Quality management and improvement
A framework and a business-process reference model

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Abstract This paper presents a reference model for the process of management of quality and improvement based on a conceptual framework for managing the process of systematically deriving improvement actions from customer expectations and strategic decisions through business processes, and prioritising actions that will most contribute to achievement of strategic objectives. After some introductory theoretical background to discuss the need for systematically managing quality and improvement as well as the contribution of mapping business processes, the process reference model is described to a certain extent and detailed by means of activity tree and event-driven process chain (EPC) diagrams. Finally, some considerations are made on the benefits of using such an approach.

Introduction
The rapidly increasing global competition that many industry sectors worldwide have been facing over the past decade, associated with rapid technological changes and product variety proliferation have led to a new scenario in which industries, in order to remain competitive, must continuously implement best practice management principles, strategies and technologies. In this sense, many theoretical works have been published emphasising the importance of a strategic management of operations and the management of quality in order to gain competitive advantage.

The competitiveness of a company is mostly dependent on its ability to perform well in dimensions such as cost, quality, delivery dependability and speed, innovation and flexibility to adapt itself to variations in demand. While alignment of operations with strategic priorities is core to competitiveness, the continuous improvement of operation processes plays a very important complementary role in quest of competitiveness in the long run. Continuous improvement has been defined as a company-wide process of focused and continuous incremental innovation (Bessant et al., 1994). It is thus complementary to the more radical change normally considered under the terms re-engineering or change management.
Since a company is not expected to perform well against all these dimensions, it is the prioritising of the dimensions based on strategic priorities and the continuous improvement of the manufacturing function plays a very important complementary role in quest of competitiveness in the long run. Continuous improvement has been defined as a company wide process of focused and continuous incremental innovation (Bessant et al., 1994). It is thus complementary to the more radical change normally considered under the terms re-engineering or change management.

Aiming at improving organisational performance through the effective use of production capability and technology, operations strategy such as total quality management (TQM), business process re-engineering (BPR), just in time (JIT), benchmarking, performance measurement and many others are commonly used (Ahmed and Montagno, 1996). Standing out in the literature are TQM and BPR approaches. TQM is based on the principle of continuous improvement of products and processes aimed at continually satisfying customer expectations regarding quality, cost, delivery and service (Ishikawa, 1990). BPR also aims at satisfying customer expectations regarding quality, cost, delivery and service, however its approach to improvements is more radical. In the words of Hammer and Champy (1991), “Reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements ...”. Despite this subtle difference, practical application and results of TQM and BPR may in some circumstances be confounded since continuous improvement is also made of high steps breakthrough improvements as proposed by reengineering as well as re-engineering or change management may be carried out in large systematic and iterative loops, the essence of continuous improvement.

However, many companies, in their attempts to rapidly adopt world class management practices such as TQM and many other acronyms, tend to devote little or no attention at all to the impact of such practices on company strategic objectives, market demands or even performance against competition. Although not frequently mentioned, this misalignment between operational management practices and competitive strategy can be listed as one of the reasons for unsuccessful TQM implementations (Tatikonda and Tatikonda, 1996).

Following this argument, it has been proposed a conceptual framework for managing the process of systematically deriving improvement actions from customer expectations and strategic decisions through business processes, and prioritising improvement actions that will most contribute to strategic objectives (Carpinetti et al., 2000).

Since this framework includes a lot of different activities, involving the use of management tools, performance measurement, benchmarking and other management practices, it has been realized the importance of developing a reference model for the business process of managing deployment and
prioritisation of strategy related improvement and change actions that could contemplate the systematic proposed.

Taking into account these initial considerations, a brief theoretical discussion is presented in the following section so as to support the reference model presented thereafter. Next, the reference model itself is presented and discussed along with an example of an event-driven process chain (EPC) chart so as to illustrate the model. Finally, some considerations are made based on the potential benefits and limitations of this proposal.

**Strategic improvement deployments**

In the past decades, an uncountable number of companies worldwide have launched TQM and BPR programs encompassing a bewildered array of tools and methodologies aiming at customer satisfaction and continuous improvement of operations. As mentioned by Garvin (1995), TQM and reengineering are powerful means of reshaping individual processes so that they serve existing categories of customers more efficiently.

Although these movements have created a legion of enthusiasts, many are the failure cases. Apart from all possible drawbacks inherent to the implementation process, Garvin (1995) commenting on the limitations of TQM and reengineering argues that it is assumed process redesign can be divorced from rethinking business strategy:

... Most TQM and reengineering programs take a strong operational view of improvement ... in an era of volatile and rapidly changing markets and technology, TQM and reengineering can generate a much improved process for competing in an environment that no longer exist.

Although it is true that operational effectiveness is different from strategic positioning, the deployment of strategic positioning into operational strategies is fundamental to competitive advantage.

The Japanese management by policies approach (Collins and Huge, 1993) of establishing, deploying and implementing policies attempts to close this gap. However, the management by policy approach of deploying policies through the vertically organised functional groups and not through the horizontal processes workflow may result in many voids and overlaps and encourages local optimisations.

