ORGANIZATIONAL EXCELLENCE THROUGH QUALITY GOVERNANCE

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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.

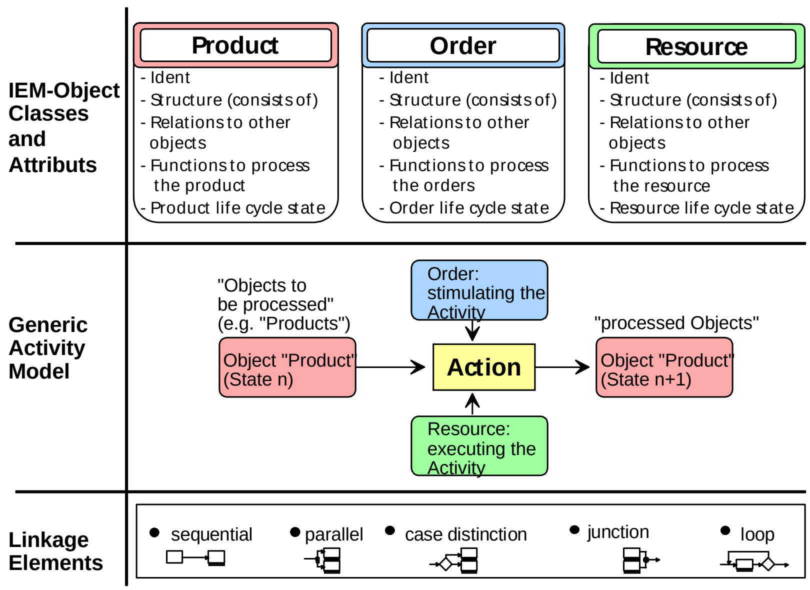
Other indicators which influence the quality of products and processes are customer orientation, cultural issues, adequate organization of work, quality of leadership, Policy Deployment (Akao, 2004). These indicators have to be covered, when we deal with the determination of adequate and reasonable criteria 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 Modeling) 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 Modeling (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'.

Figure 1: IEM Modeling Elements



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 **Figure 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).

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 its advantages and to provide a comprehensive and extendable enterprise model, the IEM method uses the object-oriented modeling 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 Modeling 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 modeled 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 Figure 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

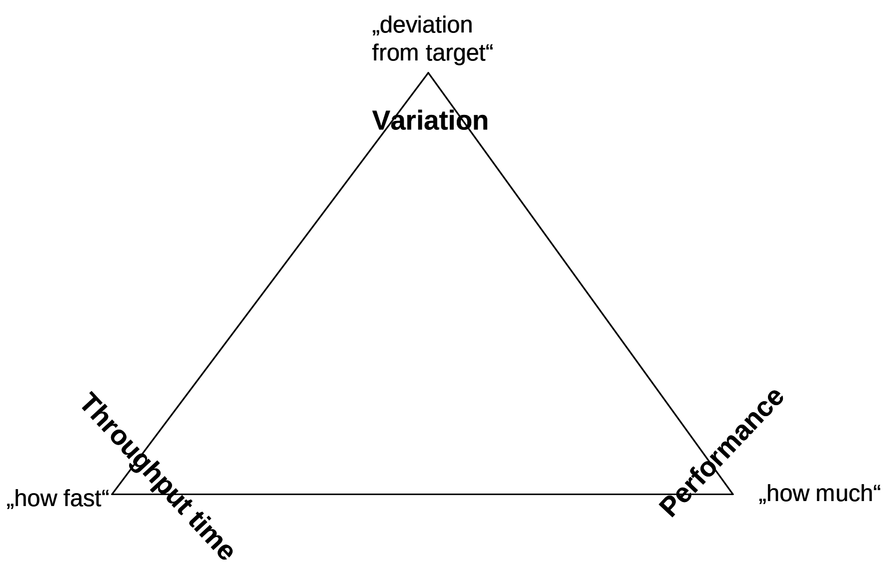
A common definition for processes is “activity or chain of activities which transform production factors, like Materials, Machines, Work, and other resources, into products or service performances”. Production factors can be controllable or not controllable (it may be too cost intensive to control). 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 kinds 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.

