

# Research Worker Tasks Modeling for Hospital Processes' Accreditation

Malgorzata Pankowska<sup>1</sup>

<sup>1</sup> University of Economics in Katowice, Katowice, Poland

pank@ue.katowice.pl

**Abstract.** In 2016, the European Union (EU) General Data Protection Regulation (GDPR) was adopted to replace the Directive 95/46/EC. This new bill significantly impacts an enterprise's business model. This regulation requires to evaluate the enterprise from a privacy perspective. In this paper, this evaluation is considered as a certain research work, which can be modeled and supported by the Information Technology. The research subject covers recognition of information resources and procedures in hospitals, description of information processing, and determining the compliance of these procedures and processes with legal regulations. The main goal of the paper is to present system architecture models for research management in information processing domain in a hospital. Therefore, the system architecture for research management is proposed. Models are implemented in ArchiMate language, Business Process Modeling Notation (BPMN), and Case Management Model and Notation (CMMN). Finally, one research result, i.e., patient hospital admission process is presented.

**Keywords:** Enterprise Architecture, Research Management, Hospital Process.

## 1 Introduction

In general, in an information society, norms and principles are constantly updated to keep control of information and knowledge under the conditions of changing technology. Norms and rules reveal values which are understood not only as majority opinions. While norms arise out of the cultural realm of values, they are expressed in the social structures and politics. In this paper, information management is assumed to be based on social norms, regulations, principles and values. Information and communication technology (ICT) is influencing the information management in the development of its infrastructure and supporting practices. These advances are visible in many initiatives ranging from the core ICT systems required to run the information management activities to websites, which promote information dissemination services and information brokering centers, and further, to the development and full implementation of information repositories.

EU data protection regulation provides data subjects with a wide range of rights that can be enforced against enterprises that process personal data. These rights force

enterprises to focus on procedures of data processing as well as on information resources. Taking into account the principles of GDPR, enterprises have to reengineer their business processes [13]. In this paper, the hospital process modelling is considered as a research work which should be managed rationally. The structure of the paper is proposed as follows. Firstly, the research management system architecture is proposed in ArchiMate language and the modeling is based on the TOGAF framework. In this paper, research workers are assumed to act in the open business model organizations. The second part of the paper includes the presentation and discussion on process oriented approach to research work management. The processes are modeled in BPMN. The hospital procedures and processes are subjects of the research work. They should be recognized, modeled, verified, collected, precisely described, modified, validated and implemented. It is a daunting research work, realized by accreditation officers at hospitals. The work is realized as it is required by the GDPR as well as for the hospital accreditation requests. The reengineering of hospital procedures and processes is considered as research work, providing knowledge to theories and to practice. Next, in this paper, for the research work management, qualitative research methods are discussed and their application in information science research is presented. In this paper, ethnography is considered a valuable method for hospital processes research, therefore the ethnographic research tasks are modeled in CMMN. Each ethnographic research task is assumed to cover one hospital process modeling, verification and validation. Taking into account that hospitals usually include hundreds of processes, this research work is quite a challenge. Further, the process models could be collected in repositories for evaluation in the aspect of privacy protection assurance. The paper conclusions cover discussion on the applicability of the mentioned above notations as well as suggestions on the future research works.

## **2 Research Management Architecture Modeling**

Presented in Figure 1 research management architecture model has been created according to the guidelines for enterprise architecture modeling included in TOGAF 9.1 framework. Authors of Open Group Architecture Framework (TOGAF) consider enterprise as any collection of organizations that has a common set of goals [5]. Therefore, each researcher can be consider as a part of an enterprise which needs to be supported by knowledge management and ICT tools. For example, an enterprise could be a government agency, a whole corporation, a division of a corporation, a university, a hospital, a single department, or a chain of geographically dispersed business units linked together by common ownership. In this paper, a hospital is considered as a business organization, whose processes have to be modeled for reengineering and later evaluation. Therefore, an accreditation officer, auditor or quality manager at a hospital can be considered as the researcher of these processes.

According to TOGAF, enterprise architecture is modeled in four domains:

- Business architecture covering business strategy, goals, business processes, functions and business units;
- Data architecture dedicated to the organization and management of information;

- Application architecture, which presents applications, application components and their interfaces;
- Technology architecture covering the technologies and components deployed, as well as networks and the physical infrastructure upon which the applications run.

