BUSINESS PROCESS DESIGN BASED ON COMMUNICATION AND INTERACTION

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Abstract: The easiest way that people describe their roles in an organization or the way that members of an organization make promises and commitments to fulfil a task is through communication and interaction. In such a communication language is used as a tool or facilitator of action when a customer requests a service and the supplier promises to provide such a service. In this paper we introduce a language-action based methodology for designing business processes for the Department of University Housing at Georgia Southern University planning to acquire a new information system for managing, supporting and improving the "process of rooms assignment" to some 4000 students. As stated, the methodology is based on language-action perspective and therefore we have used the business transaction concept for mining atomic business processes. Each business transaction identifies an essential activity and reveals the actors and their roles as an initiator or executor of the transaction. Since the transaction concept is used as a conceptual basis, the methodology is complemented with Petri net graphical notations as a modelling technique.

1 INTRODUCTION

It is very natural that members of an organization use natural language (communication) for describing how they fulfil their duty and contribute to the mission of their organization. They use communication when they are making commitments, participate in carrying out tasks, interacting with customers. Therefore the language-action perspective (LAP) became an interesting framework in understanding, analyzing and designing organizational processes, business systems, IS and IT Applications. In this paper authors uses a methodology based on the language action perspective.

How language and communication facilitate actions has been studied by philosophers for long time. Although this study traces its origin back to ancient philosophy of language, however most cited work within the community of practice is Austin (Austin, 1992) who, in his work "How to Do Things with Words", argues that human being uses communication as a means of coordinating and accomplishing actions and creating facts and by saying they mean to do something. This approach was further developed and applied in the work of other authors that made marvellous contribution to the study of language as facilitator of actions (Habermas, 1984; Searle, 1969; Winograd and Flores, 1986).

Although different approaches are used for business process design, in this paper we discuss a methodology based on the transaction concept introduced within the DEMO methodology (Dietz, 1999; Dietz, 2002) which in turn is based on the language action perspective.

The transaction concept, that will be discussed later, is about how communication leads to actions

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and how communication can serve as basis for elicitation of atomic processes – called business transactions. Consequently, each business transaction is a building block in designing business processes or a requirement for planning and designing an information system.

In order to put business transaction in an easily readable and timely order to build a complete model and communicate the results back to the users, clear and readable graphical notations are needed. For this purpose, the rich graphical notations of Petri nets are combined with the transaction concept.

A challenge in information system or business process design is adequacy, simplicity, integrity and computer support of methodologies and tools used for this purpose. In order to propose a more integrated and comprehensive methodology, we have combined the two mentioned concepts – transaction concept and Petri nets – to help analysts in designing system at conceptual level that will be further used for physical system design. The rest of this paper will introduce both the transaction concept and Petri nets, and their application in designing business processes in the Department of University Housing at Georgia Southern University planning to design an information system to make the room assignment process more effective and efficient.

2 THE TRANSACTION CONCEPT

The transaction concept is based on idea that an organization and its underlying business processes are a network of business transactions that represent the essence of this organization. This concept looks at communication, more precisely, business communication as a tool to elicit and capture underlying action patterns that represent the business processes. In this context, the notion of communication is not an exchange of information (words and sentences), but negotiation, coordination, agreement, commitment that lead to certain actions. In turn, these actions create new facts, deliver results, and accomplish the mission of an organization.

Each business transaction, as illustrated in figure 1, encompasses *action* and *interaction*. The *action* is the core of a business transaction. The action represents an activity that changes the state of the world, where the *interaction* is facilitator of this activity. The interaction represents communication (request, coordination, discussion, agreement, negotiation, commitment, promise) for the initiation and completion of the action.

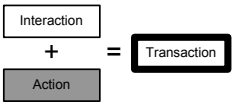

Figure 1: The business transaction concept.

Example: a customer applies for home mortgage to a loan officer in a bank. The first *interaction* takes place when the customer communicates with the officer to request a loan, and submits an application. Then the officer processes the application, checks the documents and makes a decision, that is, takes an *action*. The second *interaction* takes place when the officer, after processing the application, communicates the decision to the customer.

