

**THE IDENTIFICATION AND THE MODELLING OF PROCESSES OF THE USE OF THE TECHNICAL INFRA-  
STRUCTURE IN THE HOSPITAL ORGANIZATION  
IDENTYFIKACJA I MODELOWANIE PROCESÓW EKSPLOATACJI INFRASTRUKTURY TECHNICZNEJ W  
OBIEKCI SZPITALNYM**

*Anna BUJANOWSKA, Witold BIAŁY  
Politechnika Śląska*

**Abstract:**

The technical infrastructure of the hospital creates conditions for effective and safe leading the process of diagnosing, the treatment and the rehabilitation of patients. At the multitude of both the diversity of medical apparatus, the technical equipment and the necessity for permanent holding and the adaptation of buildings to needs of manufacturing processes of medical services, hospitals permanently employ services for plant maintenance which are gathered in technical department for exploitation. Conducted preliminary examinations from areas of the Silesian province in chosen individuals of the health care showed, that planning and carrying out works and repairs of technical infrastructure of the hospital isn't being assisted by computer tools.

From here an identification and a modeling of processes of the use of the technical infrastructure in the hospital organization will be a purpose of the article for the needs of designing the integrated Service Oriented Systems. Developing the example of the system about SOA architecture will constitute the attempt of implementing the model supporting processes of the use of the infrastructure in the hospital organization in accordance with the concept "Facility Management" (FM). FM is a synonym of modern managing building and spatial structures. Exactly systems and information technologies are a factor of integrating FM various areas.

**Key words:** BPMN, Facility Management, information resources, technical infrastructure in hospital

**Słowa kluczowe:** BPMN, Facility Management, zasoby informacyjne, infrastruktura techniczna szpitala

**SPECIFICITY OF THE TECHNICAL INFRASTRUCTURE IN THE HOSPITAL ORGANIZATION**

Hospital in an organization in which exists opportunity to define and model business processes, which are typical for it. The technical infrastructure of the hospital is creating conditions for effective and safe leading the process of diagnosing, the treatment and the rehabilitation of patients [6]. The specificity of the hospital building results from diverse needs of the medical staff and their patients and the presence of pharmacological means and the specialist medical equipment. Access of the patient to medical modern technologies, and hence to modern medical apparatus is possible only in case of the good technical level of buildings in which apparatus is functioning and good technical installations, from which this apparatus is being powered [1].

The building with its installations and the equipment constitutes the most important asset at the hospital [5], as well as crucial element of operating costs of this organization (costs of the use - of the exploitation and supporting the determined technical infrastructure). Information about these costs isn't an object of the systematic reporting [2]. Apart from standards accreditation applied by the Centre of Monitoring the Quality in the Health Care, databases

don't exist - domestic or provincial which enable the technical evaluation of the hospital.

The infrastructure management of the hospital requires, apart from typical conditioning associated with managing a real estate property, taking into account conditioning for individuals of health care and for using medical technologies. The infrastructure management constitutes extremely important area at the hospital, because it is determining the potential of organizations for carrying out treatment processes, and in the more distant perspective permits the planning and the forming of the production of medical services. Providing the normal interaction of the technical infrastructure of elements entering its composition is a condition of the undisturbed functioning. Infrastructure includes [4]:

- developing, the space of the work and installations associated with it,
- process equipment (both the equipment and the software),
- ancillary services (so as the transport or the contact).

The hospital infrastructure is on the one side typical like every real estate, but on the other one - specialist, because associated with medical modern technologies [14]. The specificity of the hospital building results from:

1. having the following installations / of devices:
  - central installation of medical oxygen,
  - central installation of the compressed air,
  - central installation of the underpressure,
  - sound installation of the warning system,
  - installation of evacuation lighting traffic routes,
  - portable fire extinguishers fulfilling requirements of Polish Norms being equivalents of European standard concerning fire extinguishers or transportable fire extinguishers,
  - sound installation of the warning system,
  - installation of the signalling of the fire,
2. duty of meeting the following requirements:
  - 2.1. general-spatial, building and requirements for some rooms, devices and the installation,
  - 2.2. an operating rooms/blocks:
    - mechanical ventilation,
    - active stay of medical gasses,
    - air-conditioning,
  - 2.3. supplying the energy:
    - double power supply from the energy network (so-called double-sided power supply),
    - generating set - at least 30% of the highest legal validity,
  - 2.4. supplying water: reserve power source into water,
  - 2.5. the safe work with sources of the ionising radiation and with radiological devices:
    - the specifications associated with the structure of the studio,
    - the requirement associated with the installation of apparatus/devices,
    - the requirement associated with the assurance additional of equipment/installation (in it the ventilation and warning light signals).