Beyond that, proponents of TOGAF include the Motivation layer in the enterprise architecture model. This layer comprises a series of elements that are important to explain the premises of enterprise architecture development. The Motivation layer is also emphasized in ArchiMate language and software tool, which are supported by the TOGAF community [1, 2]. The most important elements of this layer are as follows:

- Goals, which describe general business orientations;
- Drivers, which often justify business decisions regarding architecture changes;
- Requirements, which specify what particularly ought to be implemented to achieve the goals;
- Constraints, which are external elements that influence the enterprise organization, sometimes reducing its capacities;
- Stakeholders;
- Assessments for some areas of interests;
- Outcomes representing the final results of architecture development;
- Values, which are identified with utility or importance of a core element of enterprise architecture.

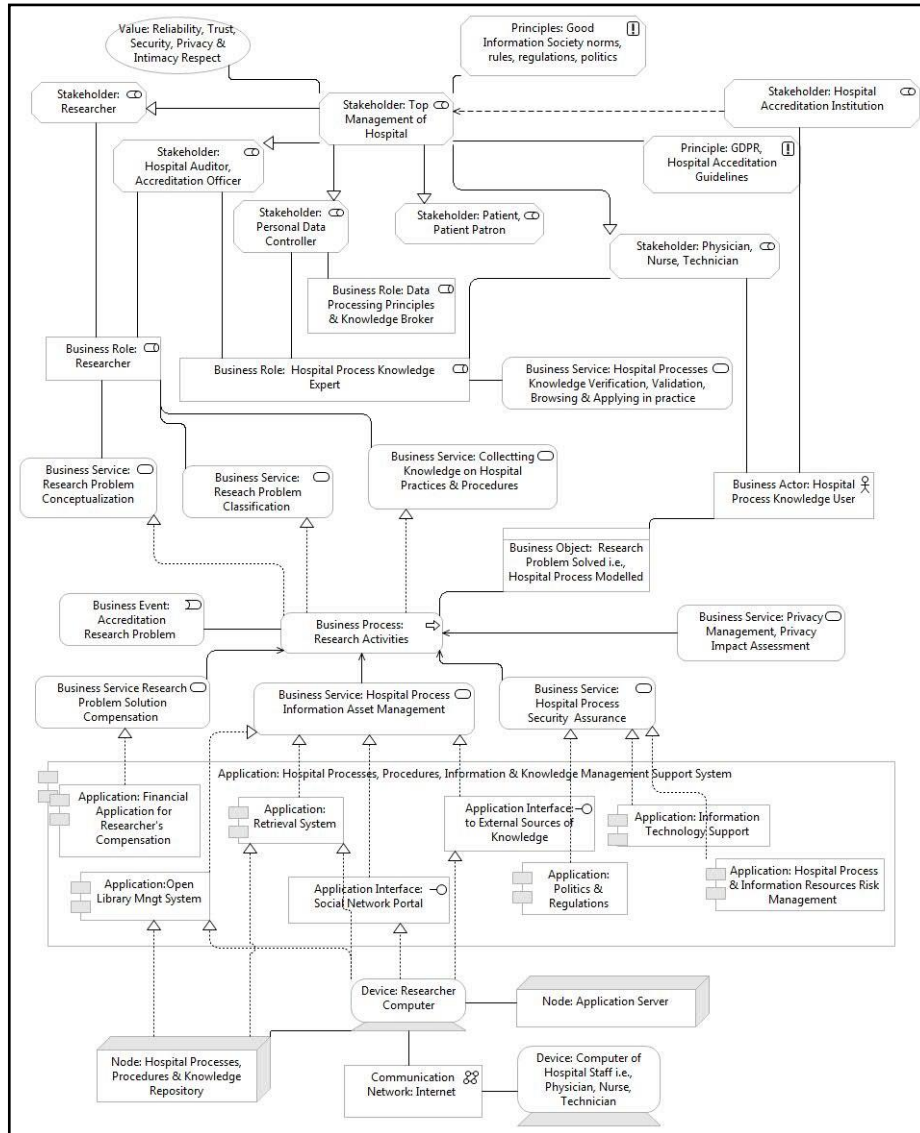
The research management architecture is assumed to include researchers as the basic stakeholders, who are interested in liberty, equality and solidarity in access to knowledge and methods of personal data processing (see Fig.1). The researchers' activities in research management domain are to be regulated by norms, rules, politics and enterprise principles.