As the 'mortgage' example shows, there are three stages in the process: the first *interaction*, the *action*, and the second *interaction*. Accordingly, as illustrated in figure 2, the transaction concept states that each business transaction consists of three phases that are called *order phase*, *execution phase*, and *result phase*. The order phase is the first interaction, the result phase is the second interaction and the execution phase is where the action takes place. These phases are abbreviated as O, E and R correspondingly. To distinguish between the *action* and *interaction*, the action (E-phase) is represented by a different colour. The diagram of figure 2 is based on Petri nets notations that will be discussed later in this paper.

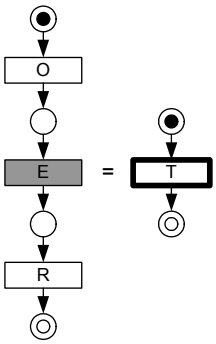

Figure 2: The transaction structure using Petri net diagram.

On the left side of figure 2, a transaction is represented as a sequence of the three phases, while, for compactness, the right side of the figure compresses the three phases into one unit called a *transaction (T)*. The importance of splitting a

transaction into three phases or compressing them into one unit arises when dealing with complex business processes, where numerous transactions are chained together. A simple transaction is carried out straightforward without triggering other transactions; therefore a compact notation is used. The compressed notation helps to build more compact models.

> **Example:** in the 'requesting mortgage' transaction, the application processing triggers another transaction 'checking credit'. In order to approve the application, the officer needs to check credit history of the customer with a credit reporting agency. It means the 'requesting mortgage' transaction is nesting the 'checking credit' transaction. Thus, the 'requesting mortgage' transaction starts first and the 'checking credit' transaction starts afterwards, but the 'requesting mortgage' transaction can't be completed until the result of the 'checking credit' transaction is known.

In real life, business processes are more complex than the 'requesting mortgage' example that is purposefully simplified in order to escape in-depth discussion for later.

The last notion to be explained in regard to the transaction concept is the role of actors involved in a business transaction. As it is apparent from the 'requesting mortgage' example, each transaction involves two actors. The actor that initiates the transaction is called the *initiator* (e.g., customer, client or consumer) of the transaction, while the actor that executes the transaction is called the *executor* (e.g., supplier, server or provider) of the transaction. Actors can be a human actor, software agent or machine. For example, if the mortgage application is submitted online, a software agent will collect data and process application instead of the loan officer and make preliminary estimates for later approval by a human actor (the loan officer).

Now that the transaction concept is introduced, it is appropriate to give a definition of business transaction used in this paper.

Definition: A *business transaction* is a generic pattern of activity carried out in a close interaction between two distinct actors called initiator and executor. The activity is carried out in three phases called order phase, execution phase, and result phase that creates a new fact and changes the state of the world. These three phases are made up of interaction and action, where the order and result phases represent the interaction and the execution phase represents the action.

Concluding this section, the following is description of the 'requesting mortgage' process using the transaction concept:

Transaction 1:	'requesting mortgage'
Initiator:	'customer'
Executor:	'officer'
Result:	'loan approved/declined'
Transaction 2:	'checking credit'
Initiator:	'officer'
Executor:	'credit agency'
Result:	'credit report is created'

From the two transactions above, transaction 2 must be initiated and executed during transaction 1. Thus, initiation, execution, or completion of a business transaction may lead to initiation and execution of new transactions. In this way transactions are chained into arbitrarily large structures, called *business processes* (Dietz, 1999).

The following is a definition of business process in the framework of the methodology that is applied in this paper based on the transaction concept.

Definition: A *business process* is network of interrelated business transactions that delivers value (good or service) to customers having one start point and one end point. It starts with a request by an actor and ends with a result communicated to the same actor. Usually a business process is one super transaction that for its completion initiates a series of other transactions.

Now having discussed the transaction concept, the following section provides a brief introduction to Petri nets in general.

