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Integrated Business Process Modeling, Analysis and Supporting Tools

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Abstract

The method of object-oriented process optimization bases its view of the company on the overall production process. In the course of the reengineering process it leads to an organization and architecture of the business processes that is commensurate with the market's requirements. The method escorts the user from a general architecture to the specific architecture of the system support and to the interfaces in his company. The model structure insures the integration and the common understanding of the business processes in the company. It creates the prerequisite for assigning the use of design processes as precise improvements of costs, quality or time to the respective business processes and resources. It is therefore the basis for any optimization process.

Keywords

Object-oriented, business process, IEM, MO²GO, ISO9000ff, STEP, EXPRESS, modeling, workflow, system analysis, process modeling, business process modeling, business process analysis, business process, reengineering, implementation.

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1 INTRODUCTION

Worldwide competition is getting fiercer every day and requires companies to strictly orient their operations towards the market. Constantly changing markets require a high speed of response and a high degree of flexibility. To survive in a competitive climate, companies also need to place great emphasis on customer orientation. Cost pressure and customer orientation call for an improvement of the quality and efficiency of business processes and for quick adjustments to shifts in the market.

To attain the objectives, companies often analyze processes. Information on the quality, control, optimization, costs and the comparison (process benchmarking) of processes as well as on responsibilities and environmental aspects may be obtained with different methods. The required data and structures, such as models of the organizational structure and the process organization (process structure, process chains), are often similar or are based on similar basic structures. A method to model and analyze business processes needs to take these different model views into consideration. The method also needs to enable users to use the recorded data and models beyond currently studied partial tasks. The objective is to introduce process models as a basis to easily record and process information in a company.

Quality management and business process modeling are already available in many companies. The development of methods to optimize business processes remains to be one of the core tasks of corporate planning. Furthermore, in view of dynamic markets and changing basic conditions such as laws and the policy environment users have to be able to analyze and adjust business processes on an ongoing basis. Methods need to be developed that allow users to continuously use business process models and the appropriate tools. IPK Berlin coined the term „Continuous Engineering" to describe the approach to continuously trace market requirements and to continuously use new technologies in the field of business processes.

2 INTEGRATED BUSINESS PROCESS MODELING

To fulfill all the different requirements an object-oriented concept is used (COA90, HAM94, RUM91). The method takes advantage of the object-oriented approach to integrally describe information and functions as views on a single model of the company. The core of the model structure includes the views 'business process model' and 'information model'. The production and all activities connected with the production are described in the model as functions and business processes related to objects (MER94a, MER95a, MER95b).

The method of object-oriented process modeling and optimization bases its view of the company on the overall production process. In the reengineering process it leads to an organization and architecture of the business processes that is commensurate with the market's requirements. The concept is based on the method of „Integrated Enterprise Modeling" IEM (SPU93, MER94c, MER95e).

In this context, business processes are understood as chains of operational activities and their network-like relations that are oriented towards the objects 'product', 'order' and 'resources'. Between the business processes is a customer-supplier-like relation. They extend over organizational and system boundaries and have a defined overall result.

The design of a model, as a description of an individual company, is based on the object classes 'product', 'order' and 'resources' (SPU93). When constructing the model, the required data and functions are related to the objects and the relations between the objects are

determined. According to a selective level of detail this results in a comprehensive registration of the tasks, the process organization, the corporate data, the manufacturing system and the components of the information system.

The view 'business process model' emphasizes the tasks and functions that are related to the objects. The structures and features that describe the objects are portrayed by the view 'information model'.

Companies are most interested in the development of products. Therefore, the products of a company are identified as specializations of the class 'product'; the business processes related to the products are modeled independent of the organizational structure. This enables the development of new organizational structures that are optimally adapted to the business processes.

The next step contains the identification of the resources and orders for the individual functions of the defined business processes. For the sake of consolidation, the functions to generate, process and provide orders and resources can be modeled. The mutual dependencies of the business processes are described by concatenation elements that represent alternatives, parallelisms and loops *(figure 1)*.

The described method is suitable for many planning and structuring tasks in companies. The application includes the design of material and information flows. In projects, the systematic and transparent description of business processes as a communication base between the departments and between the different hierarchical levels proved to be successful. Among other things, time saving potentials were made clear. The distribution of costs was improved with regard to the respective 'initiators' and the deployment of personnel was improved with regard to qualifications.

