HEALTH CARE PROCESS MODELLING AND IMPROVEMENT

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Abstract: The paper discusses the problem of process modelling and aims to introduce a new technique called the activity table to find a better solution for the problem mentioned. The activity table is a technique for process modelling and improvement. Business process modelling is done by identifying the business processes and is continued by choosing a process, defining its work processes and activities. Process improvement is achieved by simulation of the activity table, suggesting changes and improvements, and giving solutions for existing problems. To do this, we concentrate our work on understanding and analyzing the activity table. A complete understanding of the activity table is an essential precondition to moving forward with the simulation, which enables us to make improvements of the process modelled. The problem of conducting a surgery is used as an example to test the technique.

1 INTRODUCTION

Business process modelling is a complex and difficult problem. A process model, which truly represents the business process discussed, is essential for carrying out business process improvement and information system development successfully. Business process improvement became a very important way of ensuring changes in an organisation's structure and functioning in order to create better and more efficient processes which consequently lead to a competitive and successful organization.

There are many methods and techniques which cover the field of business process modelling. The aim of this work was to introduce a new technique called the activity table to develop a process model which truly represents the original business process.

In Section 2, the problem of business process modelling is discussed, different techniques and approaches which deal with this field are mentioned, and the studies of a number of researchers are addressed. In this section, the activity table technique is introduced. The activity table enables us to develop a process model by linking each of the process activities to its resource (performer). In Section 3, business process improvement is stressed. This is done by analysis and simulation of the process model developed. The last section contains some useful remarks and conclusions. The process is applied to a specific problem to illustrate the implementation of the technique.

2 BUSINESS PROCESS MODELLING

The recent literature offers various definitions of and the extent of a process or process modelling. Throughout the last decades, the fields of business process modelling and consequently business process renovation have been gaining recognition and acceptance. The reasons for such evolution are found in the literature, academic publications and research studies that deal with the theme, as well as in the increasing involvement of consultancy and software development companies. A comparative study that closely examined 25 methodologies, 72 techniques and 102 tools was conducted (Kettinger et al., 1997). Furthermore, business process modelling is one of the requirements of the ISO 9000 international standard for quality management and assur-

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ance (Ould, 1995). Both business process modelling and business process renovation are based on the fact that a business process is the key element in the analysis of the organisation.

A process is defined as a structured, measured sets of activities designed to produce a specified output for a particular customer or market (Davenport, 1993). Hence, a process converts inputs by summing their value through various activities into outputs. A business process is a collection of activities that takes one or more kinds of input and creates an output that is of value to the customer (Hammer, 1990). However, others stressed that a business process is related to the enterprise, as it defines the way in which the goals of the enterprise are achieved (Aguilar-Saven, 2003).

Successful business process modelling depends on the appropriate selection of available modelling methods, techniques or process flow analyses. There are many techniques or analyses used in this field, such as general process charts, process activity charts, flowcharts, dataflow diagrams, quality function deployment, the integrated definition of function modelling, coloured Petri-nets, object-oriented methods, seven management and planning tools and so forth.

In this paper, we introduced a technique which could be used to produce a process model that represents a true reflection of the reality of the process discussed.

2.1 Activity Table

Business process modelling is a complex and difficult task. We are looking for a technique, which could produce a process model that represents a true reflection of reality.

The activity table is a technique for process modelling, analysis and improvement. This is achieved by identifying the business processes and is continued by defining the work processes and activities of the process discussed. To do that, we have to conduct interviews with the management at different levels. The purpose of these interviews is to identify the organization's business processes, the work processes related to each business process, and the activities related to every work process identified.

The activity table uses the term "entity" to define a user, group of users or other system of importance in the organization's functioning. An entity is any source of information that is part of the system or is connected with the system by some interaction. Therefore, an entity may be internal or external. An internal entity is inside the system and takes part in the system's operation. An external entity is not part of the system, but it has one or more interactions with the system (Damij, 2000).