3 PETRI NETS (PN)

In research and commercial projects, Petri nets are extensively used as tools for systems and processes study and their design, specification, modelling, simulation and verification (Peterson, 1981). Petri nets are developed in two directions: theory and application. The theoretical development of Petri nets is based on their application in systems and processes modelling, design and simulation.

Since the application of Petri nets in systems design and modelling has driven tremendous interest among researchers and a huge number of papers, theses, and projects were devoted to this issue, Petri nets have been getting serious extensions that resulted in different types of Petri nets. Nevertheless, the basic principles of Petri nets and the basic graphical notations remain almost the same. For interested readers, the following are references to

different types of Petri nets used by analysts and researchers in different areas.

These different types of Petri nets include elementary Petri net (Peterson, 1981), High Level Petri Net (HLPN) (Reisig & Rozenberg, 1998), Coloured Petri Net (Jensen, 1997), Stochastic Petri Nets (Haas, 2002), Workflow Petri Net (Aalst and Hee, 2002), Hierarchical Petri Nets, Timed Petri Nets, Predict /Transition Nets, etc.

Definition: Petri nets are graphical and mathematical modelling tool which is particularly well suited for discrete event systems. The Petri nets diagrammatic structure consists of *places*, *transitions* and *directed arcs*, as depicted in figure 3. Places can contain tokens. Graphically, places are represented by circles (or ellipses), transitions by rectangles (or bars), and tokens by black dots (or numbers).

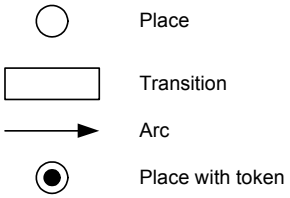

Figure 3: Graphical notations of Petri nets.

Transition – a transition represents an action, process, operation, or any activity that changes the state of the system or causes advances and progress in a process.

Place – a place represents state, or any result achieved after a specific activity (transition) takes place. Places can contain tokens that illustrate the current state of the modelled system (*the marking*). The marking used to describe the initial state of the system, is called the *initial marking*.

Arc – in its common role, an arc illustrates the course of actions, the flow of processes, or the sequence of operations.

Token – tokens are indicators of the system state. Thus an overall distribution of tokens represents the overall state of the system at a given time.

4 TRANSACTION ORIENTED PETRI NET

By now it should be apparent that the transaction concept lies in the core of our methodology and the Petri nets notations are its main graphical elements. Therefore the proposed methodology is entitled Transaction Oriented Petri nets Methodology or TOP Methodology for short.

In order to use Petri nets in systems analysis and design for the purpose of information systems design or IT application development, a few minor extensions to the graphical notation of the ordinary Petri nets is suggested in this paper. These extensions make the models easily understandable, intuitively readable and a straightforward input for simulation modelling if analysis, verification or comparison of different design alternatives is needed.

As the legend, shown in figure 2, illustrates, there are distinct graphical elements for *action* (rectangle with plain line filled in grey), *interaction* (rectangle with plain line), a complete *transaction* where action and interaction are represented together (rectangle with a bold line), and *composite transaction* where a transaction is nesting one or more transactions (multiple rectangles with a plain line). In terms of the Petri net concept, all these elements are transitions and thus represented by different types of rectangle.

Further, the proposed extensions suggest two places, *start place* and *end place* that indicate where a process starts and where it eventually ends. These two new places are used along with the standard Petri net element called *state* that shows the intermediate states of processes (transactions). Again, in terms of the Petri net concept, all these elements are places and thus represented by different types of circle.

For distinguishing between intra-organizational and inter-organizational processes, the *process boundary* element is added. Introduction of this element helps when analysts need to model or illustrate the interaction of one process with other processes within the organization or with the environment. This interaction can be modelled with a set of places on the process boundary.

In addition to standard Petri net arc, *link*, a conditional link is also used to indicate a *condition* (shown as dotted arc). The conditional link represents a situation, when a transaction is not always executed and its execution depends on certain condition.

