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Use Of International Standard Methodologies In Designing Business Processes

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Abstract: *The article presents the main approaches, methods and tools for modeling business processes. The most popular formalisms of Petri nets used for these purposes are considered.*

Keywords — Business process, reengineering, business process modeling methodologies, Petri nets, universal simulation modeling system.

Introduction:

Many modern companies continue to build their activities on the old management principles introduced by Adam Smith in 1776. In his work, Smith divides the production process into elementary work, each of which is performed by one worker, while he only needs to be able to perform individual operations and does not require high qualifications.

Naturally, after so many years, the principles noted by Smith no longer meet modern requirements. Today, products must be focused on narrow groups of consumers; we need performers with a good education who are not afraid of responsibility and strive to solve complex problems. The product market has become much wider, and competition and the fight for consumers has become more aggressive. The means and production technologies used have changed significantly. Information technology has begun to play a special role.

Many companies are trying to rethink previous ways of organizing their business and build new business processes using modern technologies.

A business process is a connected set of internal activities of a company that result in the creation of a product or service needed by the consumer.

An important step in structuring the activities of any organization is the identification and classification of business processes. In relation to obtaining the added value of a product or service, the main and supporting processes are distinguished. The first - adding value - are focused on the production of goods or provision of services that constitute the main activity of the organization and ensure the generation of income. The latter do not add value to the product or service for the consumer, but increase their cost. They are necessary for the operation of the enterprise and are designed to support the execution of basic business processes.

The basis of the modern approach to business organization is business process engineering, the most important area of which is reengineering.

Reengineering refers to “the fundamental rethinking and radical redesign of companies' business processes to achieve fundamental improvements in their most important performance indicators – cost, quality and speed.”

Reengineering is a set of tools, measures and methods, including relevant information technologies, designed to radically improve the key performance indicators of an enterprise. For this purpose, analysis and subsequent changes to existing business processes are carried out. To achieve dramatic improvements in existing business performance, reengineering involves fundamental changes to existing business processes. Therefore, reengineering methods can be used by an enterprise in the process of developing an innovative development strategy

Reengineering is aimed at using fundamentally new business processes in the organization, based on the use of modern innovative technologies.

The transition of an enterprise to the use of new information technologies does not mean automation of existing processes. Their use can lead not only to fundamental changes in the activities of employees, but also to a complete replacement of existing business processes.

When analyzing an existing business and developing a new one, an important role is played by building models of the company and the business processes occurring in it. Models can differ in the degree of detail of processes, the form of their representation, taking into account only static or also dynamic factors, etc.

When modeling business processes, it is very important to decide on the structure and content of modeling objects, to determine what elements the business process should consist of. Any sufficiently complex business process can include five main elements that must be reflected when forming models: planning activities, carrying out activities, recording factual information, control and analysis, and making management decisions.

Business process modeling is a reflection of a subjective vision of processes that actually exist in an organization using graphical, tabular, and textual presentation methods.

Modeling is the process of reflecting the actual (or planned) activities of an organization using a special methodology. It is important to understand that the modeling process is subjective. The fact is that 80% of the information for forming models comes from interviewed employees and managers of the organization. At the same time, both the employees' opinion about the actual progress of work and the view of the processes of the analyst who conducted the interview are subjective. The degree of subjectivity of the resulting models can become a serious obstacle to their further use.

The following goals of business process modeling can be distinguished:

1. Provide an understanding of the structure of the organization and the dynamics of the processes occurring in it.

2. Provide an understanding of the organization's current problems and opportunities to solve them.

3. Ensure that customers, users and developers have the same understanding of the organization's goals and objectives.

4. Determine the requirements for software that automates the organization's business processes.

The methodology (notation) for creating a business process model is understood as a set of ways in which real objects and the connections between them are represented in the form of a model. Any methodology includes three main components.

