Animated Simulation for Business Process Improvement

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Abstract. This paper is a companion paper and represents a practical example of simulation and animation modeling of business processes. The theoretical concept, methodology and modeling technique underlying this paper is presented in the main paper published in the first section of this book. In this paper we demonstrate simulation of business processes in a Pharmacy planning for IT innovations. The simulation methodology is based on a type of Petri nets adapted for business process modeling. The deliverable of this paper is a gradual improvement of business processes of the Pharmacy through series of "what-if" scenarios. We run animated simulation of each "what if" scenario to visualize the impact of the changes and the dynamic behavior of each scenario and demonstrate it to the business owner. Before proceeding, readers are suggested to read the main paper that introduces the underlying simulation methodology.

1 Introduction

In order to understand the role of simulation in business process improvements, it is important to have a look at the roots of business process redesign that marked the nineties decade as a decade of reengineering.

The revolutionary idea of reengineering, that dominated most of the research of 90s in the field, started with the fundamental work of [1]. Although the true roots of reengineering may trace back as far as the business itself, however as a research field, scientifically formulated, described and introduced, it started with these publications. One of the main contributions of [1] was illustration of recursive relationship between IT capabilities and business process redesign, which is still a fundamental tenet of organizational change. They also introduced a framework of five steps for process redesign that become a central concept for many frameworks developed afterwards. Later, the five steps framework was improved to six steps framework [2, 3] that was widely used by authors and practitioners throughout the 1990s. The concept of business process redesign attracted close attention of many other eminent researchers such as pioneering in this area [7] who contributed the "principles of reengineering". However, after the decade of reengineering behind and ubiquity of IT in every type and level of business, we are challenged not with reengineering, but Business Process Improvement (BPI), which is a continuous process rather then one time initiative as with business process reengineering.

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In this relation, a fundamental question is “why businesses need to change or improve” in the first place. A short answer would be the fact of operation of businesses in an environment of accelerating external change; it is also true that often restructuring and reorganization within any business is an inevitable fact of life. There are numerous factors that force organizations to consider changes and rethink the way they accomplish their mission, approach customers, deliver services and interact with the environment. These factors may be internal or external such as environment, competition, policy and emerging technologies. Increasing number of publications emphasize the importance of process modeling and simulation to manage, accomplish and study business process changes, design or redesign. Authors [8] study and provide evidence-based facts of significant contribution of process modeling and simulation in business process reengineering (BPR) projects. Only modeling, as suggested by [8], may not reveal sufficient information about the processes. For significant benefits and results with certain accuracy, a serious business process modeling should be complemented with simulation. On the other hand, only simulation tools may provide a little help if there is no profound conceptual modeling preceding it. It would be like “expedition without a map”. As [11] states, an analogy can be drawn as constructing a building without design and construction drawings. A valuable lesson extracted from these analogies is that, like expedition without a map, simulation without a profound concept is possible, but the desired results would be very hard to achieve if not impossible.

Now that *change, adapt and measure the impact* would be an inevitable ongoing *agenda of the 21st century enterprises*, business process modeling and simulation is not question of “to be or not to be”, but a prerequisite of success in setting the right course of sailing. According to authors [8, 10, 11] the potential and full capacity of business process modeling and simulation still have to reveal. In the following section we study a Pharmacy that is planning to improve its business processes and supporting them using new IT.

2 The Pharmacy: Prescription Filling Process

The process starts when a patient presents a prescription to the pharmacy counter and requests prescription refilling. The pharmacy technician asks if the patient is an existing one to access her profile information which should be already in the Quickscrip’s database (Quickscrip is the main IS of the pharmacy). If it is a new patient, the technician asks the patient to fill out short information including the patient’s name, address, telephone number, allergies, and whether or not the patient has any type of insurance. When the profile is created, the technician selects drugs according to the prescription. The software automatically checks the current drug for interactions which may cause concern when combined with prescriptions the patient is currently taking. The software also asks if the technician wants to transmit a claim to the patient’s insurance company, if one has been provided to the database. If a user has no insurance coverage, a cash price is assigned to the prescription.

Once a claim has been transmitted to the patient’s insurance company via the internet, a price is assigned to the prescription based upon the company’s response. The computer generates a label and sends the information to the ‘robot’ for automatic filling if the requested drug is available in the system's inventory. The drug is dispensed into a pre-selected bottle and counted using a laser and gear system which places the medication into the bottle. The medication is then checked one final time visually by a pharmacist who also reviews the original written prescription to ensure no errors are made. Once verified, the prescription is bagged and then sent out to the cashier for pick-up by the patient. The entire process normally takes no more than ten minutes. At the pick-up counter, the patient signs for their prescription and pays the cashier. The termination of this process is related to another process called inventory control. Inventory is updated every time a medication is issued. Although the inventory control process and its interrelation with the prescription filling process is also studied in the case study, here we skip the details.

