CASE ON MODELING OF MANUFACTURING SYSTEMS BY MODIFIED IDEF0 TECHNIQUE

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Abstract: The paper is concerned with a process management from the point of view of business process mapping. It is focused on methodological aspects of business process modeling leading to development map of processes with consistent linkages between all hierarchical levels. Used approach is directed at support of managing processes that flow across departments and/or functions within the organization. Developed process mapping technique is based on process decomposition that is resulting in a set of business structure models, which are represented by diagrams.

1 INTRODUCTION

Such as industrial manufacturing process models were considered as the primary management references for the last century, nowadays, services business process is going to be the dominant models of management, points out Champlin (2007). In a simplified way it means that services business processes are becoming gradually more decisive and complex. Accordingly, developed methods for services business processes analyzing and designing are adequately sophisticated. Regardless of that fact, modelling techniques for industrial manufacturing processes need to be optimized not least with the aim to achieve a common infrastructure of manufacturing and administrative operations.

The effective business process management (BPM) depends on how well it defines responsibilities and forces an employee to take control of their own performance. The first ultimate precondition for achieving this goal is a properly structured company, in which management can spend most of it's time planning, improving and monitoring results. Therefore BPM approaches emphasize a focus on business processes as holistic concepts for addressing work performed by organizations (Lind, 2005). A determination of optimal organizational structure in a company assumes to identify the globally optimal process structure by conceptual design approaches. Conceptual methods of (re)designing the process structures are usually represented by existing business process reengineering (BPR) methodology. The common practice of designing business processes is to use a so called participative methodology based on involving and stimulating a group of experts in the design of business process structures. This approach is described in more details by Peppard and Rowland (1995), J. C. Taylor (1998) and Sharp and McDermott (2001). According to Hansen (1994), BPR efforts require scientific - analytical techniques, as non-analytical approaches lead to many failures of BPR projects. However, approaches that relates to analytical BPR methodology do no really qualify as mature methodologies, but rather represent technical principles or heuristics that may be used to render superior new business process (Reijers, 2002). Technical BPR principles that primarily by Hammer and Champy (1993) were presented are often derived from experience gained within large companies. According to Davenport (1995), "classical reengineering" repeats the same mistakes as the classical approach to management by separating the design of work from its execution. For overcoming this shortage can be effectively used Integration Definition (IDEF) modelling techniques that represent alternative approach for business process redesign. The paper is structured in the following way. After a selection and description of process Modelling Technique are identified as main differences as identical signs of original and modified version of IDEF0 technique. Further the main steps of manufacturing process modelling are described. Finally some findings and research conclusions are mentioned.

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2 SELECTION AND DESCRIPTION OF THE PROCESS MODELING TECHNIQUE

Utilization of business process modelling methodologies varies depending on a particular purpose or activity. Business process models can be used as aids in re-engineering processes, for testing the processes or for developing simulation systems to automate the processes and so on. As widely exploited traditional process modelling tools can be recognized Flow charts, Data flow diagrams, Control flow diagrams, Functional flow block diagram, Gantt and PERT charts without the exception of others. Some of them provide only limited possibilities without power to properly describe complicated models of cooperating processes. Among very common modelling methods belong also IDEF models. There are several types of IDEF models. The most familiar are IDEF0 diagrams that model the tasks performed by an organization at a high level of abstraction. Process details are captured in IDEF3 diagrams. The major IDEF methods in use are described for instance by Mayer, Painter, deWitte (1992). Since modelling by IDEF0 diagrams is very usable tool also for applying and adopting of the process approach philosophy in organization it inspired to use this method as a base for modelling of real manufacturing system.

Process mapping by this technique begins with the description the system as a whole at the highest level and then decomposing this model level by level to describe each of the sub-systems within the system hierarchy. The IDEF0 notation was standardized in 1993 by the National Institute of Standards and Technology of the USA (FIPS, 1983). Use of this standard permits the construction of models comprising system functions (activities, actions, processes, and operations), functional relationships, and data (information or objects) that support systems integration. The another reason for a selection of the IDEF0 model is that it is composed of a hierarchical series of diagrams that gradually display increasing levels of detail describing functions and their interfaces within the context of a system (see fig 1a). Moreover, simple text and glossary diagrams, which provide additional information in support of graphic diagrams, help to bridge semantic gaps between model designers and model users.

The above mentioned process modelling tools presents naturally only a fraction of the methodologies used over the last decades. Hommes (2005) has identified twenty different techniques and over 350 different process modelling tools. A new group of methodologies is under development to meet the needs of modern e-businesses technology.