Hence at the multitude and the diversity of the technical infrastructure hospitals permanently employ services for plant maintenance which are gathered in technical departments for exploitation. Part from performed objectives by the staff for exploitation requires consultation with the plant manager, the medical staff, employees of the accounts department or orders of the public/shopping and approval of the director, and in part of tasks this staff take participation (e.g. reporting defects and the failure of medical equipment by the medical staff, the participation of employees of the department of public shopping/orders and accounting department in the realization of the buying decision process of supplies to the equipment). As part of guarantee services the renovation economy is being carried out by outside companies. They are also leading its as the post-warranty service on principles of orders providing that knowledge resources of employees of technical departments are insufficient, there is a lack of access to specialist parts and etc. Hospital deals with information resources on the individual, group, organizational and among organizations level.

Most hospitals describes a lack of defined strategy and business idea concerning technical infrastructure. Hospitals realise their statute tasks resulting from their mission, however exploitation process remain undefined. Some assignments might be described by procedures or director instruction, but mostly activities are made as a habit based on knowledge and experience of committed employees.

Therefore it is difficult to say about process realization of exploitation in regular way.

#### **PROCESSES OF EXPLOITATION OF THE TECHNICAL INFRA-STRUCTURE IN THE HOSPITAL**

The huge development taking place in final years of teleinformatic techniques, and the growing managerial and design culture of the organization caused, that modeling process business and perceiving associated with it information systems as tools of the support for processes became leading directions in the management and introduction of computer science in enterprises. Along with the high development of informatics technology so as J2EE or the Services Web and more and more universal broadband access with Internet there arose a concept of building information systems in service oriented architecture (SOA) as natural complementing connected tendencies from processes management in business and administration.

A point of departure for establishment of a system based on service oriented architecture is an identification of basic business processes of the organization. These processes result directly from the strategy and the business concept of enterprises.

Processes of exploitation of the technical infrastructure come out of hospital's mission. The rules of activities connected with them relate from many provisions of law. Chosen from them they are presented in table 1.

Management the entire real estate of the hospital is a folded and requiring process involving all sorts organizational units and external companies. According to criteria of division of the technical infrastructure, processes of exploitation in the hospital organization can be divided into three main groups:

- processes connected with installation systems,
- processes connected with building,
- processes connected with medical equipment.

This division seems to be accurate, because exploitation department in hospitals separates their stuff on section dealing with just mentioned particular group of infrastructure. In further part of a chapter there will be focused on processes connected with medical equipment. As all identified processes of exploitation they constitutes auxiliary processes in achieving main purposes of the hospital which are providing medical services.

The main areas of management of processes connected with medical devices are:

- planning the kind and the quantity of the equipment at the hospital
- purchase/supply of medical equipment,
- logistics of the equipment,
- use of the equipment,
- the renovation economy i.e. the plant maintenance of medical equipment,
- the liquidation and the recycling.

The use of the equipment involves:

- reviews,
- conservation,
- repair,
- renovation.