The business layer in ArchiMate model in Figure 1 covers the specification of business roles, services, processes, events, actors and objects. The business roles are as follows:

- Researcher. This role is played by Stakeholders, such as researcher, investigator, hospital auditor or accreditation officer;
- Hospital Process Knowledge User. This role belongs to the Hospital Auditor, Accreditation Officer, Personal Data Controller, Physician, Nurse, or Technician;
- Broker of Knowledge and Processing Principles. This role is played by the Personal Data Controller.

According to the GDPR [13], the data controller is obliged to respond to the data subject's requests concerning the data processed. The controller is to determine the purposes and means of personal data processing, where the purposes and means are determined by Union or EU Member State Law. Particularly, the principles relating to processing of personal data are as follows: lawfulness, fairness, transparency, purpose limitation, data minimization, accuracy, storage limitation, integrity and confidentiality, and finally accountability. In Figure 1, the prespecified business services cover research problem conceptualization and classification. In this case, the research problem concerns modeling of the hospital processes. According to the accreditation pro-

cedures for hospitals [12], there are about 140 processes for medical treatment and another 90 processes for administrative staff tasks.



**Fig. 1.** Research Management Architecture Model

For hospital research management, the other prespecified business services concern:

- Collecting Knowledge on Hospital Practices and Procedures;
- Verification and Validation of Hospital Processes Knowledge;
- Browsing and Applying of Hospital Processes Knowledge;

- Research Problem Solution Compensation;
- Hospital Process Information Asset Management;
- Hospital Process Security Assurance;
- Privacy Management and Privacy Impact Assessment (PIA).

Research Management Architecture model covers also:

- Business process, i.e., research activities;
- Business event, i.e., research problem of accreditation;
- Business actor, i.e., hospital processes knowledge user;
- Business object, i.e., research problem solved, therefore hospital process is modeled and implemented.

The application layer in ArchiMate language model in Figure 1 includes the research management support system comprising some other application components. Finally, the technology architecture model in Figure 1 covers research stakeholders' devices, access to Internet, to knowledge repositories and applications supporting the research management. The presented in Figure 1 model complies completely with the TOGAF Architecture Development Method (ADM). The ADM is critical for enterprise architecture transformation. The method defines eight sequential phases and two other special phases, i.e., the preliminary phase and the requirement management phase. The eight essential phases are as follows:

