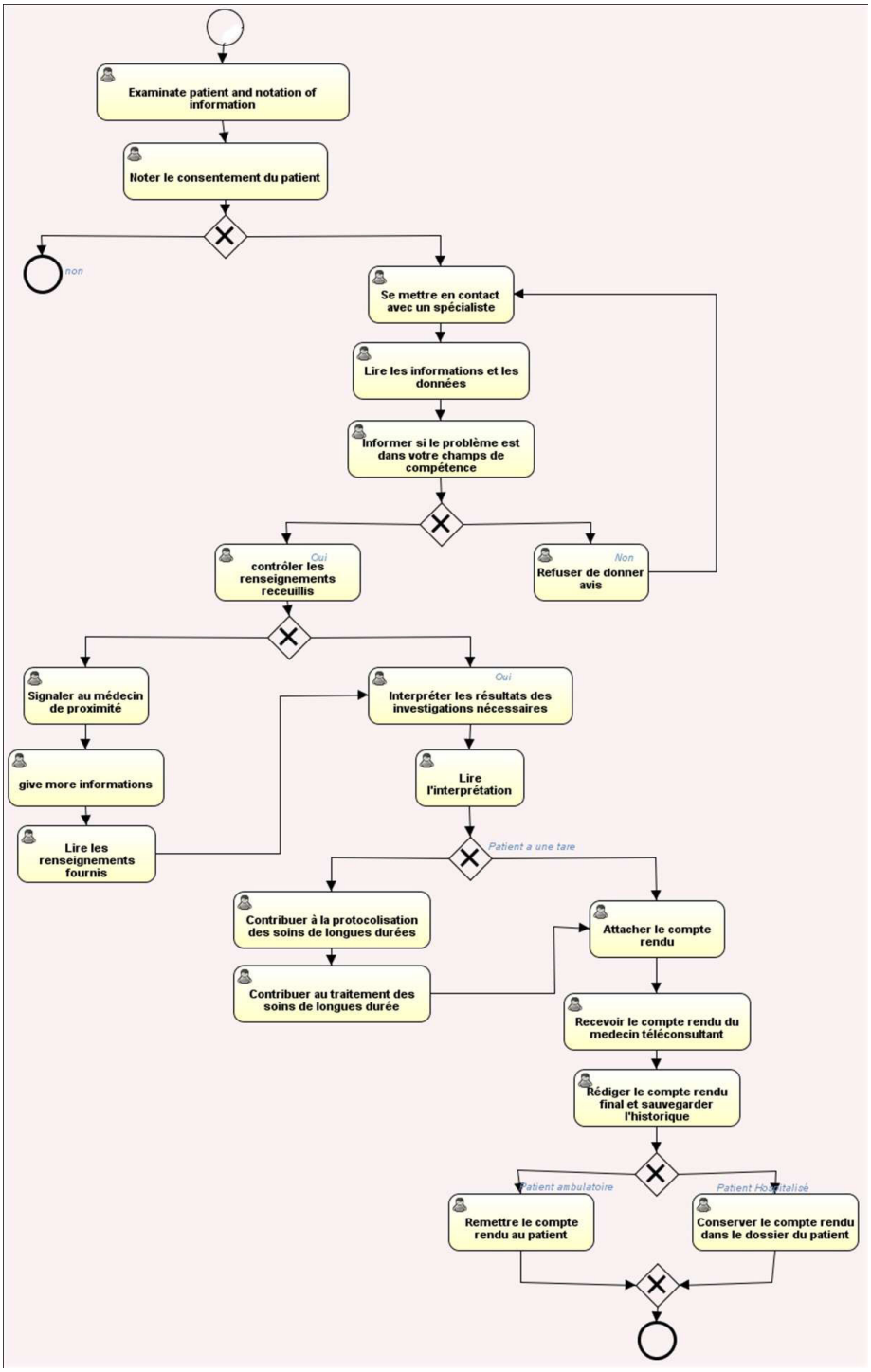

Fig.1 BPMN 2.0 Model of Teleconsulting Process

6.3 Modeling of the Teleradiology Process: Case of diagnosis

This process is an act of Teleradiology performed remotely or through a scheduled activity. It is achieved through continuity of care [11]. It allows a non radiologist to practitioner to obtain from another doctor an interpreting of an imaging study [9]. In the diagnosis there will be involvement of three parties: remote Radiologist, local doctor and electro radiology manipulator technician.
The modeling, implementation and deployment of this process have also been successfully done in the same way as the Teleconsulting process.