The exchangeability of models between project groups and companies requires a uniform modeling language with standardized constructs. The modeling concepts presented here coincide with the 'Framework for Modelling' (ISO TC 184/SC 5 WG 1). The basic language constructs are part of the European pre-standard „Computer Integrated Manufacturing-Constructs for Enterprise Modeling" ENV 12204.

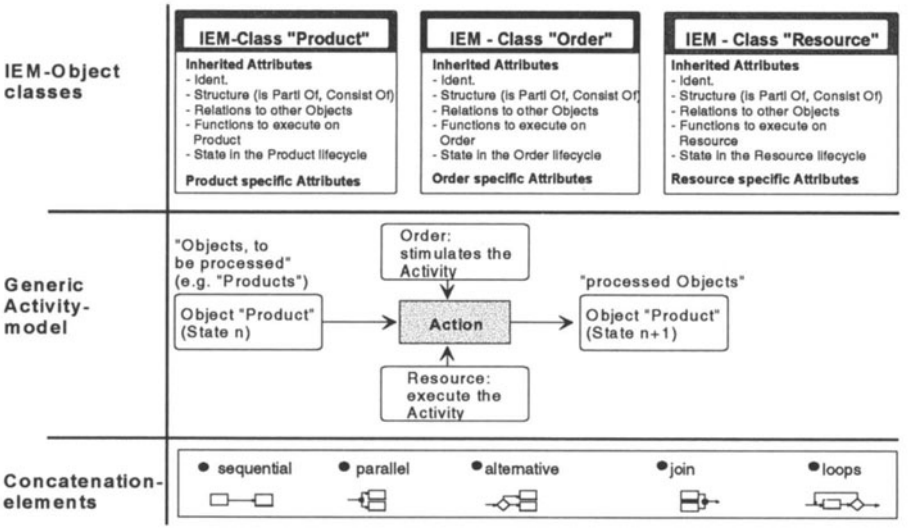

Figure 1: Modeling Elements of IEM.

3 DIFFERENT VIEWS ON THE MODEL

The object oriented approach enables the user to relate different process analyses to a model core. Models and information required for one analysis need only be supplemented for further analyses (COA90). They do not anymore need to be constructed anew.

For business process reengineering purposes the model is used to analyze weak points and to identify improvement potentials (MER95f). For that purpose the corporate structures may be visualized, reference models may be employed, times and costs may be analyzed and model-based discussions may be carried out.

IEM enables users to locate and visualize improvement potentials on the basis of the model structure. For example, interruptions of the process support by information systems and interfaces between organizational units can be located and visualized. Order processing and product development processes, construction processes and resourcing processes were studied and optimized in industrial projects.

A process model that was developed in a reengineering process can be used to create manuals (QM manual ISO 9000ff, Environmental Management Manual ISO14000) by way of adding additional classes and attributes (MER95c). A corresponding class structure for QM manuals has been developed at IPK Berlin. It has already been applied in projects. To generate QM manuals one may either use existing enterprise models or develop new ones. IPK Berlin has also developed branch-specific reference models to create QM manuals for the food industry and for software suppliers. These reference models further reduce modeling expenses and facilitate the creation of manuals for the certification of companies.

When creating the manual, additional information is linked with the process model (*figure 2*). The information can be supplied directly through a graphic description of the process model or indirectly through appropriate documents that were generated by the model, for example QM manuals. The possibility to transparently describe business processes and to provide additional information leads to further possible applications of the business process model in the company.

The model may be used to provide employees with information. The employees can identify their processes on a graphic user surface and may extract the appropriate information. In this case, the process model serves as an information system and a store of knowledge for new employees who may obtain additional information on the sequences of their processes. This results in a higher level of participation and in an improvement of the processes. Similar results were achieved with the help of CAD/CAM systems. The employment of these systems as a means of communication between development, production planning and manufacturing departments resulted in a considerable reduction of lead times (GRO94a, GRO94b, MER95d).

A key point is the continuous analysis and optimization of business processes. This may be done by employees who are adequately informed as well as by optimization measures such as process benchmarking.

For this purpose, the IEM model may also be used by way of adding process index numbers (attributes). These are required to evaluate processes and to compare different processes. Therefore, the model not only offers structural information for process benchmarking, but also explicit index numbers. The values of the attributes can be evaluated, balanced against each other and compared with the different process structures.