3 MODIFIED VERSION OF IDEF0

3.1 Some Identical Signs of Original and Modified IDEF0 Version

Both modified and original versions:

- compose of a hierarchical tree of diagrams that gradually display increasing levels of detail describing functions and their relations within the context of a system. They use three types of structured representations: graphic, text, and glossary. The graphic diagrams define functions and functional relationships via box and arrow syntax. Text and glossary components provide additional information in support of graphic diagrams,
- provide a systems engineering approach to performing systems analysis and design at all levels, for systems composed of people, machines, materials, computers and information of all varieties and producing reference documentation concurrent with development to serve as a basis for integrating new systems or improving existing systems,
- are offering reference architecture for enterprise analysis, information engineering and resource management,
- use common syntax, where arrows represent data or objects related to functions. Rules define how the components are used, and the diagrams provide a format for depicting models both verbally and graphically. A box provides a description of what happens in a designated function. Arrows that bend shall be curved using only 90 degree arcs.

3.2 Some Staple Differences between Original and Modified IDEF0 Versions

The box name in the modified version is noun that labels the object (process or entity) and moreover is denoted by alphabetic character with index describing the level of process decomposition. Objects are classified to six basic classes. Five of them are hierarchically arranged from top to bottom as follows (Modrák, 2005):

- Unified Enterprise Process (UEP),
- Integrated Process (IP),

- Elementary Process (EP),
- Complex Task (CT),
- Activity (A).

A non-hierarchical class of object is reserved for external entity (external partners of a company). In the modified version, arrows connecting boxes serve for description all important kind of flows. Basically, three kinds of flows are admitted between each potential source and receiving objects, be it information, material, or financial ones. We generalize them as commodity flows. Diagrams in the modified versions consist of the following diagrams (see fig. 1b):

- System diagram,
- Context diagrams,
- Commodity flow diagrams,
- State transition diagrams.

4 MANUFACTURING PROCESS MODELING USING MODIFIED IDEF0 DIAGRAMS

Presented manufacturing process modelling technique is based on process decomposition that is resulting in a set of manufacturing structure models, which is represented by above mentioned diagrams.

The first step of this method is the creation of a System diagram that model the structure of key processes performed by an organization at more general level of abstraction. Subsequently, relations between them and the enterprise environment are specified. The environment is represented in a System diagram by External entities, with which the system communicates, while their content is not a subject of analysis in the following steps. Even though, further these relations are analysed. They usually represent the initial source of commodity flows, or their end consumer. Fig. 2 shows an example of System diagram describing real model of manufacturing company producing plastics components.

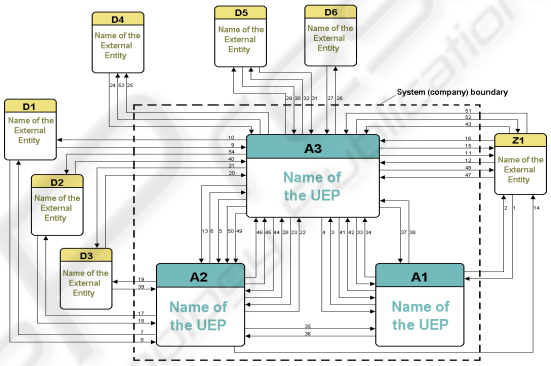

Figure 2: Example of a System diagram.

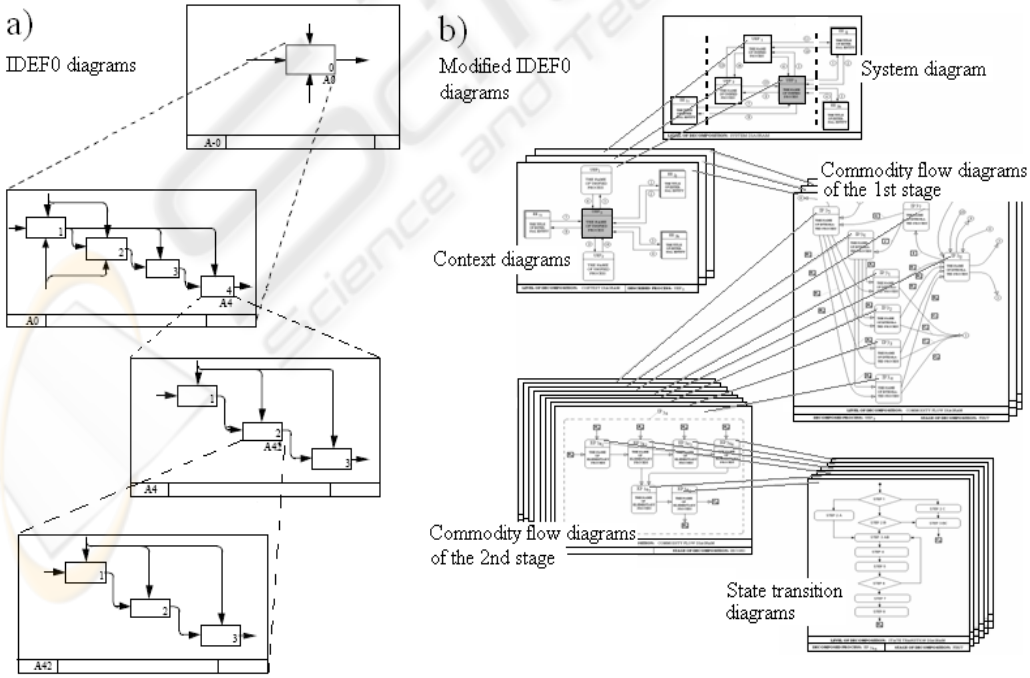

Figure 1: a) Structure of IDF0 diagrams, b) Structure of modified IFEF0 diagrams.