To address the points discussed above, an approach for deploying strategy related improvements has been proposed which basically concerns with systematically deriving improvement actions from customer expectations and strategic decisions through business processes, and prioritising improvement actions that will most contribute to strategic objectives (Carpinetti et al., 2000).

The reasoning behind this approach is that improvement projects selected for implementation are those that most contribute to the efficiency and effectiveness of business process mostly related to prioritised competitive criteria. It is thus a systematic prioritisation process in which:
competitive dimensions are prioritised for improvement based on customer expectations and performance on such dimensions against competition;

- priority processes for improvement are selected based on the impact of such a processes on dimensions taken as improvement priorities as well as on qualitative and/or quantitative diagnostic of performance;

- priority improvement actions are selected based on extent of their contribution to leveraging process performance.

To accomplish that, it is proposed that a series of concepts and practices such as process mapping, performance measurement and benchmarking be brought together in a structured way. Figure 1 presents the elements of the conceptual framework, as discussed next.

Competitive dimensions such as quality, cost, delivery and flexibility can be disaggregated into more focused aspects such as conformity, reliability, speed, dependability, cost of maintenance, flexibility of process, among others (Garvin, 1993). Other more tacit differentiating aspects can be gathered through researching target markets. Identification of priorities for improvement can be done by considering customer satisfaction with delivered products and services as well as information regarding company performance against competition.

**Figure 1.** Elements of the improvement deployment method
Moreover, since operations are in general managed from a functional perspective, mapping business processes is a fundamental step to understand the flow of information and resources through the business processes of the internal value chain. It may also help to understand relationships of processes and dimensions and consequently focus attention on the processes and activities that most impact performance on critical competitive dimensions. Mapping can also bring the benefit of helping in assessing performance of operational and supporting processes.

Moreover, assessment of performance is essential to diagnose the root causes of problems or weakness so as to determine what areas or activities are the weak points and need to be addressed. Information on process performance can be gathered with qualitative assessment of current situation. Cause and effect diagrams such as the fish-bone diagram may be used for this purpose. The current reality tree (Dettmer, 1997) from the theory of Constraints may also be used. It works by identifying cause-and-effect interrelationships among potential root causes and undesirables effects or problems. Apart from qualitative analysis of performance, quantification of performance on critical dimensions can also be used as one of the instruments for guiding the identification of processes and dimensions of operations most in need of improvements. In this sense, the approach for improvement management proposes that a system of measures be implemented focused on the drivers of performance in alignment with business, marketing and financial strategies. It should be noted that in case there is no such a system in place, the deployment of critical dimensions and processes just proposed can also be used to devise a system of performance measures.

After establishing the critical processes for improvements, specific improvement actions must be defined. Functional Benchmarking can be very useful at this phase. Benchmarking is defined as a process of continuously measuring and comparing an organisation’s business process against business leaders anywhere in the world to gain information which will help the organisation to take action to improve its performance (Lema and Price, 1995). Apart from benchmarking, a number of quality tools may still be used in this phase to guide the process of identifying problems and opportunities for improvements. Once specific improvement actions are envisaged, performance targets are set and implementation and progress review can take place.

The process of deploying and prioritising improvement actions should be part of a process of quality and improvement management, in support to the activities and processes of the added value chain, as suggested by the new edition of ISO 9001 standard (ISO, 2000). Therefore, in the following sections, after some considerations on business process modelling, a reference model for the business process of quality management and improvement is proposed and discussed.
Business-process modelling techniques

According to Harrington (1991), a business process comprises a set of activities logically interrelated that utilises resources of an organisation to provide value to customer. Examples of business processes are: developing product and process; customer order fulfilment; and so on. These macro-processes can be further disaggregated into sub-processes, activities and tasks. Understanding a company organization by its business processes and not simply by its functional hierarchy is a very important concept in production and operations management. For instance, the American Productivity and Quality Center (APQC) benchmarking clearing house (APQC, 2000) defines 11 macro-processes, including primary processes such as design products and services or market and sales and supporting processes such as develop and manage human resources, manage financial and physical resources or manage improvement and change.

Through business process modelling, it is possible to map activities and their interrelationships, resources and organisational units responsible for the activities, as well as the flow of information through operational and supporting processes of the internal value chain. According to Curtis (1992), modelling techniques should be able to represent: what should be done; when it should be done; who is responsible for the activities; and what are the input and output data.

Two important business-process-modelling techniques cited in the literature are the IDEF0 and the EPC (Vernadat, 1996). The integration definition for function modelling (IDEF0) (Cantamassa and Paolucci, 1998; Vernadat, 1996) represents the activities performed by a specific process, the relationship as well as the flow of information and material among the activities. An evolution of this technique is the IDEF3. The EPC (Curran et al., 1998; Vernadat, 1996) is similar to a PERT network, where it is possible to describe the sequence of activities of a business process. Each activity has its beginning and ending marked by an event. It is possible to integrate de EPC with information regarding organisational units responsible for activities and input and output data. This is the purpose of the ARIS architecture (Vernadat, 1996; Scheer, 1999).