1. Theoretical basis.

2. Description of the steps required to obtain a given result.

3. Recommendations for use both separately and as part of a group of techniques.

If the methodology is based on a theoretical basis, then its presence makes the methodology more reasonable and predictable. However, in the absence of a theory (mathematical model), methodologies can also be successfully applied. The main thing in the methodology is to give the user a practical sequence of steps that lead to a given result. It is the ability to obtain results with given parameters that characterizes the effectiveness of the methodology. Methodologies (techniques) can be used either separately or together.

An organization model in general is a combination of functional, organizational and information models:

1. A functional model describes a set of functional subsystems and connections that reflect the order of interaction of subsystems during the functioning of a company or its divisions.

2. The organizational model describes the composition and structure of the company's divisions and services.

3. The information model describes the information flows that exist in the functional and organizational models.

Several different methods are used to model business processes, based on both structural and object-oriented approaches to modeling. However, the division of the methods themselves into structural and object ones is quite arbitrary, since the most developed methods use elements of both approaches. The most common methods include:

1. SADT functional modeling method (IDEF0).
2. Process modeling method IDEF3.
3. Modeling DFD data flows.
4. ARIS method.
5. Ericssonn Penker method.
6. Modeling method used in Rational Unified Process technology.

Some of the existing methodologies are based on state standards, some are based on corporate developments of individual companies, some are put forward by individual authors, they are divided into three categories:

1. Project management methodologies
2. Methodologies for modeling and analyzing business processes.
3. Methodologies for using software products to model business processes in a project.

Currently, there are several fairly clearly identifiable methodologies for conducting projects related to changing business processes existing in an organization. One of the most popular approaches is the Hammer and Champy methodology. Reengineering according to Hammer and Champy is "the fundamental rethinking and radical redesign of business processes to achieve dramatic, incremental improvements in critical modern company performance indicators such as cost, service and momentum." The basis of this approach is to review the organization's activities "from scratch" and develop new, more efficient business processes.

In addition to the Hammer and Champi methodology, there are other methodologies that do not have a clear authorship, but belong to individual companies, for example, methodologies for implementing projects for the implementation of automation systems Oracle, SAP R/3, BAAN, RUP from Rational, etc.

The second group includes methodologies for modeling and analyzing business processes. Currently, there are several basic ways to describe processes, based on both standards (IDEF0) and generally accepted approaches (DFD).

In addition, there are a number of notations (methodologies) for describing processes proposed by individual software product development companies. The latter includes the ARIS (eEPC) methodology from IDS Scheer AG, Germany. Also noteworthy is the BPMN 2 methodology, supported by the OMG organization, which has become a standard among professionals and is actively used to develop "executable" automated business process models.

The third group of methodologies includes methodologies for using modeling tools to create business process models. Modern modeling tools are so difficult to use that they require the development of special methods for their use in a project. Therefore, for simple projects it is often more advisable to use a standard language for drawing flowcharts and the simplest tools for creating them (editors MS Word, Visio, etc.).

The history of the emergence of various methodologies is summarized in the table.

Currently, numerous projects are being implemented whose goal is to integrate existing modeling methods and languages and create a unified methodological and technological basis for modeling business processes, and in a broader context, enterprise modeling.

In August 2000, at the initiative of Intalio, the BPMI consortium was created. BPMI is an independent organization dedicated to developing open specifications for managing e-commerce processes.

These specifications include draft standards Business Process Modeling Language (BPML) and Business Process Query Language (BPQL), intended for managing business processes. BPML is a metalanguage for modeling business processes, just as XML is a metalanguage for modeling data. BPML allows you to create an abstract executable model of interacting processes based on the concept of a state machine.

In 2003, BPMI published a draft Business Process Modeling Notation (BPMN) standard. The goal of this project is to create a common notation for various categories of specialists: from business analysts and organizational experts to software developers.

BPMN consists of a single diagram called Business Process Diagram (BPD), which maps directly to the BPML design.