2.1 Transactions of the Prescription Filling Process

The very first interaction in the "Prescription Filling Process" starts when a patient presents a prescription to be filled. Thus, the first transaction (T1) is "prescription filling". Actually, this is a super transaction that nests many other transactions. This transaction is initiated by a "patient" and executed by a "pharmacist". The result of this transaction is a filled prescription. In this manner we identify all other transactions:

Transaction 1: prescription filling
Initiator: patient
Executor: pharmacist
Fact: prescription is filled

Since this activity is a complex process that nests quite few other transactions, this transaction is called composite transaction. The following transactions are initiated during the execution of this first transaction.

Transaction 2: creating profile
Initiator: pharmacist
Executor: patient
Fact: profile is created

Transaction 3: checking drug interaction
Initiator: user interface
Executor: computer software
Fact: interaction fact is established

Transaction 4: assigning price
Initiator: pharmacist
Executor: insurance company
Fact: price is assigned

Transaction 5: automatic filling
Initiator: pharmacist
Executor: robot
Fact: drug is dispensed into a bottle

Transaction 6: paying the drug
Initiator: pharmacist
Executor: patient
Fact: drug is paid

Transaction 4 shows interaction of the process with environment (insurance company). So, T4 is executed outside of the Pharmacy and the result is communicated back to the Pharmacy.

Figure 1 shows all these transactions as an interrelated network. It also shows that once medication is issued (result phase of the first transaction T1/R), the inventory control process updates the inventory (represented as a composite Transaction T1). Although the description of the inventory control process is skipped here, it should be apparent that this process is also a network of interrelated transactions rather then a single transaction.

Since transaction T1 is a composite transaction, it is split into three phases (T1/O, T1/E and T1/R) in order to show its relation with all transactions nested inside it. In contrast, all other transactions are simple transactions and therefore they are represented in a compact form where the three phases are compressed as one bold rectangle. It should be noted that all transactions initiated during the execution phase of the first transaction (T1/E) should be completed first before T1 result phase is achieved (T1/R).

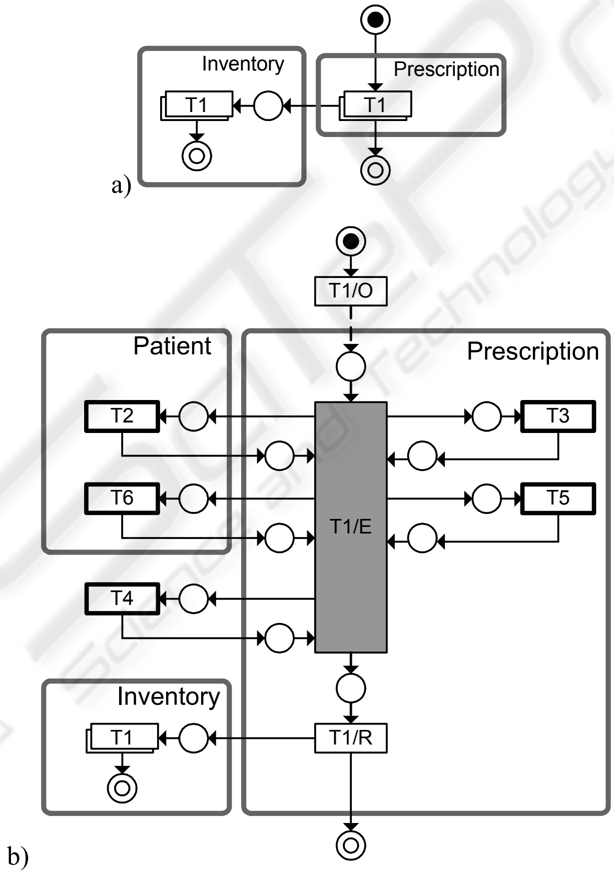

Fig. 1. Petri net model of the “Prescription Filling” process: a) high-level; b) detailed.

In order to better understand the model of figure 1, it should be read in the following manner: T1/O represents a request for prescription filling. T1/E represents execution of this request. However, this Execution phase embeds series of other interrelated transactions. Some of these transactions take place every time when a patient requests prescription filling, while a subset of them depends on certain conditions. Thus, T1/E, first of all, checks if the patient is an existing one or a new one. For a new patient, there a new profile must be created. The process of creating a new profile is represented by Transaction T2. Therefore Transaction T2 is initiated during T1/E. The phase T1/E also requires checking if the requested medication has no interaction with the medication currently taken by the patient. This process is represented as Transaction T3. Similarly, Transactions T4, T5, and T6 also must be completed during the execution of Transaction T1, because their results are needed to complete T1. Once all the nested transactions are completed, the last phase of Transaction T1, i.e., T1/R is accomplished and the process is terminated. Readers may also have noted that the completion of this process is also related to the "inventory' control process that makes sure the issued medication is subtracted from the inventory and checks if this medication should be ordered for restacking. Since the focus is not on the inventory process, it is simply represented by one composite transaction that in fact is composed of a few business transactions.

