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Confidence in a Network of Cooperating Companies -- QM-Documentation for Certification

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Abstract

Cooperation between and within enterprises should be strengthened. Transparency of the processes promotes communication and confidence between all partners. International cooperation calls for precise sequences of operation as well as for performances in line with market conditions, i.e. performances that are available on time and in the necessary quality. Modeling leads to a clear view on business processes and is an essential step in the process of organizing enterprises. Relevant aspects of modeling and discussion contain all data about the quality of processes and the quality of their performance. It could also be used as basis for QM and organizational manuals. Integrated Enterprise Modeling (IEM) represents planning information transparently and is therefore the basis for discussion between project participants. In order to evaluate the variety of planning information and description requirements IEM enables different views on one consistent model as well as the business processes belonging to them. The software tool MO²GO (method of object oriented business process optimization) supports the modeling process based on the IEM method. It allows a transparent description of the business processes as well as an analysis of costs, times or quality to enable participants to identify optimization potentials.

Keywords

Object-oriented, business process, IEM, MO²GO, ISO9000ff, enterprise modeling, process modeling, business process modeling, business process analysis, business process reengineering, reengineering quality manual, QM-documentation, certification

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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 require continuous improvements in the quality and efficiency of business processes and quick adjustments to shifts in the market.

One way to increase the flexibility and reduce costs is to introduce decentralized, self-reliable forms of organization. The use of worldwide communication networks (e.g. Internet) invalidates the importance of proximity within a decentralized company. Independent companies with locations all over the world can therefore cooperate and divide their labor.

Different customer specific demands leads to changing partners for cooperation. The identification and cooperation with new partners requires some trust in their process and product quality. 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 essential 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.

International cooperation calls for precise sequences of operation as well as for performances in line with market conditions, i.e. performances that are available on time and in the necessary quality. In the course of international job-sharing efforts between different independent companies, confidence in the productivity of the respective companies is gaining growing significance. The processes leading to and the quality of the performance are equally important. Especially the quality of the processes may be established with the corresponding documentation and subsequent certification (e.g. according to ISO 9000ff). The business process can be analyzed and improved simultaneously. The objective is to develop transparent and up-to-date documentation to insure the necessary communication between the people involved and to identify the suitable partners.

2 METHOD

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, 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 must also permit users to employ 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, to describe the efficiency and to insure the performance of the company beyond its boundaries.

Business Process Reengineering appears to be a way to develop the most successful customer-oriented business processes. To optimize business processes it is necessary to examine and plan several aspects of a company (GRO94). These aspects are illustrated in figure 1. Modeling methods used for BPR must elucidate these aspects and their interrelations.

A model core should allow users to describe changes, for example regarding the organizational structure. The effects on processes and throughput times have to become visible. To evoke the participation of management and staff the models have to be easy tocreate and understand.

The derivation of different views on the modeled information should be possible. These views should filter the information that is then focused in new structures and layouts. An important view is the documentation of QM systems. It is therefore necessary to describe the aspects that were defined by ISO 9000 ff and to transfer them into the layout of a QM manual. The derivation of a QM documentation from an enterprise model results in a documentation that is consistent and easy to update.

In this way modeling methods could support the introduction or optimization of quality management as well as the development and update of quality manuals. The use of the same models to document business processes and quality manuals enables users to automate the update of the manual with every process innovation(MER95b).

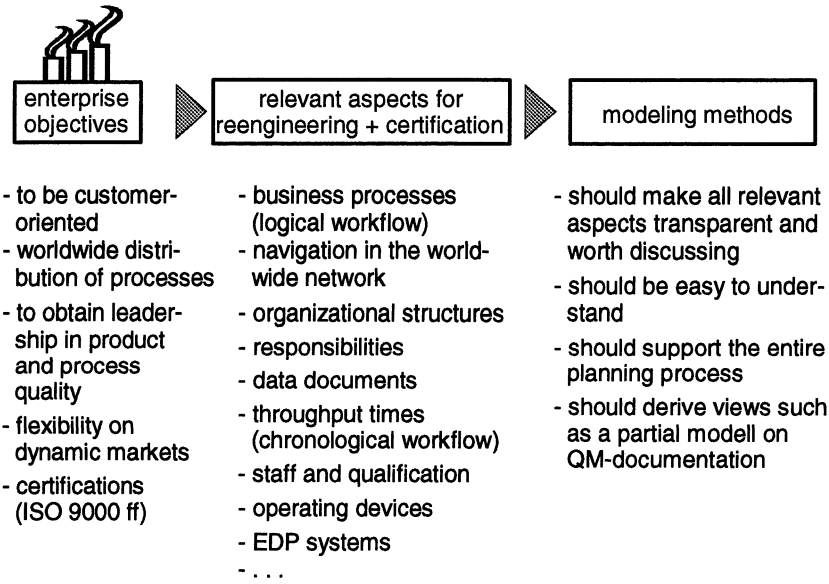

Figure 1 Requirements of Modeling Methods

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 (MER95a, MER95b). The concept is based on the method of „Integrated Enterprise Modeling" IEM (SPU93, MER95c). When constructing the model the required data and functions are related to objects (SPU93). 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.