A work process is the lowest-level group activity within the organisation (Watson, 1994). A work process is a collection of activities followed in a determined order in carrying out distinguishable work to produce a certain output.

The activity table is organised as follows: the first column represents business process, the second column shows work processes, the activities are listed in the rows of the third column, and the entities are introduced in the remaining columns of the table grouped by the departments to which they belong. Such organisation of the activity table enables us to create a clear and visible picture of every business process and its work processes, and also of each work process and its activities (see Table 1).

Each activity occupies one row of the table. A non-empty square(i,j) links the activity defined in row i with its source, this is an entity defined in column j. Developing the activity table is a result of interviews organised with the internal entities defined in the columns of the table. In the rows of the activity table we first register each activity identified during an interview and then link this activity with the entities in the columns, which cooperate in carrying it out. To make the activity table represent the real world, we link the activities horizontally and vertically. The purpose of defining horizontal and vertical connections is to define their similarity to the real world in which they occur.

Horizontal linkage means that each activity must be connected with those entities in the columns which are involved in it. To indicate this, symbols □, ◊, → and ← are used. Symbol □ or ◊ in square(i,j) indicate that entity(j) is a resource of activity(i), where j ranges from 1 to the number of internal entities and i ranges from 1 to the number of activities. An arrow drawn from square(i,j) to square(i,k) indicates an input enters activity(i) from another activity performed by entity(j), where i ranges from 1 to the number of activities, j and k rang from 1 to the number of entities, and j≠k.

Vertical linkage is used to define the order in which the activities are performed. Vertical linkage is used only in connection with the internal entities. This is achieved by using arrows ↑ or ↓ to connect the activities.

An arrow ↑ or ↓ from square(i,j) to square(m,j) means that activity(i) is a predecessor to activity(m). Two activities, which are not indicated in the same column, may be connected by horizontal and vertical arrows. For example, to connect square(i,j) to

square(i,k), we use two arrows. A horizontal arrow to connect square(i,j) to square(i,k) and then a vertical arrow ↓ to continue from square(i,k) to square(m,k). This means that activity(i) is a predecessor to activity(m), which is performed by entity(k). Of course, these two horizontal and vertical arrows can be replaced by a diagonal arrow from square(i,j) to square(m,k).

The main difference between the introduced technique and others is that this technique requires linking each activity defined in the rows of the activity table with its resource (an internal entity) defined in the columns.

Linking the activities with their resources in a visual manner helps a great deal in identifying the activities and tracing their order, which leads to discover the process as it occurs in reality, and enables us to develop a model that is a true reflection of the original process.

Surgery: The management of a clinic wished to improve the "Surgery" process by making it more efficient and less time consuming.

The process Surgery leads the patient, who needs to have surgery, through a number of activities in different departments of the hospital such as Reception Office, Clinic, Laboratory, X-Ray, Anaesthesia and Surgery Block.

The process "Surgery" was modelled using the activity table technique, see Table 1. This table shows that process Surgery consists of 4 work process, which contain 36 activities.

2.2 Property Table

As we develop the activity table we simultaneously develop another table, the property table, which is very important in describing activities in detail. So, for each activity inserted in the activity table, we open a new row in the property table, which shows detailed information about this activity.

The property table is organized as follows: the activities are represented in the rows of the table and the characteristics of the activities are defined in the columns. Description: this is used to write a short description of the activity defined in the current row of the table.

Resource: this is used to determine the entity, which performs of the activity defined in the current row of the table.

Time: this is used to denote that the activity discussed needs a determined time to be accomplished. Time may become a very useful parameter should we wish to use it to improve business processes.

Rule: this is used to define when performance of the activity requires that one or more rules must be fulfilled. Rule is a precise statement that defines a constraint, which must be satisfied in order for a certain activity to be executed.

Input/Output: this is used to indicate which inputs or outputs are connected with the activity described.

Cost: this is the sum of the costs of the resources needed to accomplish an activity. This parameter is used to calculate the cost of work and business processes and therefore is important in improving business processes.