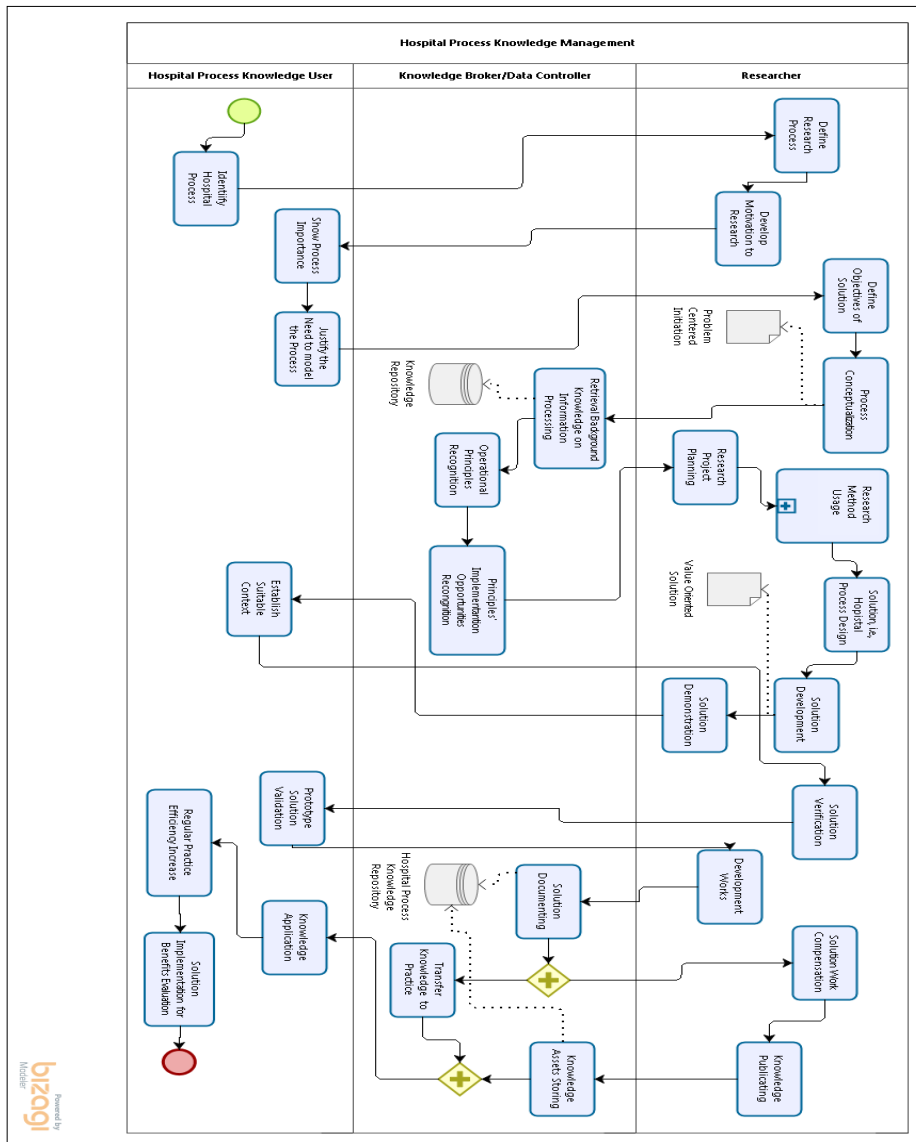
- A: Vision;
- B: Business architecture;
- C: Information systems architecture;
- D: Technology architecture;
- E: Opportunities and solutions;
- F: Migration planning;
- G: Implementation governance;
- H: Architecture change management.

For the modeling in the sequential manner, the ArchiMate language is appropriate to present the first four phases, although the main output document of the A: Vision phase is only validated during the F: Migration planning phase. It is necessary to remind that in TOGAF [5]:

- Preliminary phase and phase A cover scope definition, and key stakeholders' involvement;
- Phases B, C and D include descriptions of existing and target architectures as well as gap and impact analysis;
- Phases E and F are responsible for architecture roadmap definition as well as for projects and schedules definitions;
- Phases G and H concern enterprise architecture implementation governance.

The presented in Figure 1 model is a generic version of a research management support system, because ArchiMate language allows for generating such a holistic and abstract view. TOGAF framework permits the holistic analysis of enterprise architecture, as well as modeling of the structure of enterprise architecture components, their inter-relationships, and the specification of the principles and guidelines governing their designs and evolution over time. The ArchiMate language and software tools are the most suitable for strategic issues visualization and analysis [1, 2]. Therefore, the

specification of researchers' tasks can be modeled in ArchiMate and usually it starts with establishing the strategic business goals, principles, drivers, stakeholders, their requirements, and values. These considerations allow for further development of re-search process, which includes hospital process knowledge development tasks.



**Fig. 2.** Hospital Process Research Process Development.  
source: own.

Taking into account the strategic role of ArchiMate language and tool, the operationalisation of the enterprise architecture strategy could be further supported by other tools and notations. Therefore, assuming business process-orientation as dominant for business analytics, a more detailed analysis of researchers' tasks can be supported by BPMN [3, 5, 8]. Therefore, Figure 2 covers the specification of activities, roles and repositories in BPMN. The presented in Figure 2 hospital process knowledge development and research management activities can be further profiled according to particular research methodologies applied. Modeling and implementation of that processes is a challenge which requires the specification of actors, methods and techniques, knowledge repositories, knowledge usage and compliance. Usually, the research problem of hospital processes is assumed to be identified by the user of knowledge about the process, i.e., a physician, a nurse, an accreditation officer or an auditor. The researcher should define the research process and develop motivation to the research. A user of knowledge is expected to show process importance. Later on, the researcher should define the objective of hospital processes and create a concept of the process. In the hospital, the data controller is expected to retrieve knowledge on personal data processing, recognize operational principles and their implementation opportunities. Next, the researcher should plan the project for hospital process modeling. Usage of different methods allows to develop the solution, i.e., the reengineered process for the hospital. The proposed process is to be verified, validated, documented, stored and implemented.

