Quality Governance based on Enterprise Engineering Method and Six Sigma Approach

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ABSTRACT
Enterprise Modeling (EM) is currently in operation either as a technique to represent and understand the structure and behavior of the enterprise, or as a technique to analyze business processes, and in many cases as support technique for business process reengineering. However, EM architectures and methods for Enterprise Engineering can also used to support new management techniques like SIX SIGMA, because these new techniques need a clear, transparent and integrated definition and description of the business activities of the enterprise to be able to build up, optimize and operate an successful enterprise. The main goal of SIX SIGMA is to optimize the performance of processes. A still open question is: "What are the adequate Quality criteria and methods to ensure such performance? What must we do to get Quality governance?" This paper describes a method including an Enterprise Engineering method and SIX SIGMA strategy to reach Quality Governance.

Keywords: Enterprise Engineering, Enterprise Modelling, SIX SIGMA, Quality profile, Quality Cockpit

1. Introduction

In today's highly competitive global economy, the demand for high quality products manufactured at low costs with shorter cycle times has forced a number of manufacturing industries to consider various new product design, manufacturing, and management strategies. Recently, due to the rapid advances in Information Technology (IT), new paradigms have successively emerged such as e-commerce, automation of business processes to process orders with internet via Enterprise Portals. To cover these new requirements methods like Concurrent Engineering, Business Process Engineering, TQM and more Enterprise Engineering (EE) are needed [Jochem, 1999]. A new paradigm in this area of management strategies is SIX SIGMA. The main goal of SIX SIGMA is to optimize the performance of processes.

Other indicators which influence the quality of products and processes are customer orientation, cultural issues, adequate organization of work, quality of leadership, Policy Deployment [Akao, 2004]. These indicators have to be covered, when we deal with the determination of adequate and reasonable criteria for the assessment and measurement of the "Quality of an Enterprise" and for the operation of enterprises in an adequate and reasonable manner. These both together are then called "Quality Governance".

This paper provides an overview of an Enterprise Engineering method called IEM (Integrated Enterprise Modelling) and it describes the usage of SIX SIGMA approach for performance measurement of an enterprise. Based on these two instruments a methodology including procedure and tools is developed, which allows enterprises to define their adequate quality criteria for performance, to measure performance and quality and to derive reasonable actions to take for optimization. Determination of adequate quality and performance criteria and reasonable measures for the enterprise organization means "Quality Governance".

2. Integrated Enterprise Modelling (IEM)

The method employs the object-oriented approach to describe information and functions of objects as views on a single model of the system 'Enterprise' integrally. The core of the model structure contains the views 'business process model' and 'information model'.

The basis for the development of the model as a description of an individual company is formed by the object classes 'product', 'resource' and 'order' (see **Fig. 1**). The required corporate data and functions are assigned to these objects when creating the model. The relations between the objects are also determined. The result is that all tasks, the process organization, the corporate data, the production facilities and all components of the information system are registered comprehensively on any desired level of detail [Mertins, 1998].