6.4 Main features of Developed prototype

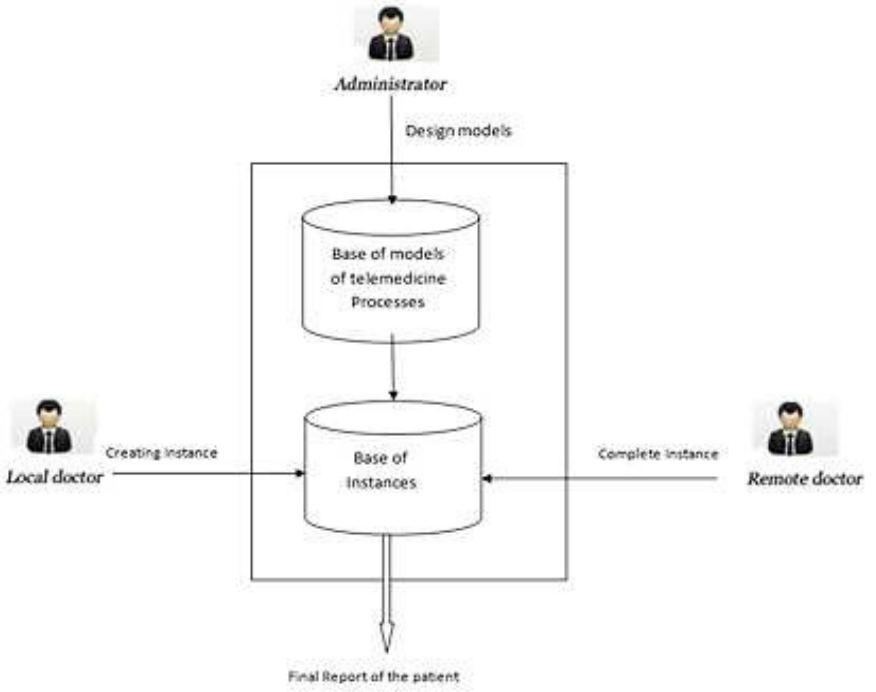

Fig.2 Features of developed prototype

We present in figure 2 a schema illustrating the way in which actors are involved and the major offered features of the developed prototype. In fact, the administrator starts with the design and modeling of BPMN 2.0 models which will be stored in the base of models of telemedicine processes.
After deployment of Activiti Explorer model, the local doctor will start the process by creating an instance that will be completed with another remote doctor. He can access to instances of data and give his opinion. The expected result of this care process is the preparation of a final report for the patient.

7. Experimentation of the proposed approach

Teleconsulting scenario designed in Section 6.2 was successfully experimented by two doctors using our BPMS. In fact, after designing telemedicine processes: Teleconsulting and Teleradiology, we developed a BPM solution in Activiti from Alfresco Environment, and also in Activiti Explorer runtime. The Teleconsulting process starts by the use of proposing and getting the approval for Teleconsultation from the patient. After that the local doctor records clinical information and consent from the patient. This is shown in

figure 3 which describes the interaction between local doctor and remote doctor.