Developing the activity and property tables is an iterative process. Some of the interviews have to be repeated to arrive at a precise understanding of the user's work. If anything is misunderstood, then we have to organize new interviews with the responsible users until everything is clear.

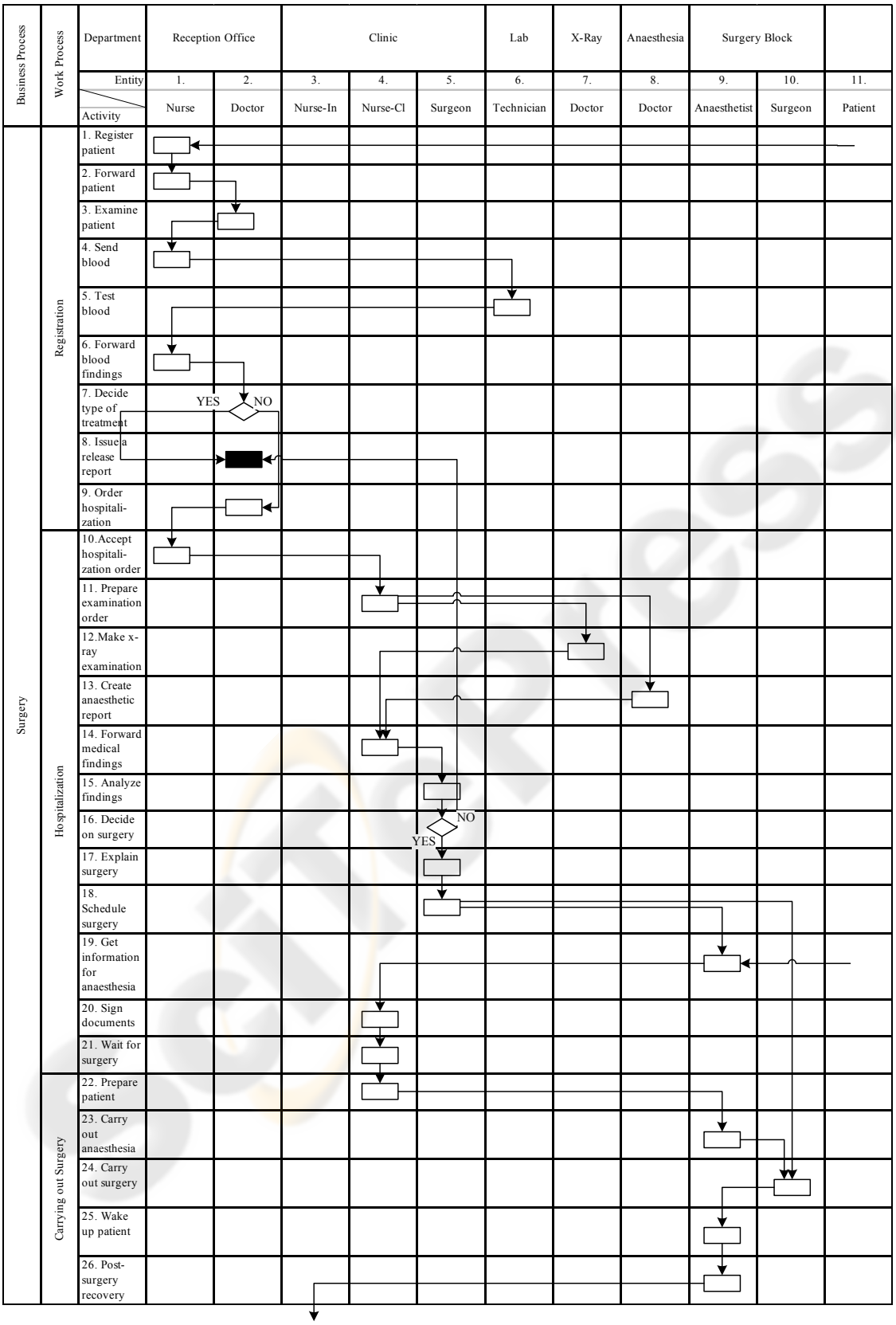
Surgery: Because of space limitations, only ten activities defined in the activity table are described in detail in the property table, Table 2. The values shown in the column Time in Table 2 are approximate values obtained from the medical staff. Unfortunately, we could not get any information concerning the costs of the listed activities from the management of the hospital.