Figure 2: The SIX SIGMA performance and optimization triangle for processes (Magnusson 2001)



Each process has a throughput time and a performance indicator (see Figure 2). In SIX SIGMA the optimization of both is based on the reduction of deviation and the optimization of centering (Magnusson, 2004).

4. Method to determine and measure Quality Governance

The method to determine and to measure Quality Governance integrates the method of Integrated Enterprise Modeling (IEM) and the SIX SIGMA approach with different Quality-oriented instruments. It 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 optimization

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 information 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, analyze, optimize and evaluate the performance indicators described within the model.

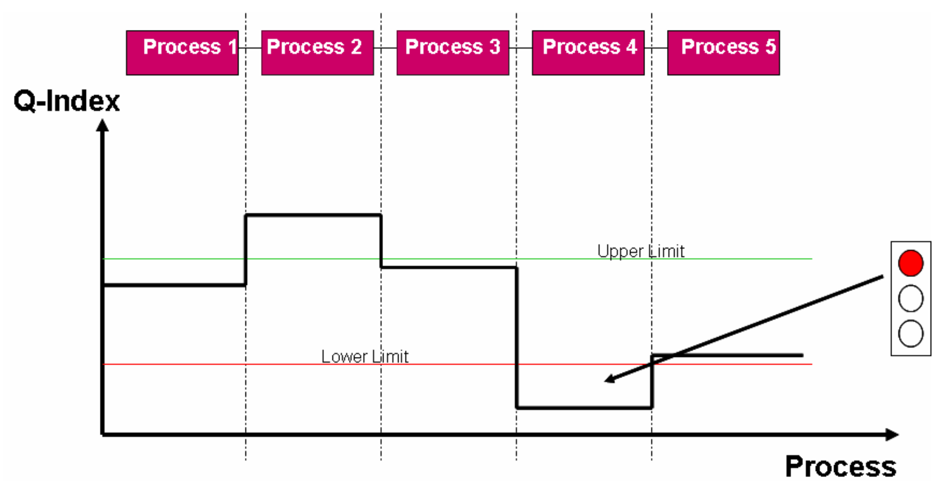
4.2 Process Quality Criteria in a "Process Quality Index/Profile" related to Enterprise Processes

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

1 Time (planned lead time/actual lead time),
2 Cost (planned cost/actual cost related to personnel cost, IT-cost, resource cost),
3 Conformance (rate of failures, first path yield),
4 Performance (planned output rate/actual output rate),
5 Customer satisfaction (number of complains internal/external).

This Process Quality Index is 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 (see Figure 3). This profile 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 modeled process.

Figure 3: Quality Profile



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 Scorecard” is provided. It consists 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 Dimensions and criteria like

1 Quality of Organization (structure)
2 Quality of Relations (internal/external)
3 Quality of used Methods/Tools
4 Quality of Culture
5 Quality of Human/Knowledge

The control perspective includes Quality Dimensions and criteria like

1 Quality of Process (from Process Quality Index, see Section 4.2)
2 Quality of Product
3 Quality of Enterprise Results
4 Quality of Cost
5 Quality of Innovation

The individual enterprise quality strategy determines the detailed indicators and their target/actual values of these dimensions and criteria within the individual enterprise. That means a change in strategy results other indicators and values for the same enterprise organization. The consequence is that the enterprise organization has to follow the strategy (enterprise organization and processes follow enterprise strategy). Figure 4 shows a general schema for the description of possible indicators.