### **3 Qualitative Research Methods' Modelling**

Information science research addresses a wide range of issues concerning the technology, development and management of information, as well as organizational and social impact [9]. As a key component of the research and development process, technology has played a vital role in providing solutions to new and existing problems, and achieving the goal of improving the quality of human life. Easterby-Smith et al.[6] discuss three forms of research:

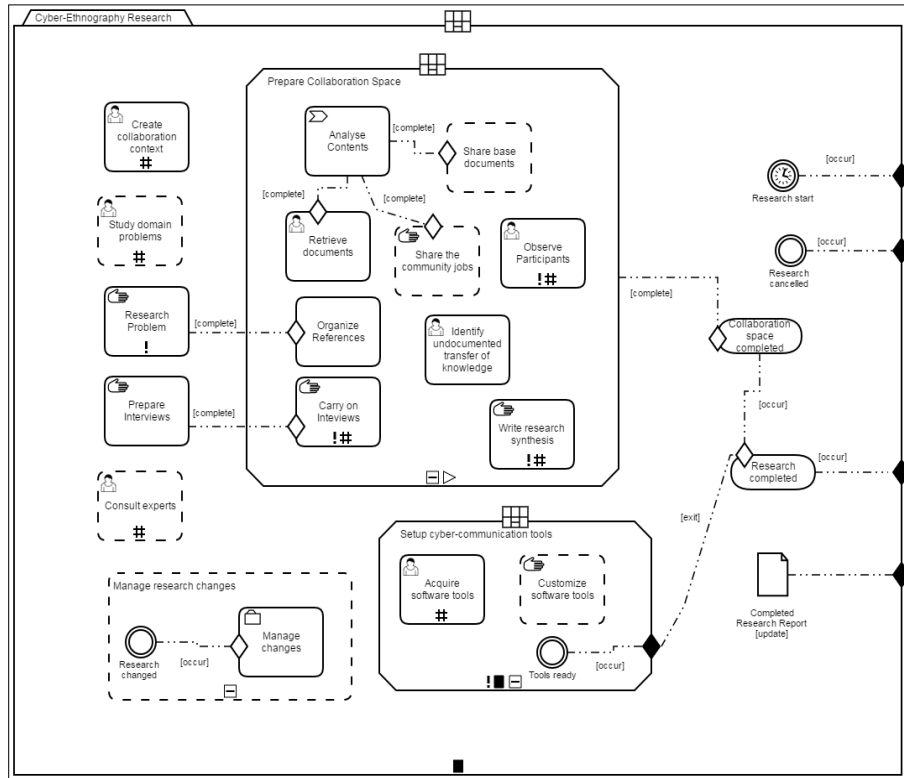
- Pure research, leading to theoretical developments;
- Applied research, intended to lead to the solution of specific problems;
- Action research as a new research paradigm to establish collaboration between the researcher and knowledge user.

Traditionally, research works cover activities conducted to solve an immediate problem (i.e., applied research), to assess the performance or impact of an action or policy of a person, a group or an organization, or to develop a theory (basic research or pure research). However, the real value of the action research is in improving information service provision, as well as in encouraging reflective practice, structuring, and disseminating experience to the wider community. Action research is suggested to be used to investigate organizational functions such as the role of researcher in the provision of knowledge to users. The approach combines theoretical considerations and practical works. Through action research, the practitioners are encouraged to take over the habits and behaviors of the researchers in their workplace and to improve the