As a final remark, it should be noted that the derived Petri net model serves as an input model for any tool based on discrete event concept such as Arena™ simulation system.

3 Animated Simulation of the Prescription Process

In this section we construct an animated simulation model of the prescription process using the Arena™ simulation system that is widely used for business process modeling [9, 12]. Arena has an integrated environment for developing Model Logic, Animation model and conducting Statistical Analysis. Before building an animation model, it is needed to develop a logical model, as illustrated in Figure 2a. Once a logical model is built, an animation model, using different entities (graphics, pictures, human agents, decorations), is developed (Figure 2b). However, the animation model needs to be demonstrated on computer; therefore the animation model is not included to save the paper space; however some outcomes of the simulations are discussed below.

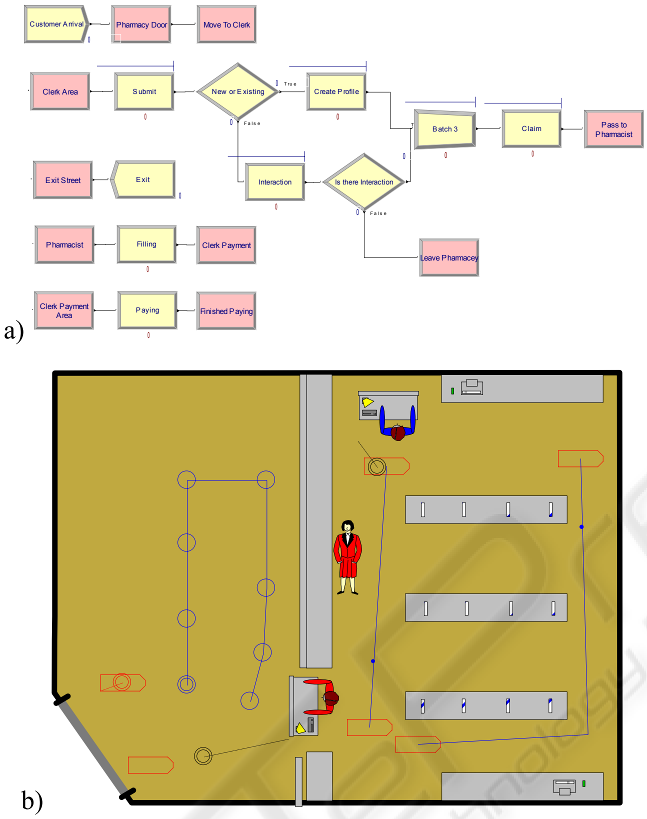

Fig. 2. Screenshot of the Model Logic and Animation Model.

As illustrated above, the Prescription Filling Process consists of six business transactions. In figure 2a, these transactions are represented as processes, grey rectangles identified as Submit, Profile, Interaction, Claim, Filling and Paying. Figure 2b represents an animated model in which entities are moving, resources have states (idle, busy), queues are created, etc.

Since the Arena software provides integrated package for constructing a model and conducting simulation, analyst can run simulations of the process to analyze performance and resource usage, to identify repetitive loops and inefficient bottlenecks, and to predict process performance and productivity. For better analysis and comparison, Arena simulation package provides analysts with features such as generating a report on the simulation results. a full report of simulation may include several pages detailing average time, queues, busy, idle, etc.

4 Conclusion

In this paper we discussed animation simulation for business process improvement. In illustrating how all the steps from business process description to modeling and, finally, simulation can be followed, we used a real life case of the Pharmacy.

This integrated study shows that the transaction concept is a profound concept in identifying atomic processes and their relevant actors and their roles as an initiator or executor. The Petri net models used in this paper show that these models are very easy to build, understand and simulate. Although numerous tools are available to simulate directly the Petri net models, we used Arena for its animation features, rich library of entities and tool for importing diagrams from applications such as Visio.

Through this small example we learned that animated simulation allow analysts to easily communicate different scenarios to non-technical users such as employees of the Pharmacy or manager of the store.

As a conclusion, although it is a research in progress, we do believe that this paper provides (or at least has the potential) pragmatic value for business process simulation and business alignment with IT and communication of the results to non-technical users via animation.

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