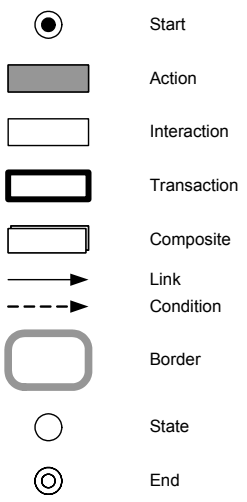

Figure 4: Legend of the TOP Methodology.

The advantage of the compact presentation, where the three phases are compressed together, is that the model becomes smaller and easier to communicate between analysts, practitioners and users. It can be applied to simple transactions, i.e. when there are no transactions to be executed during this transaction, or if there are any transactions, they are considered as a black box.

Before proceeding further, readers should be reminded that the structure illustrated in figure 2 represents a business transaction at a high level. Its decomposition will lead to a workflow model having one input and one output, that is, by virtue a business transaction (meanly its E-phase) encapsulates a workflow where flow of data, documents, services or goods takes place. However, due to limited scope of this paper, we will leave this discussion for future research.

5 THE FRAMEWORK OF THE TOP METHODOLOGY

For a successful system design or its model construction, a practitioner needs to follow some formal framework. The framework will help where to seek for pieces of essential or business related information. Since we are applying the TOP Methodology, this methodology suggests that first an organization is described in terms of major business processes (patient examination, order processing, customer call processing, inventory control, etc.). Then each of these major business processes is studied and described as a network of business transactions (core activities), where each of these transactions involve two actors, one initiator of the activity and one executor of this activity. According to the transaction concept underlying this methodology, an activity is considered as a business transaction if it creates a new fact, changes the status of the system or brings results. Now having this in mind, the following is a high-level framework to follow:

1. Definition of major business processes

This is a high level definition of major processes that can be done reading the documentation of the organization. Examples of a major process can be 'order processing', 'delivery', 'procurement', 'restocking', etc.

2. Description of each major business process

This is either based on documentation of the organization where processes and procedures are described or such a description can be prepared through interviews with the manger of the business process.

3. Identification of business transactions (core activities or key processes) and relevant actors for each major business process

Identify transactions (main activities) that cause changes in the states of the process and advance the process; Identify who is initiator and who is executor for each transaction.

4. Constructing a model(s) of each major business process

In this part, using the notations of the TOP methodology, all the identified transactions are put together in a sequential order

6 APPLICATION OF THE TOP METHODOLOGY

In order to illustrate the application of the TOP Methodology, this section provides a case example carried out in the department of university housing planning to design a new information system to support and improve the work of this office. For the ease of reference, we will identify our case example as the Room Assignment Process, or RAP for short.

6.1 The Housing Department

Currently the Department of University Housing (or simply housing office) is serving about 4,000 on-campus residents and managing hundreds of new applications all the time. Using a paper-based

system to fill 4,000 spaces is virtually out of the question and would take weeks or even months to complete not mentioning the possible number of human errors. Therefore this department recently acquired a new web based IT system, called RMS, that helps to automate, simplify and improve the room assignment process. Although there are still some paper elements to the system, most of them have been eliminated and improved, since it is no longer necessary for people to have to individually sift through housing applications and match roommates.

The New Student Application Process

When a new student applies for housing, they first visit the Housing web site and following the site to the RMS home page. Here, they log in using their school-assigned login account, automatically created by the Housing department when the student has been entered into the campus student database. Upon logging in, they are prompted to create a profile first. Most information, since it is extracted from WINGS is already filled in on the form, and the student need only verify their information and submit the form to confirm their account in the system. From there, the student can then continue to apply for housing. After clicking the "apply" link on the RMS homepage, the student is first prompted to choose the term for which they are applying list their preferences for the halls/communities in which they do or do not wish to live. If so desired, the student also has the opportunity to specify the ID numbers of other students with which they specifically would like to live. Each student who requests specific roommates must also ensure that their potential roommates have requested him or her as well. After all this information has been filled out by the applicant, they proceed to submit the application data and complete the application. Since they are currently not living on campus, the Department of University Housing requires that they pay a $300 refundable security deposit toward their room. This deposit confirms that a student does indeed wish to live on-campus, and also serves as the security deposit for their potential assignment. At this point, the student is directed to a billing page on the Housing site that either collects credit card information or provides instructions about alternate payment methods. Upon payment of the deposit, the student has completed the application process. From here, a student may log in to RMS at any time and view their application and/or assignment status. However, the student is not required to take any further action until the assignments have been made by the Housing department.