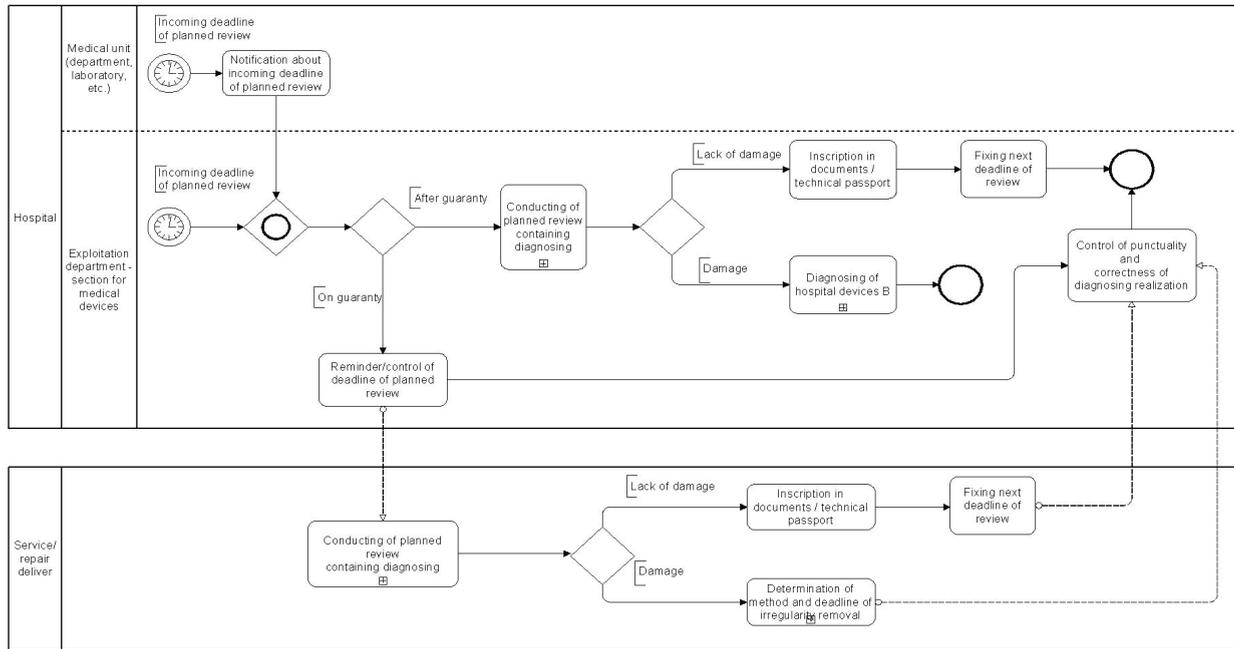
Typical process concerning medical equipment is a review. Procedures connected with this processes will be drawn in notation BPMN (business processing modeling notation) on figure 1.

**Table 1**  
**The chosen regulations concerning the infrastructure of the hospital organization**  
**Tabela 1**  
**Wybrane regulacje prawne dotyczące infrastruktury w obiekcie szpitalnym**