3 PROCESS IMPROVEMENT

The aim of process improvement is to improve the organisation's processes in achieving greater customer satisfaction by developing, reforming and advancing their quality, effectiveness, availability, and in lowering the cost of business processes within the organisation. Also, process improvement helps in increasing the efficiency of the process, improving customer service, sharing data and information, effectively deploying information technology, and reducing duplicate processes.

According to Harrington et al. (1997) a great deal of effort is being focused on continuous improvement of subprocesses, activities, and tasks. If the management of the organisation stops the evolution of the process once process improvement has been completed, the organisation will lose the value gained. Consequently, continuous improvement tasks need to be performed and as a result, as stated in Harrington et al. (1997), this should result in a 10 – 15 % yearly ongoing improvement in the process.

Table 1: Activity table of the process "Surgery".



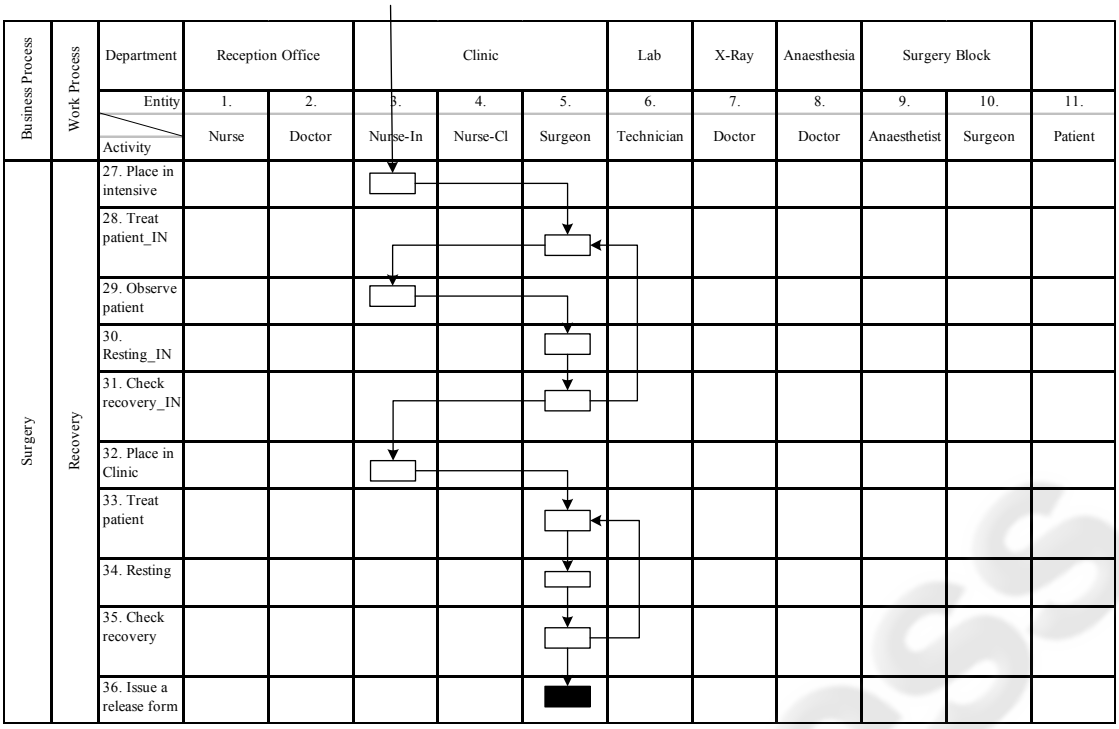


Table 2: Property table of the process "Surgery".

