Integrating Benchmarking and Poor Quality Cost Measurement for Assisting the Quality Management Work

by

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ABSTRACT The two quality management concepts of benchmarking and poor quality cost measurement have been developed completely separate from each other and without any interaction between them. Both have also experienced some shortcomings that to some extent has limited their use and results. This paper explores these shortcomings and demonstrates how benchmarking and poor quality cost measurement in some ways are similar and in other ways complement each others' weaknesses. An integrated framework that combines the two concepts into a powerful approach for assisting an organization's quality management work is presented. Different points of intersection between the two concepts in this integrated framework are discussed, and it is demonstrated how they support and enhance each other. Such enhancements occur throughout all phases of the benchmarking process, while benchmarking provides an extra dimension to the use of the poor quality cost measurements.

INTRODUCTION AND RATIONALE

Both benchmarking and poor quality cost measurements are two concepts that have been developed rather much on their own, to some extent in isolation from other fields, and certainly not in connection with each other. Although they are both widely acknowledged as important concepts in the quality management field, important shortcomings have been identified in both cases:

- In the case of benchmarking, there has been a development over time in which focus has shifted from performance benchmarking, centered around pure quantitative measures of financial performance, to process benchmarking, where qualitative comparisons of practice is the focal point. This development has now more or less culminated in a state where benchmarkers often find it difficult to determine which practice is better, due to the lack of relevant and operational performance measures.
- Poor quality cost measurement, on the other hand, has always focused on the quantitative aspect of poor performance. However, due to the lack of any widespread standards defining how poor quality costs are measured, these numbers have found very little use outside the individual enterprise. Comparing poor quality cost levels among different organizations has been very difficult.

Furthermore, both benchmarking and poor quality cost measurement have not reached the expected and preferred level of dissemination and use. This can probably be attributed to the shortcomings pointed to plus the lack of documented results achieved through the use of these approaches. Thus, if some further development can be undertaken to rectify these weaknesses, the use and benefits from benchmarking and poor quality cost measurement can be improved. The fact that this paper deals with these two quality management concepts in particular is not

coincidental. Due to their inherent nature, they naturally complement each other and can, if brought together, represent a combined approach far more powerful than each on their own. First, they are similar in the sense that both are concepts based on measurement and geared toward process improvement, and they both work as decision-making support for an organization's improvement efforts. Secondly, while benchmarking represents the key concept of comparison and external referencing, poor quality cost measurement provides an accepted approach to process performance measurement. Integrated, this will open up for a coherent approach to process improvement.

RESEARCH BACKGROUND

The development of an integrated process improvement approach based on benchmarking and poor quality cost measurement is based on the outcomes from two research projects completed during the last years that have individually brought these two concepts further:

1. Among benchmarkers there has been some frustration due to the lack of a standard benchmarking process model (Bogan and English 1994, Watson 1993). The benchmarking wheel is a benchmarking process model that synthesizes strong sides of a high number of existing benchmarking models (Andersen 1995). The new process displays characteristics that make it superior to others in terms of ease of understanding, use, and achievable results.
2. A customer and process focused poor quality cost model that represents a considerable development compared to previous knowledge in offering an accurate and easy-to-use framework for poor quality cost measurement (Moen 1997).

Benchmarking is a new concept developed on a broad basis of industrial utilization, without a strong theoretical foundation, making it very result oriented (Godfrey 1993, Watson 1993). The concept of quality cost measurement was introduced in the early 1950s based on the theories of Juran (1951) and Feigenbaum (1956), and has not developed adequately with changing business environments. Quality cost measures have never gained sufficient acceptance as a performance measurement tool and have mainly been used for theoretical exercises.

Parts of each model have been implemented and tested separately, but they have not been integrated and operationalized. The objective of this paper is to describe how these two models can be integrated into a very powerful framework for assisting the quality management work in an organization, based on a theoretical platform supported by results from industrial applications.

THE BENCHMARKING WHEEL

The purpose of benchmarking process models is to describe the steps that should be performed when conducting a benchmarking study (American Productivity & Quality Center 1993). However, a large number of different organizations have developed their own, tailored models (Watson 1993). In the research project leading up to the benchmarking wheel, sixty different existing models were analyzed to design a new model that should compensate for some of the shortcomings in these existing ones. The resulting benchmarking wheel is shown in Figure 1.