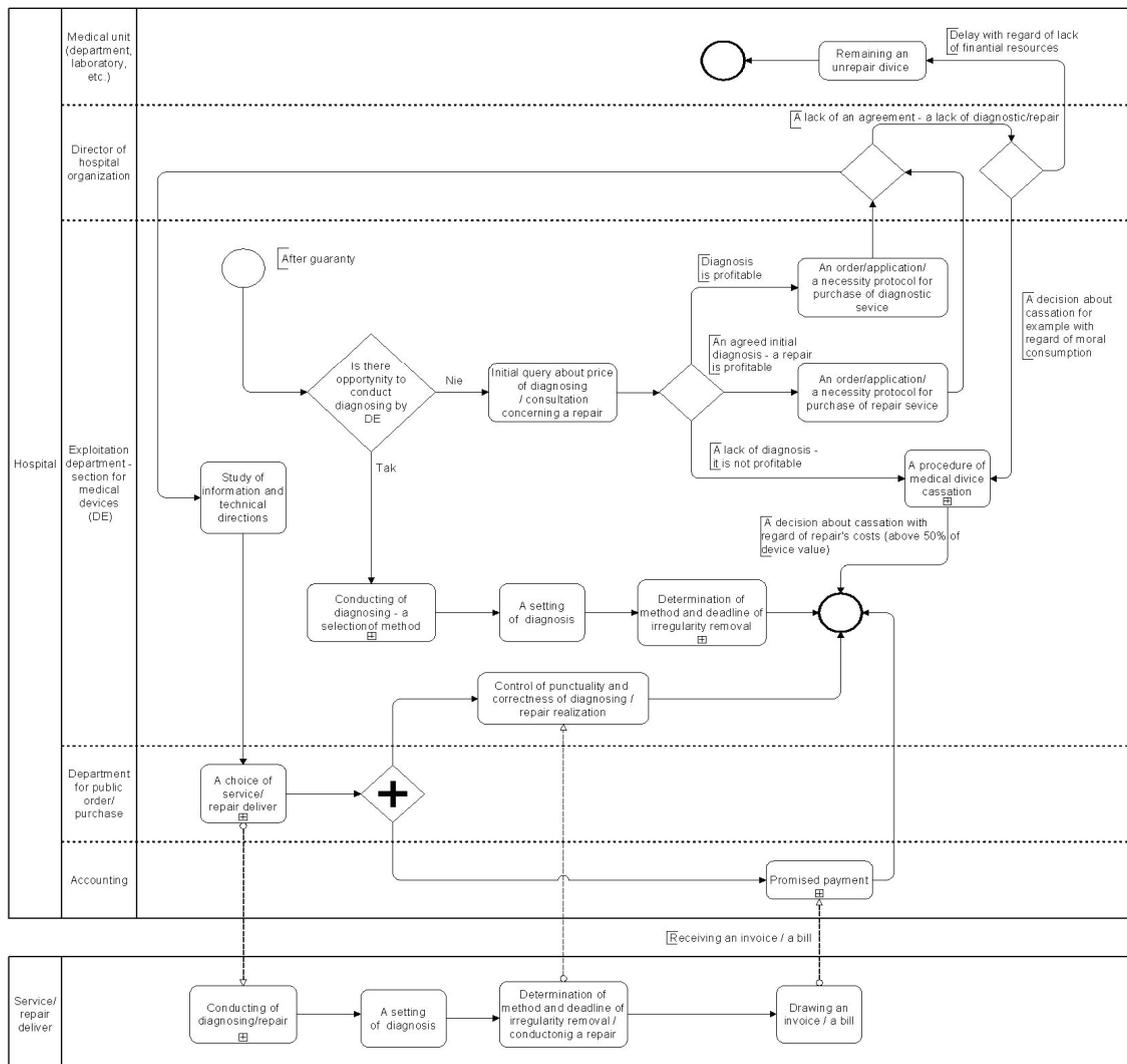
Category	Legal grounds	Name of the legal document
Spaces of hospital	Dz. U. z 2007 r. Nr 14, poz. 89	The act from 30 August 1991 about healthcare centers (art. 9 ust. 1, art. 65 ust. 1)
	Dz. U. 2011, nr 51, poz. 265	The decree of Health Minister from 18 February 2011 r. about conditions of safe applying the ionizing radiation for all types of the medical exposition
	Dz. U. z 2007 r. Nr 42, poz. 276	The act from 29 November 2000 r. Atomic law (art. 33 ust. 1 lit. D)
	Dz. U. z 2006 r. Nr 156, poz. 1118	The act from 7 July 1994 r. Building law (art. 7 ust. 2)
	Dz. U. z 2002 r. Nr 75, poz. 690	The decree from 12 April 2002 r. Specifications which buildings and their situation should correspond to (§3 pkt 6, §69, §84-85)
	Dz. U. z 2006 r. Nr 213, poz. 1568	The decree from 10 November 2006 r. The requirement, which rooms and establishing the healthcare centre should fulfill under the professional and sanitary account
	Dz. U. z 2005 r. Nr 210, poz. 1756	The decree from 17 October 2005 r. Determining essentials element of agreements concerning the access of clinical wards on performance teaching and research tasks connecting with granting health benefits
	Dz. U. z 2004 r. Nr 93, poz. 896	The act from 20 April 2004 r. Medical devices
	Dz. U. z 2002 r. Nr 173, poz. 1419	The decree from 30 September 2002 r. Obtaining the title of the specialist in fields being used for a health care
	Dz. Urz. Min. Zdr. z 2001 r. Nr 5, poz. 34 regulation from 28 May 2001 r.	Determining of principles of the purchase or accepting donation apparatus and medical equipment and on the sale, the lease or renting the non-current asset by the public healthcare centre created by the Health Minister.
Illumination and ventilation	Dz. U. z 2006 r. Nr 213, poz. 1568	The decree from 10 November 2006 r. The requirement, which rooms and establishing the healthcare centre should fulfill under the professional and sanitary account (§ 12-16)
Exploitation of premise	Dz. U. z 2007 r. Nr 14, poz. 89	The act from 30 August 1991 r. about healthcare centers (art. 1-2, art. 20a, art. 20 ust. 1 pkt 3, art. 43e, art. 53)
	Dz. U. z 2001 r. Nr 57, poz. 602	The act from 5 July 1996 r. Occupation of the nurse and the midwife (art. 25 ust. 6, art. 25a ust. 7)
	Dz. U. z 2008 r. Nr 81, poz. 484	The decree from 6 May 2008 r. General conditions of granting benefits agreement of the health care
	Dz. U. z 2006 r. Nr 156, poz. 1118	The act from 7 July 1994 r. Building law (art. 3 ust. 2a)
	Dz. U. z 2000 r. Nr 20, poz. 254	The decree from 9 March 2000 r. Requirements to which rooms, devices and medical equipment should correspond to, performing the individual medical practice, the individual specialist medical practice and the group practice (§ 5)
	Dz. U. z 2006 r. Nr 213, poz. 1568	The decree from 10 November 2006 r. The requirement, which rooms and establishing the healthcare centre should fulfill under the professional and sanitary account
	Dz. U. z 2006 r. Nr 56, poz. 397	The decree from 15 March 2006 r. Specifications and sanitary requirements for rooms, in which it is possible to execute the practice of nurses and midwives, and requirements to which devices and medical equipment enabling to grant health benefits should correspond
	Dz. U. z 2004 r. Nr 93, poz. 896	The act from 20 April 2004 r. Medical devices
	Dz. U. z 2004 r. Nr 210, poz. 2135	The act from 27 August 2004 r. Benefits of the health care financed from public means
	Dz. U. z 2002 r. Nr 75, poz. 690	The decree from 12 April 2002 r. Specifications which buildings and their situation should correspond to
Building inspections	Dz. U. z 2000 r. nr 106, poz. 1126	The act from 7 July 1994 r. Building law (art. 62.1, 64.1, 64.3)
	Dz. U. z 1999 r. nr 74, poz. 836	The decree of the Minister of Internal Affairs and Administration from 16 August 1999 r. concerning technical conditions of exploitation residential buildings (§ 5.2)
	Dz. U. z 2000 r. nr 122, poz. 1321	The act from 21 December 2000 r. about the technical inspection (Art. 14.1, 19)
Medical laboratories	PN-EN ISO 15189 / PN-EN ISO/IEC17025	Medical laboratories — Particular requirements for quality and competence / General requirements for competence of test and calibration laboratories