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. On the basis of this relation, one may develop network-like structures with different partners.

Customers are mainly interested in the provision of a service, less in how this service was provided. However, customers have to trust the performance of the supplier. The quality of services and products according to the schedules are therefore of crucial importance. QM documented by business process modeling is a way to achievethese confidence.

The modeling approach permits the description of a network of processes along with the respective companies as well as the description of the processes of the own company. The described method is suitable for many planning and structuring tasks in companies. The application includes the design of material and information flows. 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 in several projects. 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 Modeling' (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.

3 DERIVATION

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. 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 resource processes were studied and optimized in industrial projects.

Figure 2 shows the most important aspects to evaluate such processes. To model these aspects means to have the basis for a documentation of the Quality Management. It can be used as information for all partners in a network about the functional capacities and the QM of the enterprise.

Aspects to model	Why?
Processes	is the kernel of planning task; thinking in processes should be improved against identification with departments
executing organizational units	identification of organizational breaks and potentials for cooperation
Responsibilities	necessary for QM-Manuals
Data Documents and EDP-Systems	to show sources and needs of informations; breaks between EDP-Systems
Time	important aspect for process optimization (Throughtput-times) and project-management
Costs	one of the main aspects for evaluation of processes
operating devices (e.g. measuring tools)	necessary for QM-Manuals

Figure 2 Important aspects for enterprise modeling.

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 (MER95b). A corresponding class structure for QM manuals has been developed at IPK Berlin. It has already been applied in projects. Two ways are possible to come up with enterprise specific models for automated generation of QM-manuals. One may either use and adapt existing enterprise models or develop new ones. IPK Berlin has also developed branch-specific reference models 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.

The relevant information may be described as part of the process model, as attributes of the object structures or as textual descriptions of objects. The structures of the QM-manual, the general orders and the work assignments are defined as resources. Each chapter and each instruction is specified individually and is supplemented by textual descriptions. The usage of the general orders and work assignments, of other documents, devices and responsibilities is described in the process model

When creating the manual, additional information is linked with the process model (figure 3). The information can be supplied directly by a graphic description of the process model or indirectly by appropriate documents that were generated by the model. 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.

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 processes, but also explicit index numbers. The attributes and their values permit the use of the model as an information platform as well as the evaluation and comparison of sequences of processes.

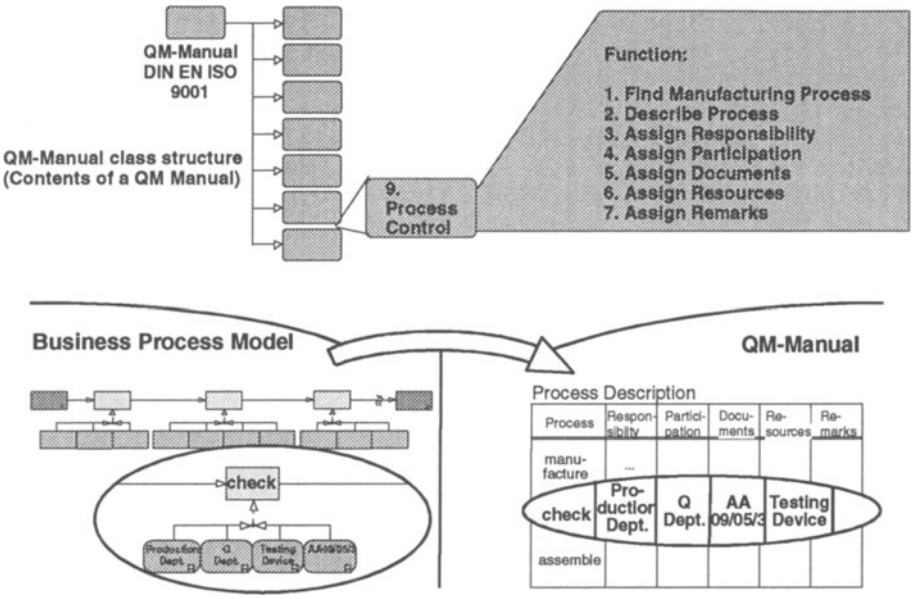

Figure 3 Automatic Derivation of Documents from the Process Model

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.

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. Important prerequisites include the possibility to exchange data between different software systems (PPC, business process

modeling tools, workflow and information systems) and the appropriate connection between the companies.

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 enabled.