6.2 Business Transactions

According to the description, the room assignment process starts from creating a student profile and then by filling and submitting the form student applies for a room. However, before clicking the submission button, the student is prompted to another transaction that requires for one month deposit. So, the making deposit processes is nested inside the applying for a room process. Otherwise said, applying for a room transaction starts then the making deposit transaction starts and completes before completing the room application form. The following are the three business transactions involved in the process:

T1 – Creating a profile
Initiator – house office; *Executor* – student
Result – a new profile is created

T2 – Applying for a room
Initiator – student; *Executor* – house office
Result – an application is submitted

T3 – Making a deposit
Initiator – house office; *Executor* – student
Result – a deposit is made

Note: It should be noted that T3 (making deposit) is nested inside T2 (applying for a room). It means that T2 starts first and during its execution T3 is initiated and completed. The result of T2 is condition for the completion of T3.

Now having all the transactions identified, we place these transactions into the boundary of their corresponding business process; the resulting model is illustrated in figure 5.

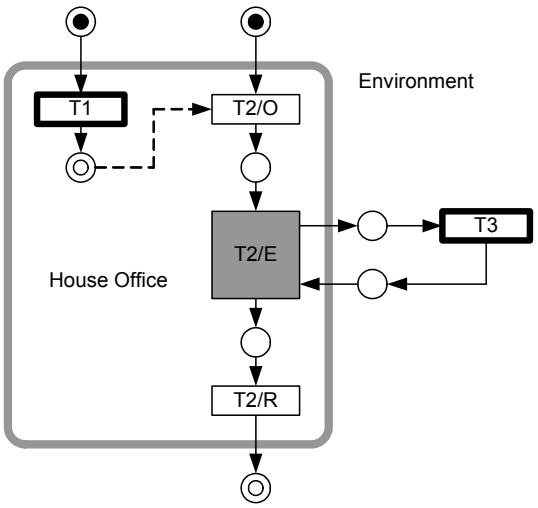

Figure 5: Detailed business processes.

The above figure illustrates main business transactions of the room assignment process. As the figure shows, the depositing process (T3) is initiated from the room assignment process but executed in the environment (outside of the boundary of this process). The result of this transaction is communicated back to the initiator. Actually, its result completes the execution of T2. Therefore T2 is split into three phases to show that this transaction is nesting transaction T3. However, transaction T1 is a simple transaction, it is represented in compact notation (all three phases are compressed into one).

It should be noted that figure 5 is a simplified version of business process model of the room assignment process. The reason for this simplification is that inclusion of all details will exceed the limit of the paper's space and scope.

7 CONCLUSION

We have studied how by communicating people mean acting, doing something or carrying out certain tasks. The paper introduced a methodology that combines the transaction concept and the Petri nets notations for constructing business process models for the purpose of IS design or IT application development. The methodology can be used for a wide range of related purposes such as to help system designers in business process modelling, business process engineering, requirements engineering, information system design and IT application development. Although for a complete IS design or IT application development much more data and details are needed, however the transactions identified and the models constructed represent essential information to understand the main business processes of an organization.

Petri nets graphical notations provide a rich set of elements for building models of systems and processes, analyzing these models using simulation software, and communicating the results with the users. The resulting business processes model, as the RAP example showed, is represented in a easily readable fashion. It will not require any expertise or technical skills to communicate such a model to business owners or among system analysts.

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