This notation enables smooth translation to language BPEL using in most packets supporting designing systems SOA. Procedures were executed in the igrafx process pro-

gram which lets for the graphical visualisation, analysis and the simulation of the course of processes.



**Fig. 1. Procedure of medical equipment review**  
**Rys. 1. Procedura przeglądu sprzętu medycznego**



**Fig. 2. Procedure of medical equipment diagnosing B**  
**Rys. 2. Procedura diagnozowania sprzętu medycznego B**

In the proposed diagram there were reflected:

- a course of the review when the equipment is on guarantee as well as after the guarantee,
- a course of the review when defect/damage appeared in the equipment,
- it was taken into account names of departments and documents different for all sorts units (e.g. at some

hospitals technical section and the section of medical apparatus constitute independent organizational units, in some the section of medical apparatus is a part of the technical section, the part of hospitals is using documents named the protocol of the necessity, in remaining it is simply an application).

**Table 2**  
*Identification of services for process of medical equipment review*  
**Tabela 2**  
*Identyfikacja usług w procesie przeglądu sprzętu medycznego*

Service	Purpose of service	Conditions for its making	Expected result	Contractor	Recipient/ recipients
Information about incoming deadline of planned review	Delivering information about incoming deadline of planned review	Prepared schedule of medical equipment reviews	Registration information about incoming deadline of planned review	Medical unit or/Exploitation department	Exploitation department or/and service/repair deliver
Information about guaranty of medical equipment	Delivering information about who is responsible for conducting of planned review	Prepared schedule of guaranties of medical equipment	Delivering information about state of guaranty of particular medical device	Exploitation department	Exploitation department or/and service/repair deliver
Information about results of planned review	Delivering information about results of planned review	Conducting of planned review of medical equipment	Information about state of medical equipment, inscription to the technical documentation and fixing next deadline of review	Exploitation department	Exploitation department or/and service/repair deliver