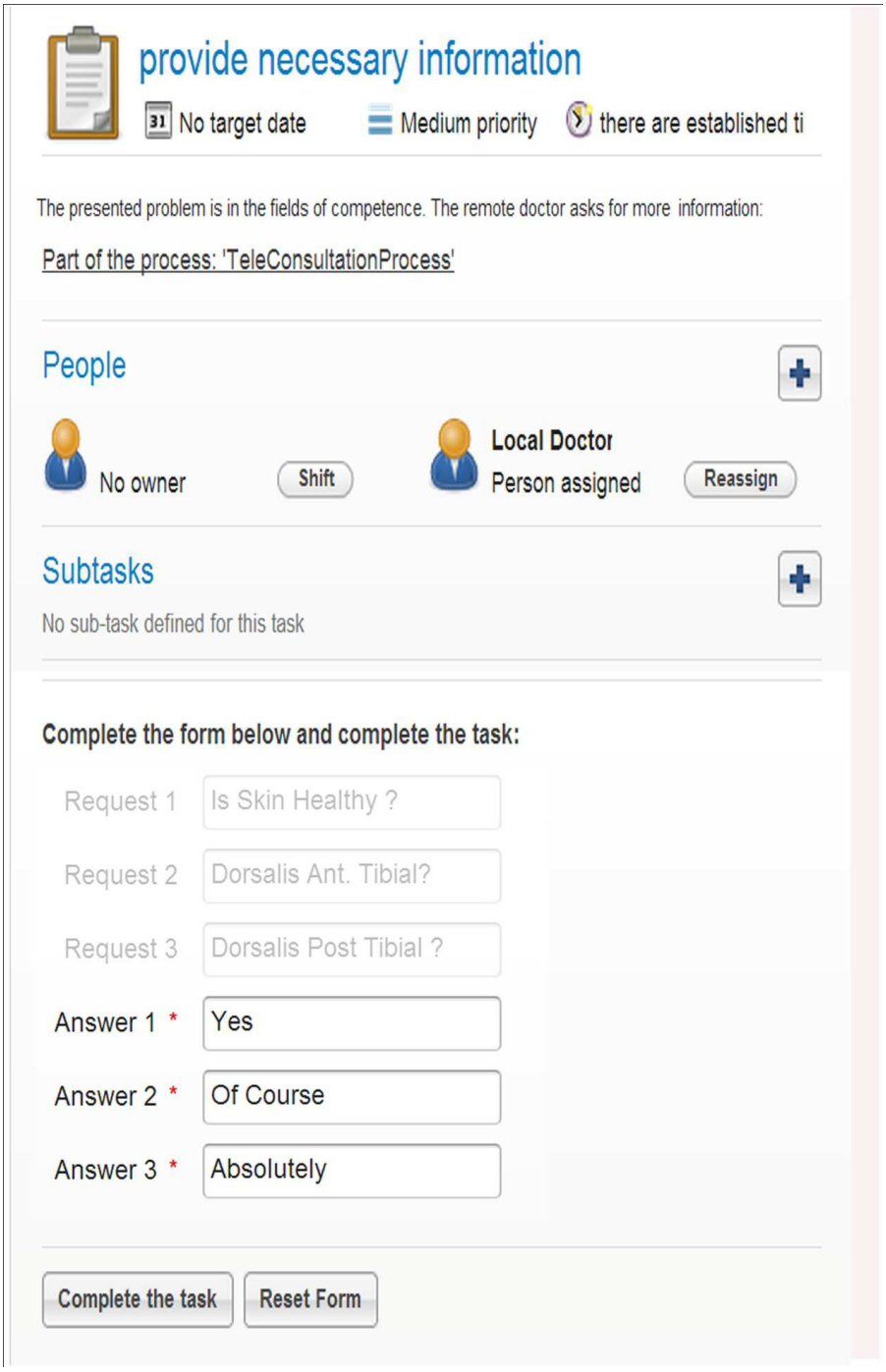

Fig.3 Interaction between doctors

Other interfaces are offered in order to support the interaction between the local and the distant doctors and to allow them collaborating and discussing the considered health case of the patient.

8. Conclusion and perspectives

Business Process Management BPM appeared a few years ago, to provide a concrete and relevant approach for business transformation of the company. Faced with the continuous quest for productivity and the missing of overall vision between different processes leading to placing a new product on the market, companies are increasingly using computer tools. To support the company in its reorganization and its continual attempts to adapt, streamline and optimize Business Processes to better meet the changing needs of its customers first, and secondly to manage competitiveness among organizations, the introduction of a change is needed to give better satisfaction to end users. In the life cycle of BPM, modeling and execution are two essential steps that affect the entire life cycle of Business Processes.

We confirmed the contribution of BPM in the field of health by improving and implementing various relevant business processes. Our objectives in this study were firstly to have a better overview of the whole process of telemedicine. On the other hand, we targeted to optimize the interactions between the actors of these processes. And finally, Telemedicine process automation was another objective of this research. We have deployed both Teleconsulting process and remote diagnosis and, we have experienced the Teleconsulting process. In addition, the opinion of experts in the field of health allowed us to improve our contribution.

Our work has provided a better management of care processes. We aim its implementation in health facilities after the agreement of the government. In addition, this work is open to a number of research perspectives. The first perspective is to model and implement other telemedicine processes such as remote supervision. A second perspective is to examine the contribution of architectures like SOA (Service Oriented Architecture) to improve the solution. Moreover, the event logs stored in the adopted BPMS gave us the idea of using Process Mining in order to extract knowledge from these logs and better manage the telemedicine processes. Finally, in order to validate our solution and prove that it really allowed improving the considered processes, we should refer to BPM metrics, and do some comparisons between implemented processes and those that don’t use BPMS. Such comparisons should be carried out by consulting doctors and other involved actors.

References

[1] Lamine GHEMATI, Guide pour implémenter un outil BPM: une opportunité pour reconfigurer ses processus métiers, Université Paris 10 Nanterre, MIAGE Agilité des SI & E-business 2010.
[2] Patrice Briol, Ingénierie des processus métiers : De l’élaboration à l’exploitation, ISBN 978-1-4092-0040-6 2008.
[3] Xavier Godefroy, Rapport sur le BPM : Urbanisation et architecture des SI, CNAM cours NFE107, 2009.
[4] R. Wooton and J. Craig, Introduction to Telemedicine London, Royal Society of Medicine, 1999.
[5] Cécile RENSON, La télémédecine : ses avantages et ses limites, 2010.
[6] Sonia Ayachi Ghannouchi and Slah-Eddine Ghannouchi, Une expérience de BPR dans un hôpital tunisien, 2008.
[7] Carole Absil, Télémédecine: des soins de santé, de qualité, partout Agoria E Health Version 4.
[8] Taha Zaghdoudi, Intervention de l'Etat dans le domaine sanitaire et le rôle du dossier médical dans la gestion des malades, 2004.
[9] Maha Chebil, Sonia Ayachi-Ghannouchi and Slah-Eddine Ghannouchi, Vers une meilleure compréhension des processus de télémédecine E-MEDISYS 2008, E-Medical Systems 2008.
[10] Michael Ferrari, La conception artistique d'un référentiel d'entreprise, 2009.
[11] PRT Projet Régional de santé d’Alsace, Programme regional de télémédecine 2012-2016, 2011.