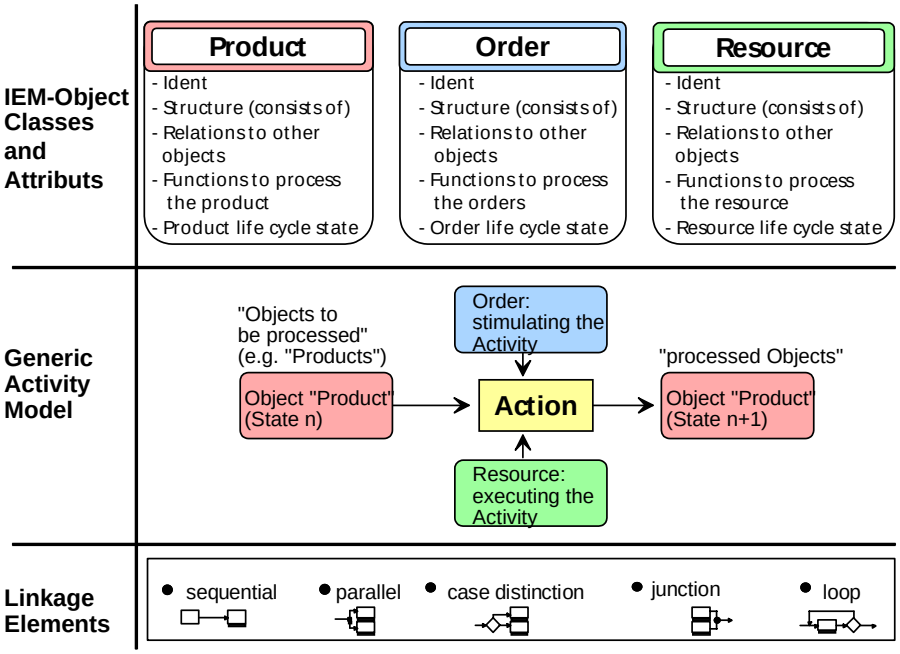

Figure 1: IEM Modelling Elements

The view 'business process model' emphasizes the tasks and business processes that are executed on the objects; the view 'information model' emphasizes the structures and features that describe objects. You are enabled to view one integrated model of the company from different angles. Business processes and the related information are described integrally in a model core. The information systems, the organizational structure, quality requirements and quality profiles constitute user views that relate to the model core. This enables you to evaluate process-organizational alternatives or modifications with regard to the effects on the control, the quality, the system support, the organizational structure and the staff's qualification profile [Jochem, 1999].

In order to utilize it's advantages and to provide a comprehensive and extendable enterprise model, the IEM method uses the object-oriented modelling approach, thus allowing the integration of different views on an enterprise in one consistent model and the easy adaptation of the model to changes within the enterprise.

The generic classes Product, Resource and Order form the basis of Integrated Enterprise Modelling for developing models from the user's point of view. They will be specialized according to the specifics of an individual enterprise. Each generic class prescribes a specific generic attribute structure, thus defining a frame for describing the structure and behavior of objects of its subclasses. Real enterprise objects will be modelled as objects of these subclasses [Mertins, 1998].

Required enterprise data and the business processes, i.e. the tasks referring to objects, are structured in accordance to the object classes (see **Fig. 1**). Furthermore, the relations between objects are determined. The result is a complete description of tasks, business processes, enterprise data, production equipment and information systems of the enterprise at any level of detail.

3. SIX SIGMA Approach

A common definition for processes is "activity or chain of activities which transform production factors, like Materials, Machines, Work, and other resources, into products or service performances". Production factors can be controllable or not controllable (it may be too cost intensive to control). The SIX SIGMA –model for process optimization can be expressed as function

$y = f(x)$.

y is the result variable (characteristic of a process) and x is the factor (represented by characteristics of the enterprise factors). Goal is to find the factors x_s which lead to better values of the result variable y. Each process has one or more specific characteristics or attributes, which can be described or documented. Theses characteristics are used to measure the performance of processes [Magnusson, 2004].

There are two kind of characteristics: continuous (e.g. length, time or temperature) and discrete (e.g. correct/wrong, acceptable/not acceptable). The measurement of these characteristics shows the variation of the values of the process characteristics. Goal of process optimization is to reduce the variation of these values of process characteristics.

Each process has a throughput time and a performance indicator. In SIX SIGMA the optimization of both is based on the reduction of deviation and the optimization of centering [Magnusson, 2004].