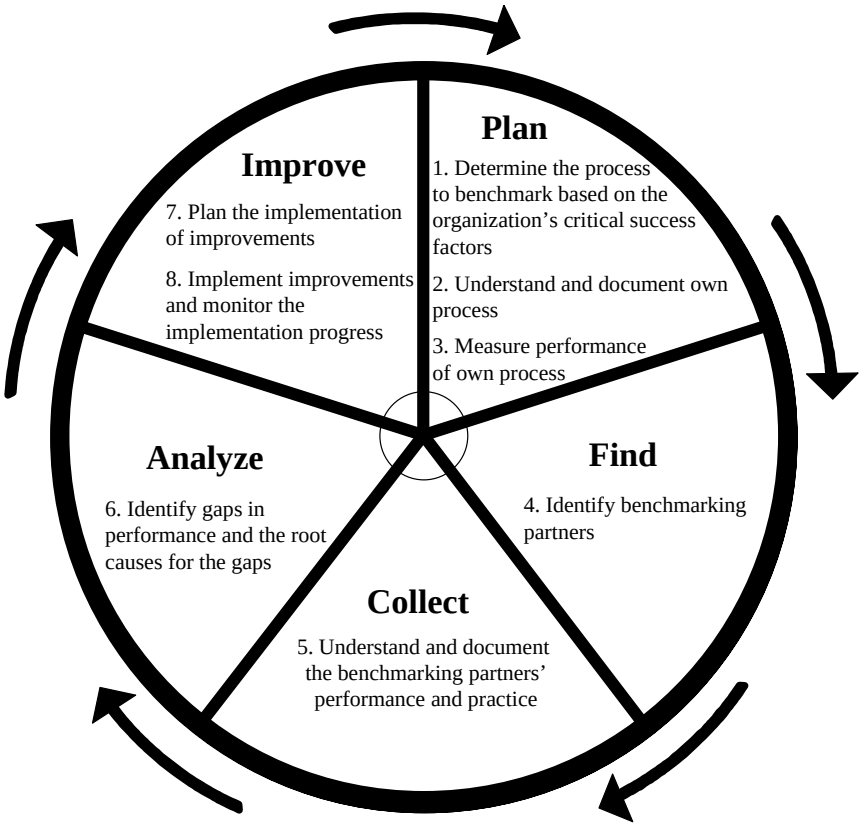


Figure 1 The Benchmarking Wheel

Briefly explained, the contents of each of the five phases of a benchmarking study are:

1. Plan, a preparatory phase providing the foundation for the ensuing study. At this stage the improvement efforts are prioritized by selecting the business process to be benchmarked, usually based on an assessment of current performance. Next, a team to undertake the benchmarking study is assembled, and the selected process is documented. Finally, performance measures for the process are defined, but these are usually of a simple type of time, quality, or cost measures.
2. Find, which is often the most challenging phase of the entire study. The sole purpose is to identify relevant benchmarking partners and gain their acceptance for participation in the study. This phase is often made difficult by the lack of standard performance measures that can be used to facilitate an initial comparison to determine which companies have the better processes.
3. Collect, the phase where the best practice processes of the benchmarking partners are observed and documented in much the same way as the company's own process was documented in the planning phase. The purpose is to collect sufficient relevant data to obtain an in-depth understanding of the partners' processes.
4. Analyze, in which the process knowledge from the planning and collection phases are put together to identify the gaps in performance between the benchmarking partners and the causes for the gaps. Ultimately, this leads to recommendations as to what elements of the best practices should be implemented to create improvements.
5. Improve, the last phase of the study, where improvements based on input from the benchmarking partners are implemented. This phase can often be lengthy in duration compared to the previous four phases.

The benchmarking wheel and many other benchmarking process models have been applied in various industrial benchmarking studies. Research into the results achieved in such studies has landed on varying conclusions. There have been many reports of very positive results in terms of financial savings and operation improvements, for example by Balm (1992), Camp (1992), Mittelstaedt (1992), O'Dell (1992), and Watson (1993). Similarly, opposite claims of poor results have surfaced from others, by Ernst & Young and American Quality Foundation (1992), Foster (1992), and Hequet (1993). A study of 70 companies' results from benchmarking concluded that there are no true determinants of benchmarking success: both success and failure can be achieved independently of organization size, benchmarking experience, resources available, etc. (Andersen 1995). It was also found that the most widespread type of benchmarking was process benchmarking, thus providing a foundation for incorporating poor quality cost measurement into benchmarking.

CUSTOMER AND PROCESS FOCUSED POOR QUALITY COST MODEL

Quality cost measurement is an old concept that has not kept up with the extensive changes we have seen in our business environment during the last decades. Several new cost elements have been introduced since Feigenbaum (1956) classified quality costs in prevention, appraisal, and failure (PFA), but the concept is still based on the same premises as in the early 1950s. There are several shortcomings in the traditional approach (Moen 1997):

- It is internally company focused and reactive in nature. Costs are recorded based on failures, rework, and negative feedback from the customer after the problem has occurred.
- Customer requirements, needs, and expectations are not used proactively to direct quality improvement, and increased customer satisfaction and loyalty are not measured.
- Management decisions are based on traditional accounting information, which institutionalize waste by relating it to a pre-established standard. This standard usually includes a substantial amount of failure cost and rework.
- For administrative activities, no discrimination is made between doing something and doing it over (IAQ 1995).
- Minor failures are not addressed since isolated they are unprofitable to remove, but added up, they become unacceptable to the customer.
- Failure costs are driven by defect rates, which are based on specification limits. These limits are based on convenience, internal company opinions about customers' needs, and the performance of production equipment (Diallo, et. al. 1995).
- Prevention costs imply that it is necessary to distinguish between normal, error-prone activities, and some extra effort to perform them error free. Error free design and work is normally the duty of everyone in an organization, making the distinction difficult if not impossible (Porter and Rayner 1992).
- Appraisal costs have no optimum value. A high figure may indicate badly performed production or an intrinsic necessity of the process. Understanding these costs require thorough process knowledge, and reporting an aggregated figure serves no purpose.