The Unified Enterprise Modeling Language (UEML) project was undertaken with the goal of integrating multiple Enterprise Modeling Languages and eventually creating a unified modeling language with clearly defined syntax, semantics, and mapping rules between different modeling tools. The basis for this integration was the GERAM (Generalized Enterprise Reference Architecture and Methodology) and Zachman models. The UEML project includes the development of:

1) a common visual, template-based language for commercial modeling tools;

2) standard, tool-independent mechanisms for transferring models between projects;

3) repository of enterprise models

OMG is a consortium of software developers and users representing a variety of commercial, government and academic organizations, with approximately 800 members. OMG is developing various standards in the field of interaction of distributed systems (the most famous of them are CORBA and UML).

OMG's work in the field of business process modeling is primarily related to the concept of Model Driven Architecture (MDA). MDA integrates different modeling approaches and introduces a set of mappings between models at different levels of abstraction. Any organization using MDA can develop only those models that are required for its own purposes. Currently, OMG's three main initiatives are the creation of metamodels for describing business processes (Business Process Definition Metamodel - BPDM), business rules (Business Semantics of Business Rules, and Production Rule Representation) and ontology (Ontology Definition Metamodel). The purpose of BPDM is to integrate and provide interoperability between models used by different organizations (such as UML or BPMN diagrams). BPDM is expected to be implemented as a UML 2.0 profile. Likewise, OMG is working to standardize business rules and make them compatible with BPDM. All this taken together should in the future provide a new level of compatibility between the models used to describe business processes and software.

Among modern tools for modeling and analyzing business processes, Rational Rose, Oracle Designer, BPWin and ERwin, ARIS, etc. are widely used [1]. BPwin, ARIS and Rational Rose are more suitable for modeling business processes; let's look at them in more detail.

Rational Rose is one of the leading visual modeling tools in the software industry with full support for the UML language and multi-language support for team development, supporting the component-oriented process of creating systems. Any models created using this tool are interrelated: business model, functional model, analysis model, design model, database model, component model and physical system deployment model. Allows you to solve almost any problem in the design of information systems: from business process analysis to code generation in a specific programming language. Allows you to develop both high-level and low-level models, thereby performing either abstract or logical design.

The BPWin package is based on the IDEF methodology and is intended for functional modeling and analysis of enterprise activities. The IDEF methodology, which is an official US federal standard, is a set of methods, rules and procedures designed to build a functional model of an object in a particular subject area. The IDEF functional model displays the functional structure of an object, that is, the actions it performs and the connections between these actions.

B Pwin supports three standard notations - IDEF0, DFD and IDEF3, allows you to optimize procedures in the company, facilitates certification for compliance with ISO9000 quality standards, contains its own report generator, and has a wide range of tools for documenting models and projects.

The ERWin package is used for modeling and creating databases of arbitrary complexity based on entity-relationship diagrams; it is the most popular data modeling package due to its support for a wide range of DBMSs of various classes.

ERWin supports the SADT structural modeling methodology and the IDEF1x notation for ER diagrams of data models, allows you to reuse components of previously created models, as well as use the developments of other developers; joint work of a group of designers with the same models is possible.

The ARIS system is a set of tools for analyzing and modeling enterprise activities. Its methodological basis is a combination of different modeling methods, reflecting different views on the system under study. The same model

can be developed using several methods, which allows ARIS to be used by specialists with different theoretical knowledge and configured to work with systems that have their own specifics. The ARIS modeling methodology is based on the theory of integrated information systems developed by Professor August Scher, which defines the principles of visual display of all aspects of the functioning of the analyzed companies. ARIS supports four types of models that reflect various aspects of the system under study: organizational, functional, information and management models.

To build the listed types of models, both ARIS's own modeling methods and various well-known modeling methods and languages are used. Models in ARIS are diagrams, the elements of which are various objects - "function", "event", "structural unit", "document", etc. ARIS is focused on process description.

It was noted above that the use of new information technologies is an integral part of reengineering. At the same time, models of new business processes are directly implemented in the environment of the information support system (ISS) of the new business. The importance of COI lies not only in the fact that it is a necessary element of reengineering, but in the fact that often the use of COI largely determines the technology for conducting a new business. ISP is a specially developed software - a software system that is built on the basis of the use of appropriate tools. Another tool for modeling business processes is the Petri net (SP) apparatus. The main advantages of using SP in modeling are the following: 1) the process defined in terms of SP has a clear and precise representation; 2) the clarity of the network construction graph, thanks to which all its definitions and algorithms are easily perceived; 3) the possibility of using various analysis methods. The popularity of SP is also due to the successful representation of various types of objects present in many simulated systems, and the "event" approach to modeling. They have the best capabilities for describing the relationships and interactions of parallel processes.