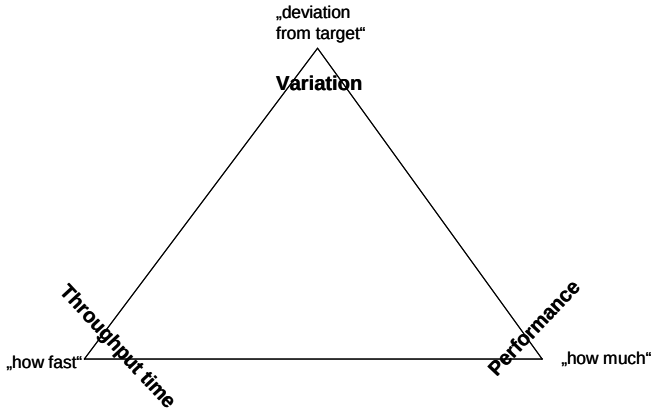

Figure 2: The SIX SIGMA performance and optimisation triangle for processes

4. Method to determine and measure Quality Governance

The method to determine and to measure Quality Governance consists of 5 Steps:

1. Description of Enterprise Objects and Processes in an Enterprise Model
2. Definition and measurement of Process Quality Criteria in a ”Process Quality Index/Profile” related to the Enterprise Processes
3. Definition and assessment of Enterprise Quality Criteria in a ”Enterprise Quality Scorecard”
4. Monitoring and Control of Process Quality Index/Profile and Enterprise Quality Scorecard in a ”Quality Cockpit”
5. Derivation of required measures and usage of SIX SIGMA method for optimisation

4.1 Description of Enterprise Objects and Processes in an Enterprise Model

With the usage of the IEM Method it possible to represent the characteristics of processes and the production factors by attributes of an enterprise model. Production factors can be described by the resource objects and their attributes of the IEM method. The result variables of the SIX SIGMA function ($y = f(x)$) can be represented by attributes of the IEM-product object. The characteristics of processes can be described by attributes of the IEM activity. The needed control infomation for the execution of this function can be described by attributes of the IEM-order object.

The resulting enterprise model of described processes and described production factors of the whole enterprise can be used to measure, analyse, optimise and evaluate the performance indicators described within the model.

4.2 Process Quality Criteria in a ”Process Quality Index/Profile” related to Enterprise Processes

To each modelled process of the enterprise model a Quality Index is formed concerning the process related quality criteria

- time,
- cost,
- conformance,
- performance,
- customer satisfaction,
- methods/knowledge.

This Process Quality Index is then assigned to each process in an added value chain of the enterprise, so that it results in a kind of ”Quality Profile” of all added value chains of the enterprise. This profil can be used for weak-point analysis, and internal or external benchmarking. The Index could also be represented in the enterprise model as a specific aggregated attribute of the modelled process.

4.3 Enterprise Quality Criteria in a ”Enterprise Quality Scorecard”

For the representation of all quality related criteria of an enterprise, that mean also the immaterial and intellectual related quality criteria a so called ”Quality Scorcard” is provided. It consits of two main perspectives. One perspective contains all dimensions and criteria for the design of an enterprise and the other contains them for the control of an enterprise. The design perspective includes intellectual Quality Dimensions and criteria like

- Organisation(structure)
- Relations (internal/external)

- Methods/Tools
- Culture
- Human/Knowledge

The control perspective includes Quality Dimensions and criteria like

- Process (from Process Quality Index, see 4.2)
- Product
- Results
- Cost
- Innovation

The enterprise quality strategy determines the detailed indicators and their target values of these dimensions and criteria within an enterprise.