A selection of the various possible applications of the IEM enterprise model was presented. The simultaneous execution of different activities may be sensible and may also reduce costs. The creation of a QM manual, for example, could be connected with a study and optimization of existing business processes.

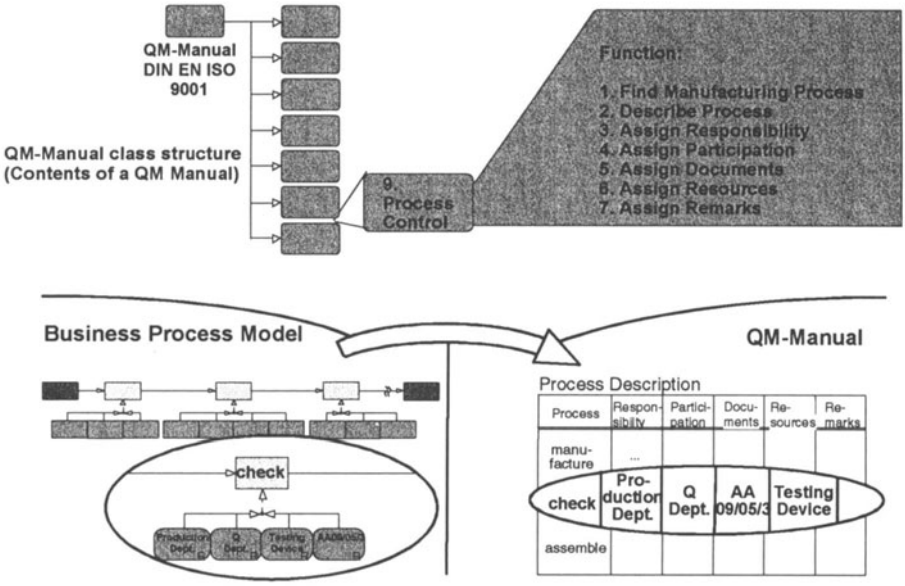

Figure 2: Automatic Derivation of Documents from the Process Model

4 FURTHER DEVELOPMENT

The various possibilities of application of IEM business process models presented thus far have all been tested and have mostly been employed in industrial projects. In the future, the integration of business process models and business process analyses needs to be emphasized. Ultimately, the business processes and tools have to be continuously adapted to the ever-changing environment. Therefore, the employees have to be integrated into the business processes, for example through supporting workflow systems. An important prerequisite is the possibility to exchange data between different software systems (PPS, business process modeling tools, workflow and information systems). Adapted business process models could then be implemented much faster. If the models do not prove successful in reality the actual processes should be updated directly within the model.

The data exchange between software systems within the company and tools to model and optimize business processes enables users to continuously analyze, inspect and control the business. Constant expenses for modeling and data input are reduced or become void. Therefore, the determination of the processes' need to adjust on the basis of pre-defined critical values is possible.

The connection of corporate data with the business process model may be based on existing or currently developed standards. Product specifications can be exchanged through STEP (Standard for the Exchange of Product Model Data; ISO 10303). A standard for the exchange of data through processes and proceedings is currently being developed as STEP, part 49 (Process Structure and Properties Model). Corresponding standardization studies are carried out, among others, by the Workflow Management Coalition.

5 SUPPORTING TOOLS

Tools are available to effectively apply the object-oriented modeling to business process modeling and analyzing

A manual with modeling rules describes effective proceedings to design an enterprise model with IEM (MER94b). The rule book includes descriptions of detailed modeling rules with examples of application for different fields of application, for example, the identification of the product structure and relevant processes and the identification of weak points and improvement potentials.

Libraries containing examples and reference models to design models effectively and quickly are supplied. System-specific reference models support the selection and introduction of standard software. Classes for analyses and specific applications, examples of various industrial projects and reference models for specific fields of application, for example the production of unique items or the creation of QM manuals, are available. A support system for the application of reference models and their dynamic adjustment is being developed. In the future, they have to support and speed up the development of company-specific (reference) models through appropriate tools. For that purpose, certain procedures are supported, for example the introduction of decentral structures. The construction of the model will then take place interactively in a dialogue with the user.

Many of the applications and fields of application described in this paper, such as the automatic generation of manuals, can only be employed successfully with the support of appropriate software. A suitable software tool has been developed.