evaluations of their practices. Action research is similar to ethnographic research, because it also requires the researcher to obtain an accurate and comprehensive understanding of the situation being addresses before taking any action to solve the problem. Participant observation is suggested as a preliminary to action research. In general, information science research works cover the application of qualitative and quantitative methods. Quantitative research methods are concerned with acquiring and analyzing relatively small amounts of data from a large number of subjects. They are oriented towards the generalization of research results [14]. Qualitative research methods are concerned with acquiring and analyzing relatively large amounts of data from a small number of subjects to investigate experiences and attitudes [7]. The tools useful for qualitative research include in-depth interviewing, case studies, analytic interpretations, critical analysis, literature review, content analysis, or participant observation. Action research and case study are realized according to the process-oriented research guidelines. However, ethnography research is different and as such is particularly suitable for research where the problem is complex and not clear, and where the research phenomenon is embedded in a social system, which is poorly understood or even unknown. In ethnography, the researcher is entering the organization context and becomes part of it, while in action research the researcher is already inside the context and has considerable knowledge about the situation. In case study approach, researchers are outside the organization context, but they are able to describe it. According to Wilcox [7, 11], the goal of ethnography is to combine the view of an insider with that of an outsider to describe a social setting. The focus of ethnography is to describe and interpret a cultural and social group, whereas the focus of a case study is to develop an in-depth analysis of a single case. Although researcher is an outsider, the emphasis is on the entry to the community and even on the creation of a context. Going into the community of users of information, the researcher wants to take over the subjective experiences of the community as well as its interpretations of concepts and other processed information. Therefore, the researcher should be able to catch the complexity and nuances, as well as constantly changing situations and human experiences. They have to reveal tacit knowledge and apply it appropriately. Researchers should collect data from multiple sources, monitor the whole business environment, process data, constantly analyze, evaluate and validate collected evidence.

Assuming non-procedural activities in ethnography research, the application of case management model and notation (CMMN) is proposed as a more suitable solution for modeling (see Fig. 3). In general, the application of CMMN is appropriate for government institutions modeling, as well as for claim processing in insurance, patient care and medical diagnosis in healthcare, problem resolution in call centers, or engineering of made-to-order products [4]. The CMMN is suitable for modeling any activities, which occur occasionally and in changeable order, and which are unique and unrepeatable. CMMN modeling provides some essential values to the business architecture modeling. Sometimes, in the domain of business process modeling a certain degree of flexibility is required. Processes can change or need to be adjusted, because of many different situations. Flexibility means the ability to deal with process task changes.





**Fig. 3.** Ethnography Research Case Management Model  
source: own

According to the Object Management Group (OMG) [4], the case is a collection of tasks and the case manager is the researcher who realized these tasks. The case managers (i.e., ethnography researchers) are responsible for the tasks and they can directly make decisions on which tasks will be realized. They can handle the case in the best way, if only it respects the constraints imposed. In CMMN, a human task performed by the case manager can be:

- blocking – the task is waiting until the work associated with the task is completed, e.g., in Figure 3 tasks "create collaboration context", "retrieve documents", "acquire software tools";
- non-blocking – the task is not waiting for the work to complete and completes immediately upon instantiation, e.g., in Figure 3 task "manage change".

In CMMN, some of the tasks are considered discretionary. These are available to the case manager and their applicability depends on their discretion. For example, in Figure 3 "study domain problem" is proposed as a discretionary task. Tasks "consult experts" and "share base documents" are also considered as discretionary tasks. In CMMN, a milestone (e.g., "research completed" in Figure 3) represents an achievable

target to enable the evaluation of the case progress. Although CMMN language supports flexibility of tasks specified in a case, there are some weaknesses of this modeling. BPMN modeling language better presents information and knowledge resources allocation. This notation also precisely expresses who is the task executor. In CMMN, on a case file item is proposed and there is no opportunity to define available resources. Beyond that, there is no way to present a hierarchy of work. The strength of the CMMN is that it enables the representation of discretionary items, which may become concrete at runtime. The case manager can choose the order of tasks in runtime. Any order is possible since it does not violate any constraints of the ethnographic method.

## **4 Research Results**

The GDPR implementation encourages data processors and controllers at every business organization to carefully rethink what data, how, where, for what, with whom, and why it is processed. Verification and modeling of data processing procedures and tasks seems to be necessary. There is always a question of how many processes a business organization can have. Just in the case of a hospital, the answer can be received through an analysis of hospital accreditation guidelines and legal acts. Figure 4 includes the process of patient admission to the hospital. This process is the result of ethnography research process realized according to the tasks in Figure 3 and respecting the activities specified in Figure 4. The process of patient admission to hospital in Figure 4 looks like quite an ordinary process. Unfortunately, at each hospital this process is suspected to be realized in a different way. The differences can be hardly identifiable, but they are important. Therefore, the research methods' application seems to be important. The hospital accreditation guidelines as well as the GDPR principles are supposed to allow for the idiosyncrasies of the hospital processes in different hospitals in different countries. Quite so, Figure 4 covers ordinary admissions, but in emergency cases the admission process is realized in a different way, and as such it is another process, which requires a separate research and modeling. The hospital process modeling allows for reengineering the processes, as well as for analyses of where the personal data repositories are placed, what personal data is processed, by whom, and who has access to the data. Further activities, such as privacy risk management and security risk management can be realized basing on the hospital processes' collection.