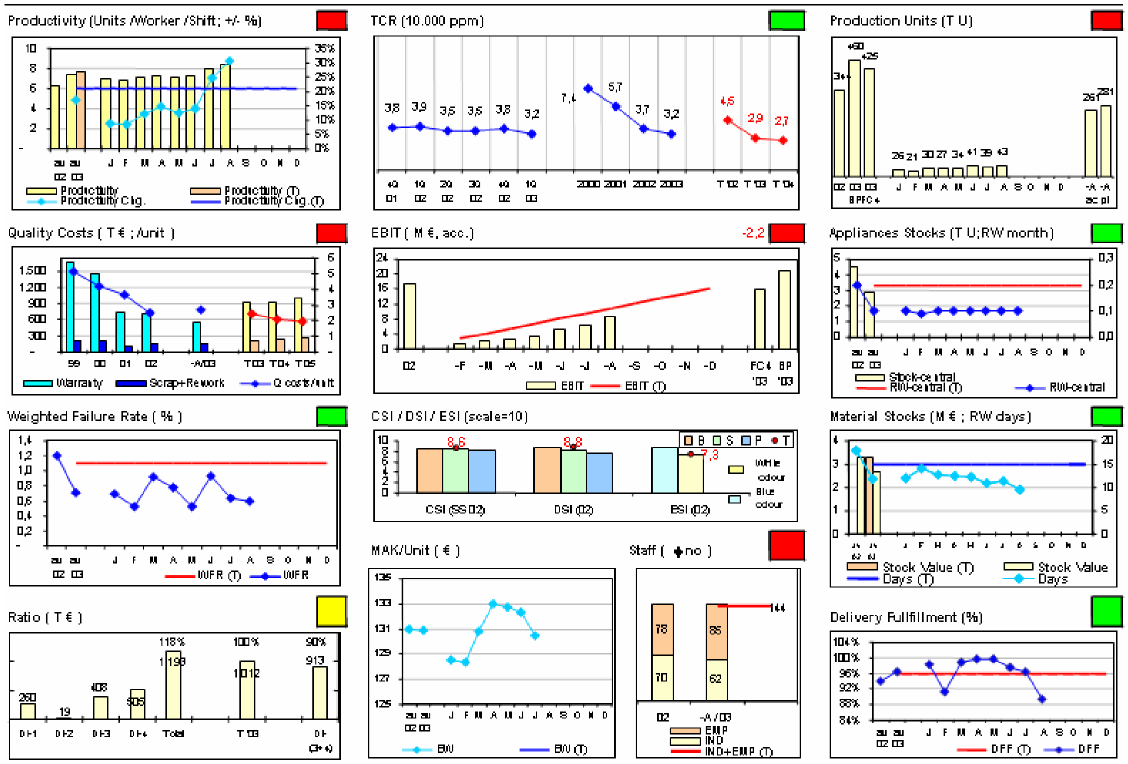
Figure 4: General Schema for description of Indicators

Perspective	Target (strategic/operational)	Drivers/Success Factors
Measurement of criterion/ indicator		
qualitative description		
Formula for Measurement		
Measurement Unit		
Prerequisites/Rules for Measurement		
Source/Method and responsible		
Acquisition level		
Frequence		
Target		
Variation for yellow		
Variation for red		
Responsibility for Control		

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 (see Section 4.3). The management gets the basis to derive and to decide on adequate and reasonable measures and actions for optimization. An example cockpit is shown in Figure 5.