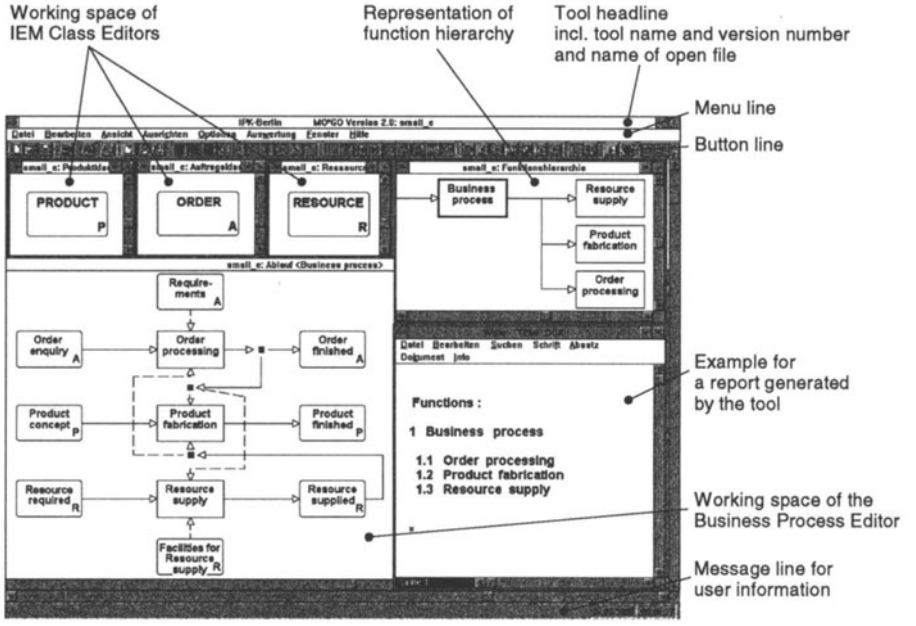

Figure 3: MO²GO User Interface.

The software tool MO²GO (*figure 3*) supports object-oriented modeling with IEM. The universal tool for the description and analysis of operational structures and business processes

allows the comfortable description and the purposive analysis of products, orders, resources and the respective business processes. The main advantages of the application of the tool are the possibilities to systematize the reengineering and optimization process and to reuse the enterprise model for later projects with different objectives and optimization tasks.

With MO²GO the design and certification of companies are sped up and facilitated. MO²GO increases the acceptance by employees and thus reduces costs. Refinement functions, deposited modeling rules and structured procedures support a structured approach to modeling tasks. The possibilities of the object-oriented approach and extensive functions to define objects and business processes enable the user to describe his specific notion ofthe company.

The illustration of the results of reengineering and optimization processes is supported by various evaluation and documentation functions. Results may therefore enter the operational decision-making processes much faster.

Additional classes and attributes can be added to MO²GO models easily. These would then be available in libraries and could be loaded from there. For example, corresponding class structures to generate ISO9000ff documents could be loaded into existing models. With the help of these classes, QM manuals, based on business process models, can be developed automatically *(figure 2)*. The maintenance of the manuals is facilitated if changes within the company are directly documented in the models. The design of business processes and the development and actualization of QM manuals are being integrated into one operation.

To support standardization efforts within the framework of STEP an EXPRESS (IND92a, IND92b) interface was specified for MO²GO. The interface, as a connection between the process model and the product model, may be further developed and may then be implemented. MO²GO includes a method to connect the process and the product model. The description of the product structure is connected with the process model through object relations and stages of the product life cycle *(figure 4)*.

Macros to develop specific display formats of results are available, for example to automatically generate formatted WinWord documents or EXCEL graphics. These techniques allow the statistical analysis of cost and time attributes of the model as well as their graphic representation. Statements on order and resource relations as well as on the creation and the use of documents can also be made. Target performance comparisons or benchmarking may use these index numbers of different models.

The system environment for the employment of the tool MO²GO should include an IBM PC or compatible computer with MS-DOS/Windows 3.1® or higher (Windows 95, Windows NT). A 486 chip computer is required. The hard disk drive should have at least 10MB; 8MB RAM should be available. For the implementation of the user interface a special commercial class set is used which supports different platforms. The system core is implemented in C++. This enables easy and fast movements to other platforms, for example to UNIX. The system architecture enables the availability of an external programming interface. The training costs for the tool functionality should be low because the user interface is oriented towards other MS-Windows software, e.g. WinWord.