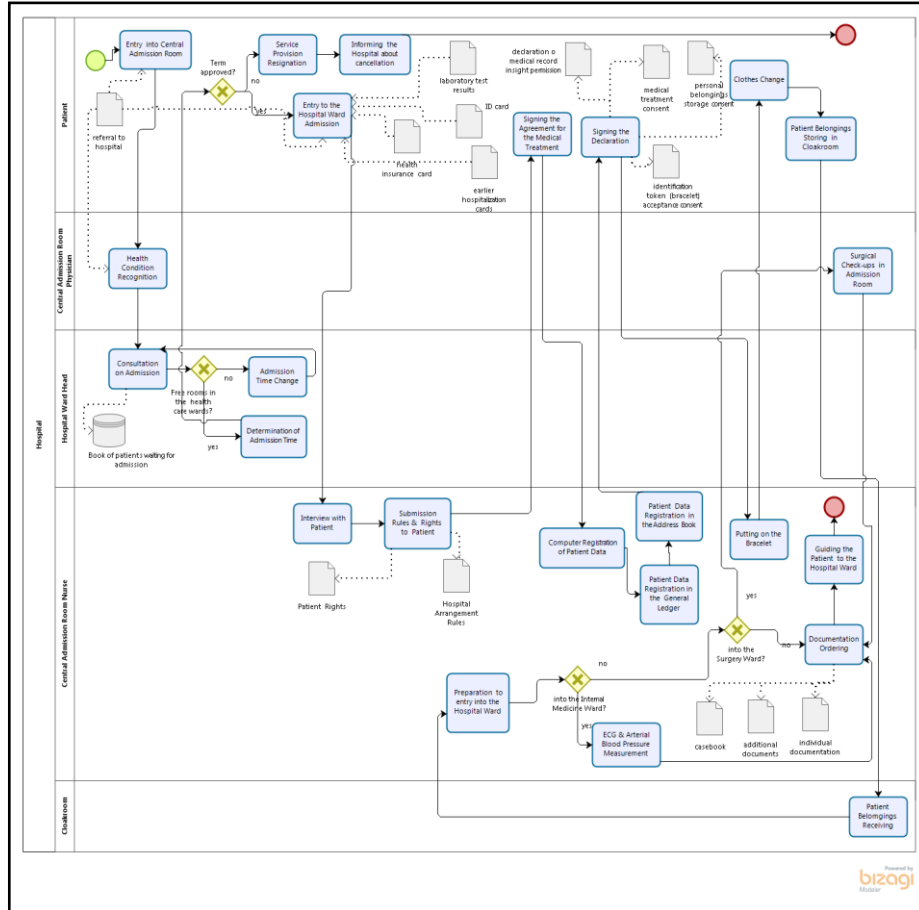


Fig. 4. Patient Admission to Hospital  
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## 5 Conclusions

Knowledge management encourages researchers to elaborate the holistic approaches, which allow successfully to cope with knowledge complexity. This holistic approach is possible by the application of any enterprise architecture (EA) framework, i.e., TOGAF and by application modeling suitable language, e.g., ArchiMate for EA modeling. However, because of the ArchiMate language weaknesses for business process modeling, there is a need to apply other notations. The BPMN is appropriate for modeling process-oriented business architecture, but it is not flexible enough to cope with non-procedural tasks. Therefore, the CMMN was developed by OMG and it is presented in this paper, how this notation can be applied for modeling ethnographic research works. There are still some open questions for future works. It would be ade-

quate to answer how to integrate the available modeling languages as well as how to model resource-oriented business organizations. In this paper, the modeling of hospital processes is considered as a research task, but further investigation can concern modeling and the general healthcare practice processes.

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