A reference model for the process of quality management and improvement

Managing quality and improvement actions can be seen as a sequence of connected and logically ordered activities in support to the business processes of the value adding chain. Thus, it can be understood as a supporting business process of the value-adding chain.

Although there is not a unique understanding of the activities embraced by this macro-process, the reference model proposed here, based basically on the framework of Figure 1, includes the following main activities:
understanding business strategy related to quality management and improvement;

- qualitative and quantitative assessment of performance;
- deployment and implementation of improvement actions;
- implementation and maintenance the quality assurance system.

Each of these activities is broken up into nested activities. Also, for each activity, it can be defined input and output information and materials, resources and organisational units or elements involved in those activities.

Another way of representing the activities of a business process is by means of an activity tree diagram (Scheer, 1999) in which:

- a box connected to other boxes by a line starting from the bottom means the activity in the box is further detailed in the connected boxes;
- a box connected to another box by a line starting from the side means the activities in the boxes are performed sequentially;
- boxes connected in parallel to a previous box means the activities in the boxes are performed simultaneously.

A view of the activity of deploying and implementing improvement actions is illustrated in Figure 2. It is divided in two main activities: deploy and prioritize; and implement and review progress. Deploy and prioritize is then divided in three main activities: identify critical dimensions and processes; propose actions; and develop performance metrics.

The activity of identifying critical competitive dimensions illustrated in Figure 3 follows from the main activity of analysing and understanding business strategy related to quality and improvement, in which several inputs have to be analysed, such as identify and prioritise expectations of customers, stockholders and other stakeholders. Therefore it can be seen that these two
activities are interconnected in the sense that output information from one activity is input information to another. The same is true for the activities of developing performance metrics or assessing critical processes in Figures 2 and 3 respectively.

After defining critical dimensions, it is needed to identify critical processes for improvement. For that, it is proposed mapping the processes and activities of the value adding chain as well as supporting processes. This is a first step to identify and assess critical business processes and activities, as illustrated in Figure 3.

The outputs of these activities are dimensions of performance and processes for which improvement actions have to be developed and implemented. Thus, the next step in the reference model presented here is related to defining improvement actions, as illustrated in Figure 4. The identification of possible improvement actions should start by further developing knowledge on product or processes aspects related to improvement needs. In that, developing benchmarking projects can be very helpful in identifying improvement actions. Once this is done, a decision has to be taken on which actions to implement. For that, the proposition of actions should be detailed to include envisaged benefits, cost of implementation, possible constraints to successful outcomes and implementation plans and timing. After going through these activities, a better
decision can probably be taken on which action to implement or which to implement first.

Finally, the activities related to implementation and progress review are depicted in Figure 5. Implementation should be preceded by adequate planning and resource allocation. Next, the implementation process itself should be managed and results followed up. For this, performance measurement may be adopted, as illustrated in Figure 5.
It should be noted that although all these activities are considered to be part of the business process of quality management and improvement, the responsibility for performing many of the activities is shared with organisational elements from different process or functions such as product development, production, procurement and so on.

Implementation of the reference model

The reference model for the process of improvement proposed above has been implemented using the Architecture for Integrated Information System (ARIS©) toolset. This software tool for process modelling is based on the concept of integrating different description views of business processes such as data, organizational unit and other information objects in a process chain diagram, based on the EPC method of process modelling (Scheer, 1999).

The implementation has been developed for teaching purpose, of a company that manufactures gearbox components. As an example of the modelled process, Figure 6 describes the EPC for the activity of identifying processes for improvement. Each activity in Figure 6 can be broken down, depending on the required level of detailing.

Final comments

This paper has presented a framework and a reference model for the process of quality management and improvement based on a conceptual framework for

![Figure 6. EPC diagram for the activity of defining processes for improvement](image-url)
deploying strategy related continuous improvement actions that emphasises the importance of:

- deploying improvement actions from strategic decisions, customer expectations and performance in face of competition so as improvement efforts remains focused on and integrated with strategic and competitive issues;
- deploying improvement actions through the business processes of the organisation and not through the functional hierarchy;
- prioritising processes for improvement that can most positively impact performance on dimensions critical to competitiveness.

The proposed reference model for the process of quality management and improvement aims at:

- identifying and detailing the activities required for quality management and improvement;
- defining relationship and hierarchy among several activities;
- defining responsibilities among different functional organisational units and business processes engaged in quality management and improvement efforts.

Implementation of the reference model using a process modelling software tool brings the benefits of communication, standardisation and integration to other organizational business processes. These attributes are essential to manage quality and improvement, an activity that by its nature must be performed by the whole organization.

Finally, it should also be mentioned that the conceptual model for improvement deployment presented in this paper is much more complete, since it encompasses different practices such as benchmarking, performance measurement and other tools. Therefore, the business process reference model can be further enhanced and modified according to specific needs and practices of different industrial segments.

References