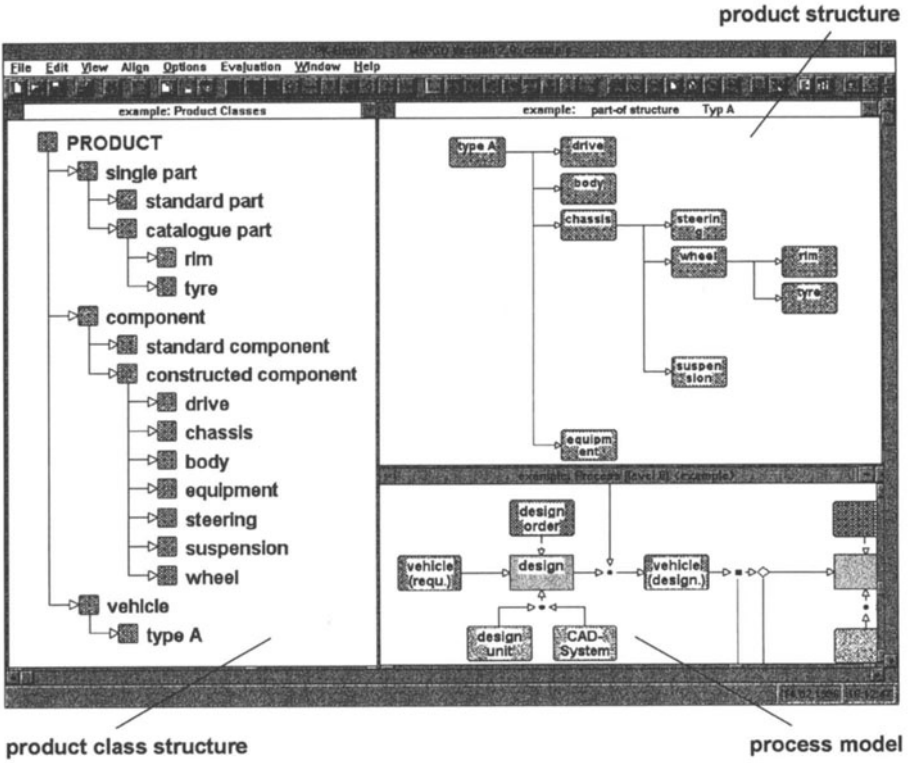

Figure 4 Process Model and Product Structure

6 CONCLUSION

Integrated Enterprise Modeling (IEM) enables users to describe the company-wide control, production and resource provision processes along with the required data in one integrated model. The object-oriented method was developed in compliance with the requirements of industrial projects and standardization efforts. The method was tried and tested in a multitude of operational applications. It enables users to parametrize processes easily and describes the life cycles of the objects changed by the processes, e.g. product life cycles. IEM is supported by a modeling tool for the object-oriented business process optimization (MO²GO). The transparent description of the business processes, supported by this method, serves as an effective basis for discussions and enables users to identify optimization potentials on the basis of the model structure. The object-oriented method may serve as basis for workflow analyses, the calculation of process costs, benchmarking and simulation. Furthermore, it should be used to specify and implementworkflow systems.

The approach reduces the expenses to register the required data and, in connection with a software tool, also the expenses to develop specific documents. The utilization of the model in the company is facilitated as well.

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8 BIOGRAPHY

Dr.-Ing. Kai Mertins was born 1947 in the Federal Republic of Germany. After studying Control theory in Hamburg and Economy together with production technology at the Technical University of Berlin, he became member of the scientific staff of the University Institute for Machine Tool and manufacturing Technology (IWF), Berlin/FRG.

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He has more than 15 years experience in design, planning, simulation and control of flexible manufacturing systems (FMS), manufacturing control systems (MCS), shop floor control systems, and computer integrated manufacturing (CIM). He was General Project Manager in several international industrial projects and gave lectures and seminars at the Technical University Berlin, Polytechnic Nottingham/UK, Czech Republic, Indonesia and China.

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Dipl.-Ing. Roland Jochem was born in 1962, studied mechanical engineering at the university of technology in Berlin. Experience in industry working as mechanical engineer. Since 1988 researcher, since 1991 leader of a group working in manufacturing integration within the Fraunhofer Institute for Production Systems and Design Technology (IPK Berlin), department of systems planning.

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