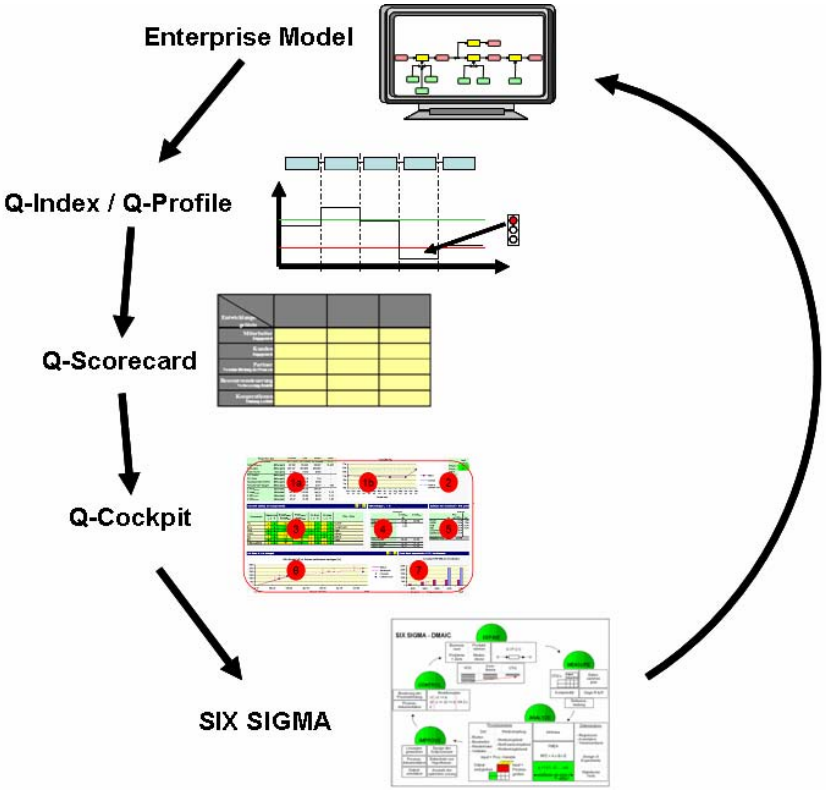

Figure 2: Method to determine and measure Quality Governance

4.4 Monitoring and Control in a "Quality Cockpit"

Process Quality Index/Profile and Enterprise Quality Scorecard representations are integrated in a so called "Quality Cockpit", where all the criteria and indicators are monitored and controlled over time. It serves as a Quality Monitor for enterprise management to see the actual status of "Enterprise Quality" in all dimensions and criteria in relation to the targets. They get the basis to derive and to decide on adeaquate and reasonable measures and actions for optimisation.

4.5 Derivation of required measures and usage of SIX SIGMA method for optimisation

From the comparison of targets and results in the Quality Cockpit the user can derive measurements for optimisation. Based on the Enterprise Model the user is able to follow the approach of SIX SIGMA (see chapter 3) and to reduce the variation of the respective process attribute values or related quality criteria. He can reach forecast related to specific measures and can get performance indicators for the application of these new measures within his enterprise by using the procedure again.

That means it is the ”basic circle” for continous optimisation of the processes of the entire enterprise.
Additionally the Quality Cockpit serves as kind of “benchmark scale” or “scorecard” for quality and performance measurement during enterprise operation (monitoring and control).

5. Summary

The described method answers the questions “What are the adequate Quality criteria and methods to ensure Enterprise Performance and Quality?” and “What must we do to get Quality governance?” by
providing a procedure and tools for the determination of adequate quality and performance criteria and for derivation reasonable optimization measures .
Further work has to be investigated into optimization of the interaction of the different tools, practical tests in industry and the implementation of procedure and tools within a software prototype.

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Author’s Background

Prof. Dr.-Ing. Roland Jochem *is Head of Department Quality Management, University Kassel, Germany. His key qualifications are:*
Business Process Management*: Project management of more than 20 industrial projects*
Modeling methodologies*: Development of a new object oriented methodology for enterprise modeling*
Modeling tools*: Development of a tool supporting object oriented methodology for enterprise modelling*
Quality management*: Model based Quality Management; Quality oriented business process management*
Standardization*: Working in ISOTC184/SC5/WG1 „Framework for Enterprise Modeling”, ISO TC184/SC4/WG8 „Resource Usage Management“ and CEN TC310/WG1: CIM System Arcitecture.*
Publications*: Author of 5 books (3 in German, 2 in English); Author of more than 50 Articles published in Journals, Conference Proceedings or Edited Books.*