In general, a Petri net is defined by the following set.

$$C = (P, T, E), \quad (1)$$

где:

P is a non-empty finite set of network positions;

T is a non-empty finite set of transitions;

E – incidence ratio of positions and transitions (set of network arcs).

In relation to business process modeling, WF Petri nets or work flow networks are most often used. This formalism was introduced by Wil van der Aalst to model work flows in workflow systems. A Petri net PN = (P, T, F) is called a work flow net (WF net) if the following conditions are met.

1) there is only one initial position i, such that there are no transitions included in i;

2) there is only one final position o, such that there are no transitions leaving o;

3) each node of this network is located on the path from i to o.

It should be noted that Petri nets, unlike all the approaches presented above, make it possible to obtain a dynamic simulation model of a business process. From the point of view of behavior over time, business processes can be generally classified as hybrid systems; they can simultaneously contain both continuous and discrete components. The continuous component reflects the continuity of processes in a real organization over time; discrete - can reflect control actions aimed at continuous processes. To model hybrid systems, a modified apparatus of nested hybrid Petri nets was presented.

VGSP can be defined by the following set:

$$NHPN = \{Atom, Lab, SN(HPN), (EN1,..., ENk), \Lambda\}, \quad (2)$$

In the VGSP apparatus it is possible to use the concepts of global and local times. The first represents time external to the system, with which it is connected by the concept of a modeling step, which allows one to evaluate the temporary change in the state of the system relative to external systems. The second is used to determine the response delays of discrete transitions and the throughput of continuous transitions of the VGSP. All discrete transitions are divided into instantaneous, deterministic time and exponential deterministic. The division is associated with determining the delay interval for transitions. For continuous transitions, the concept of throughput is introduced, which reflects the speed of movement of a continuous flow of tokens through the transition.

In addition to all of the above, the concept of arc weight and inhibitory arcs, characteristic of high-level joint ventures, has been introduced into the device.

A significant addition to the apparatus is the ability to use fractional and negative values for the weight of the arc emanating from the transition. When using a negative arc weight, one should talk about the potential of the chips located in this position. Regardless of the interpretation of the network labeling, the network dynamics equation does not change.

The dynamics of the VGSP behavior is described by the following four types of actuation steps:

1. The system-autonomous step is the triggering of the transition of the system network in accordance with the rules for the GSP, while the element networks are considered as chips that do not have their own structure.

2. The elementary-autonomous step changes only the internal state (labeling) of the element network, without changing its location in the system network.

3. The horizontal synchronization step is used to synchronize transitions in two element networks located in the same position of the system network.

4. The vertical synchronization step is used to synchronize the transition in the system network with some transitions of the element networks.

To describe the dynamics of VGSP behavior, the following equation is used:

$$\mathbf{M_k = M_{k-1} + C(p, t)U_k}$$

The modified apparatus of nested hybrid Petri nets significantly expands the scope of application of classical SPs and existing extensions, and makes it possible to study hybrid systems with a complex structure as a single whole.

As noted above, the creation of a universal business process modeling tool is a pressing task today. Nested hybrid Petri nets can become such a device. Combining the features of various extensions of classical Petri nets, they have all their advantages, allowing one to study systems of varying complexity.

The modified apparatus of nested hybrid Petri nets can be used as the basis for constructing a universal modeling system, which will not only save time in the development and implementation of a simulation model, but also make the modeling process simpler and more accessible. At the same time, the likelihood of errors occurring during the creation of models due to insufficient knowledge of language tools, inattention when working with large amounts of information, etc. is reduced.

Research in the field of modeling business processes using Petri nets and building a universal simulation modeling system will be continued in the future.

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