**Table 3**  
*Identification of services for process of medical equipment diagnosing B*  
**Tabela 3**  
*Identyfikacja usług w procesie diagnozowania sprzętu medycznego B*

Service	Purpose of service	Conditions for its making	Expected result	Contractor	Recipient/ recipients
Information about possibilities to conduct diagnosing by DE	Delivering information about necessity/un necessity for searching service/repair deliver	Recognition of means and knowledge to conduct diagnosing	Decision about necessity/un necessity for searching service/repair deliver	Exploitation department	Exploitation department
Information about an action which should be undertaken with medical equipment	Delivering information about further steps to be done	Initial query about price of diagnosing or consultation concerning a repair	Preparing a document for purchase of diagnostic/repair service or decision about implementing procedure of cassation	Exploitation department	Exploitation department
Information about an agreement or disagreement for purchase one of service	Delivering information about results of planned review	Prepared document for purchase of diagnostic/repair service	Study of information and technical directions and choice of service/repair deliver or waiting for financial resources or decision about implementing procedure of cassation	Director of hospital organization	Exploitation department or/and department for public order/purchase
Information about results of planned review	Delivering information about results of planned review	Conducting of planned review of medical equipment	Information about state of medical equipment, inscription to the technical documentation and fixing next deadline of review	Exploitation department	Exploitation department or/and service/repair deliver
Information about drawing a bill or an invoice	Delivering information drawing a bill or an invoice and its height	Conducting of diagnosing or repair	Information about state of medical equipment and inscription to the technical documentation	Service/repair deliver	Accounting

In the aim of simplification of the degree of complicating the picture a subprocess was implemented: medical equipment diagnosing B (fig. 2) and a course of individual subprocesses wasn't shown e.g. conducting the planned

review with regard of diagnosing whether procedure of the cassation of the equipment.

On the basis of an analysis of business processes it is possible to distinguish services essential for their automation. Automation of processes through the informatics sys-

tem about SOA architecture requires defining services and mutual connections among them and then for building functional applications using these services for the automation of chosen processes. According to examples of business processes presented at the hospital organization it is possible to identify the sequence of services, of which connecting a computer system in frames will allow for automating the key processes and streamlining performing typical tasks connected with the operations in the hospital organization. For defining the service a knowledge is essential about the purpose of service, conditions for its making, contractor, recipient or recipients of the service and the expected result. Basing on examples from figure 1 and 2 concerning review of medical equipment, there can be identified services, which after the appropriate composition, will let the automation for building the system and supports for these processes. They are introduced in table 2 and 3.

### SUMMARIZATION

It results from above analysis that it is possible to identify joint services for a few business processes. SOA architecture is disqualifying the need for duplicating of these services and resulting from them functionalities what would take place in case of introducing the system consisting of a few applications monolithic. Identified services in frames of occurring business processes in the organization are constituting the basis of construction of the system about SOA architecture. Based on them there are built applications for the end user.

SOA architecture can try to meet requirements a concept "Facility Management" (FM), because system and information technologies are a factor of integrating FM various areas. FM is a synonym of modern managing civil structures and spatial structures. In FM the building is treated as the load-bearing element for the management with conveniences. Maintaining objects and delivering ancillary services is a mission of this concept in the framework of required standards [8]. In principle only professional colleagues pursuing this profession know the FM definition. In

Poland this date is being used for 10 years, but more widely became well-known five years ago [7]. FM is an American term determining the area of the activity of the company dealing with so-called not production possessions, in it with especially a property management which are necessary in the process of the operations of this enterprise: with office blocks, halls, magazines etc. [3]. For raising the effectiveness carrying out of exploitation processes at the hospital there is suggested using the FM concept which can be applied via a computer system built based on SOA architecture.

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mgr inż. Anna Bujanowska  
 dr hab. inż. Witold Biały, prof. Pol. Śl.  
 Silesian University of Technology  
 Faculty of Organisation and Management  
 Institute of Production Engineering  
 ul. Roosevelta 26, 41-800 Zabrze  
 e-mail: [anna.bujanowska@polsl.pl](mailto:anna.bujanowska@polsl.pl); [witold.bialy@polsl.pl](mailto:witold.bialy@polsl.pl)