The purpose of the CFDs is gradual decomposition of UEP, up to the level of so-called elementary processes. CFDs of the second stage are constructed in an analogous way as CFDs of the first stage. It is the last stage of commodity flow diagrams because the Elementary processes, which present the objects of modelling, are considered to be the primitive processes.

Subsequently are created context diagrams for each Unified enterprise process depicted in a System diagram. Individual Context diagrams express relations only of the given UEP with its environment.
All surrounding elements of the give in UEP in Context diagram, irrespective of whether they represent objects outside the enterprise or internal processes, are considered as External entities. Supplier/customers rules might be the same as for external as for internal mutual relations.
Consecutively, Commodity Flow Diagrams (CFDs) of the first stage are designed for A1, A2 and A3 process, which describe relations usually between Integrated processes. Two of them for the A2 and A3 processes are shown on Fig. 3 and 4.

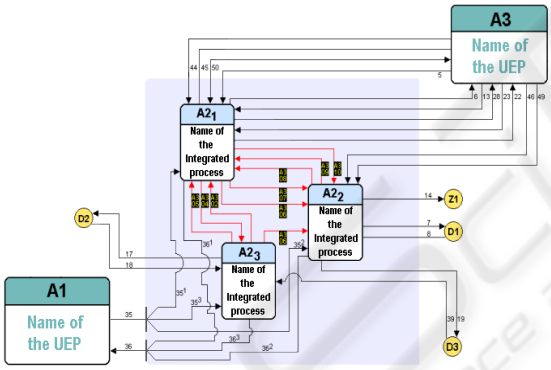

Figure 3: CFD of the 1st stage for the process A2.

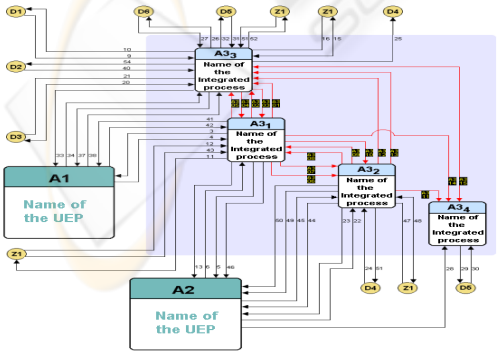

Figure 4: Commodity flow diagram of the 1st stage for the process A3.

The objective of the State transition diagram is the description of the dynamics of Elementary processes by modelling states, in which objects occur and transitions between actual states. These diagrams also describe events that initiate transitions between states and conditions for the realization of these transitions. In analogical way, State transition diagrams of the second stage are sequentially created. As the consistency of inputs and outputs is rigidly respected, so that it is possible to create process maps, starting at the level of Commodity Flow Diagrams at the first stage, up to the level of state transition diagrams. An example of the creation of the process map from the previous Commodity flow diagrams is depicted in Fig. 5.

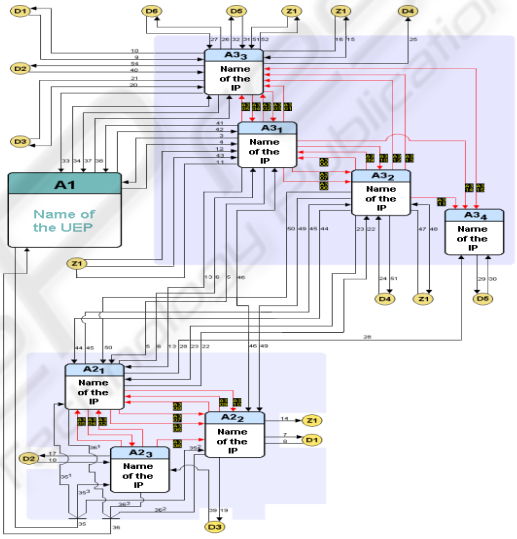

Figure 5: Example of a process map by the merging of two CFDs.

5 DISCUSSION AND CONCLUSIONS

Presented static model is used to understand an enterprise or a system and its processes prior to implementation. This form of enterprise modeling also can help reduce complexity or/and act as a documentation tool for quality management system by ISO 9001:2000. One of the potential effects of such models is creation precondition for applying and adopting process management in organization. The meaning of the process approach lies in a increasing of the effectiveness of the organisation management and a creation of preconditions for an effective information system development. The formation of a process-oriented organisation cannot

be narrowed to the redefining of processes in the form of their new description and redesign on the basis of the abstract models creation. The transition to the process-oriented organisation envisages a noticeable change in its very existence. That includes the use of potent management tools, such as information systems, which automate business processes by controlling the sequence of activities and by the activation of necessary resources.

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