Characteristic / Activity	Description	Resourse	Time	Rule	Input/ Output	Cost
1. Register patient	Nurse in Reception Office accepts patient's medical card, Doctor's order, registers her/him	Nurse	10 min	Check medical card validity	Doctor's order, Medical card	
2. Forward patient	Forward the patient and patient's documents to the doctor	Nurse	5 min		Medical card	
3. Examine patient	Doctor in Reception Office examines the Patient	Doctor	10-20 min	Check patient medical record	Medical record	
4. Send blood	Nurse in Reception Office takes patient's blood sample and send it to Laboratory	Nurse	10 min	Indicate needed blood examination order	Blood examination order	
5. Test blood	Technician in Laboratory tests blood example and sends results back to reception office	Technician	30 min	Check blood examination order	Blood exam. order, blood findings	
6. Forward blood findings	Nurse in Reception Office prints patient's blood findings and gives it to Doctor	Nurse	5 min		Blood findings	
7. Decide type of treatment	Doctor in Reception Office decides for a conservative treatment or for surgery after analyzing blood findings	Doctor	10 min	Check blood findings	Medical record,Blood findings	
8. Issue a release report	Doctor in Reception Office issues a release report and prescribes needed medications	Doctor	20-40 min	Prescribe medications	Medical report	
9. Order hospitalization	Doctor in Reception Office asks Nurse to prepare hospitalization order	Doctor	30 min		Hospitalization order	
10. Accept hospitalization order	Nurse in Clinic accepts hospitalization order from Nurse in Reception office to hospitalize the patient	Nurse	30-60 min	Check hospit orders & register the patient	Hospitalization order	

The relationship between the essence of process modelling and overall business effectiveness and the efficiency of the organization depends on the consumer's satisfaction with the desired output. If the latter is everything the consumer required and aimed for, business processes are well-designed, efficient, as well as effective and will in time result in successful organizations (Aguilar-Saven, 2003). On the other hand, if the consumer lacks appropriate satisfaction or the organization's growth and profit are decreasing, it is crucial to understand that improvement of business processes has to be planned and carefully carried out.

The goal of process improvement is achieved by simulation of the process presented in activity and property tables in order to suggest changes and improvements, and giving solutions for existing problems.

3.1 Simulation

Business processes are modelled with the aim of analyzing their current states within the organization, as well as improving them through the execution of potential "what-if" simulation scenarios.

Simulation modeling according to Pidd (1998) is based on very simple principles: the analyst builds a model of the system of interest, writes a computer program which embodies the model and uses a computer to initiate the system's behaviour when subject to a variety of operating policies.

Simulation is the imitation of the operation of a real-world process or system over time (Banks et al., 2001). A simulation model enables the analyst to observe and study the system's behaviour as it advances through time.

Surgery: We ran the simulation of the process "Surgery" shown in Table 1, taking into consideration a Clinic for abdominal surgery with a capacity of 30 beds. We simulated the process "Surgery" with 20 patients, who were already in the Clinic in different phases of the process, and with 30 patients who were scheduled for different operations. In addition to this, we postulated that 3 patients, from the planned 30 patients were hospitalized every day.

4 CONCLUSIONS

The aim of this work was to study the possibility of developing an effective technique for carrying out business process modeling and improvement. The technique has to enable the analyst to develop a visible and comprehensible model, which represents a true reflection of the real business process. This fact is essential in making the task of process analysis and identification of the necessary changes possible, so as to carry out a successful business process improvement.

We are certain that including resources (entities) in the process model is a new and important additional modelling dimension, which makes the modelling process easier and more precise.

To continue with the improvement of the business process "Surgery", Table 1 was transformed into a diagram of iGrafx software to run a simulation of the process. The results of the process simulation are very encouraging and show that the process "Surgery" is well planned and does not have major problems. Nevertheless, the process could be improved by shortening the time of 2.94 days spent before surgery. Some of the medical examinations could be done before hospitalization and also the time of waiting for surgery could be shortened. We are aware that these suggestions cannot be generalized for all patients, but they are good points for the medical staff to rethink.

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