Figure 5: Example of a Quality Cockpit

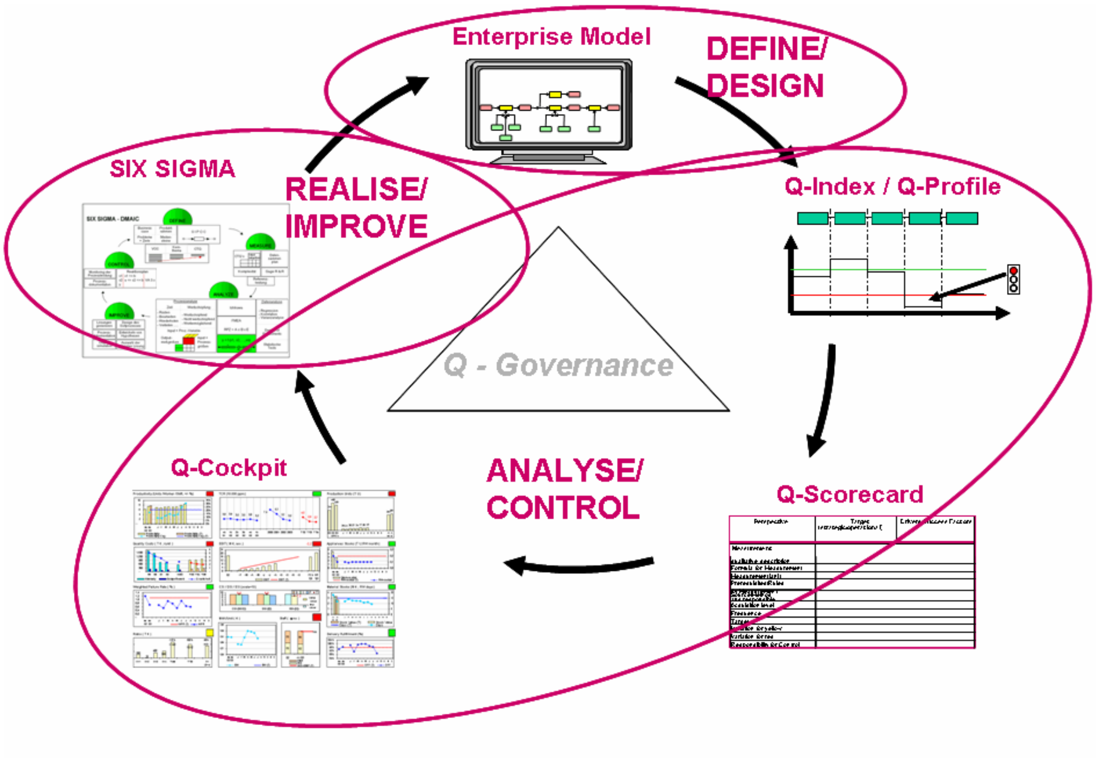


4.5 Derivation of required measures and usage of SIX SIGMA methods for optimization

From the comparison of targets and results in the Quality Cockpit the user can derive measurements for optimization. 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 (see Figure 6).

That means it is the ”basic circle” for continuous optimization 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).

Figure 6: Method to determine and measure Quality Governance



5. Usage in an Example

In the following example, an organization has identified several quality objectives (Customer requirements, regulatory requirements, defect rate and customer returns, QMS controls, Purchasing) and has collected data on the results of these objectives (customer satisfaction, regulatory compliance, quality system metrics, inspection and test, supplier performance). These objectives were described in an enterprise model using IEM method and the related data filled into the Quality Scorecards. Using the Quality Cockpit, the results are compared to the objectives/target values and the degree of effectiveness of the QMS is established for a given time period. The gap between results and target values measures the lack of effectiveness of the quality management system, the narrower the gap, the more effective the QMS.

The same data also allows the organization to measure improvement and to take any necessary action based on the information and results (see Figure 7).

Figure 7: Usage of method in an example for analysis and improvement

In this example the company derived three key actions for improving the QMS: customer focus, corrective action and procurement. These actions may cause the organization to revise its objectives.

After analyzing the data and reaching a conclusion on the effectiveness of the QMS, the same Quality Governance method with the 5 steps is again used to determine, if the quality management system has had an effect on the Organization's business and/or financial results (QMS results vs. Organizational Business Results). The gap between results and target values now measures the lack of business effectiveness of the organization. The narrower the gap, the more effective the organization.

And again, the improvements in the organization can be measured and managed. The procedure is cyclical and can be used as often as required by an Organization (see Figure 6).

The overall result of using the Quality Governance method in this example is an enhanced pro-active approach to meet QMS objectives and more importantly their related corporate business and/or financial objectives.

6. 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 further optimization of the interaction of the different instruments in the different steps of the method. Also more practical tests in industry have to be done and the implementation of procedure and instruments within a software prototype seems to be required for easy usage of the method.

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