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 TOOLS

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

As a tool to develop a model-based QM documentation the user is equipped with a guide. The guide includes the description of procedures of certification in conjunction with the necessary steps to develop a company-specific model. The QM documentation can be derived automatically from this model.The guide includes the description of the following steps:

1. Realization of a preparatory workshop - the goals and sectors of the company relevant for certification are determined, a job schedule for further activities is set up.
2. Development of an aggregate planning concept of the QM system - the enterprise model is developed, improvement potentials of the business processes and the QM system are identified: cost-benefits are estimated, a plan to introduce or extend the QM system is established.
3. Initiation of a QM team - a project team is set up and is entrusted with the task of introducing the QM system.
4. Development and realization of the QM system - the QM elements are defined and, afterwards, described in the enterprise model; measures to optimize the business processes are developed and enacted.
5. Introduction of the QM system - the employees are informed and trained; the QM system is 'exemplified' by selected promoters.
6. Certification - an internal pre-audit and the certification audit are carried out.
7. Stabilization, QM coaching - the QM system is improved continuously and is documented and prepared for following certification activities.

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 decentralize 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.

The software tool MO²GO (figure 4) 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 of the 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 3). 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 (figure4).

Macros to develop specific display formats of results are available, for example to automatically generate formatted MS-Word for Windows 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.

6 Practical Experiences in a Few Words

The method is used in manufacturing sectors, service sectors and distribution areas. It enables users to design and analyze integrated enterprise models. Different companies may be involved

in the individual processes. An example is the integration along the process sequence product development, production, shipping, maintenance and recycling

Experiences using the method and the tool for the automatic generation of QM manuals on the basis of a business process model were made in the food and software industries. The experiences revealed that customers prefer certified contractors. But why do they want their suppliers to be certified and what are the benefits of certification really? These questions need to be answered because the quality of certificates still varies!

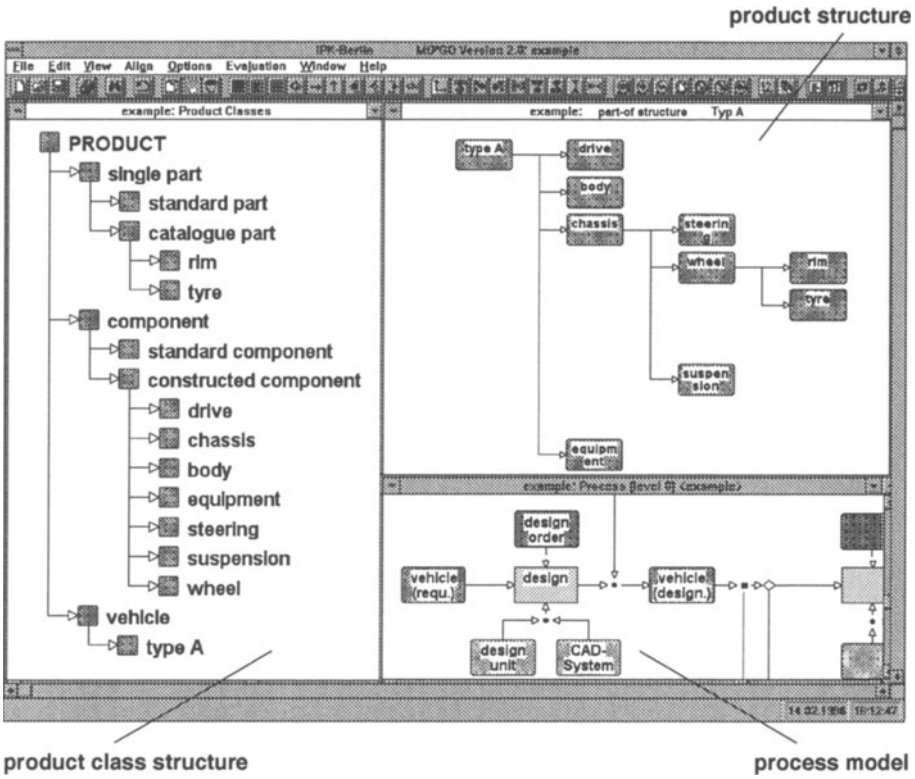

Figure 4 Process Model and Product Structure.

7 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 description of distributed structures (networks) can take place with the same method as the description of the individual processes or performers. 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 could be used to specify and implement workflow 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 (such as the ISO 9000 ff documentation). The utilization of the model in the company is facilitated as well.

The method leads to cost effective documentation of business processes and QM systems. The process models specify possibilities and requirements for the cooperation of companies. To prepare these transparent descriptions of processes and used QM methods for possible partners cooperation means to start an honestly and open partnership. It is an effective way to achieve confidence in a dynamic network of cooperating companies.

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9 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, PolytechnicNottingham/UK, Czech Republic, Indonesia and China.

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