A new proactive Poor Quality Cost model has been developed to overcome previous problems. The model is based on customer requirements, needs, and expectations as input (❶ in Figure 2), which are translated to key process parameters using the QFD matrix ❷. Key process parameters are process parameters that have a direct influence on the fulfillment of customer requirements, needs, and expectations. The output is poor quality costs ❸ that are

measured by integrating asymmetric loss functions with multiple intervals to actual measured process performance ❹. A simplified Activity Based Costing approach is used to determine each interval of the loss function by breaking down the consequences of not meeting customer requirements into activities that have to be undertaken to regain acceptable process performance. The QFD matrix is also used to make estimates of intangible poor quality costs, e.g. lost revenue due to dissatisfied customers and loss of good will, in addition to lack of process efficiency costs measured through competitive assessments.

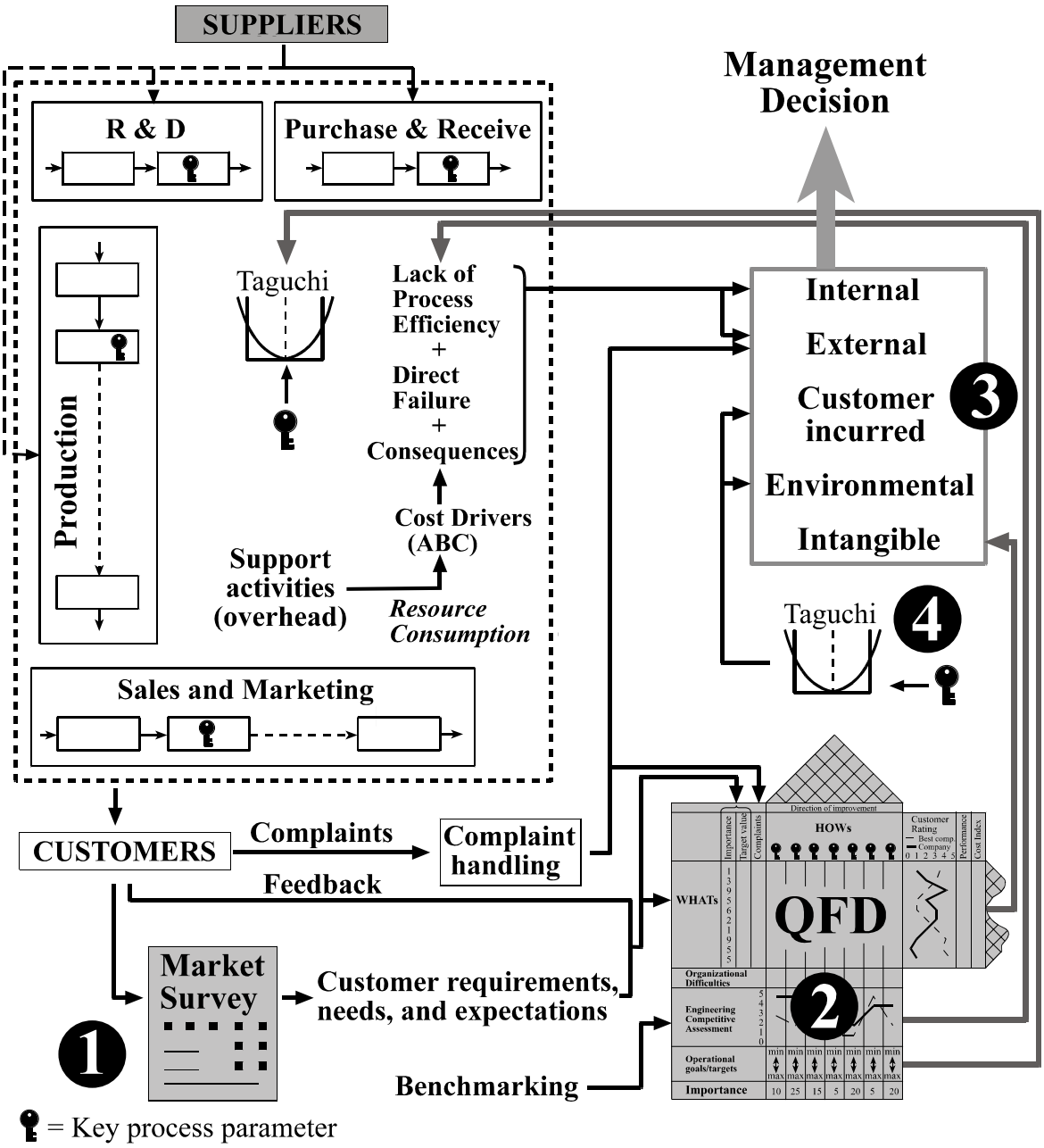


Figure 2 New Proactive Poor Quality Cost Model

The new model provides a much more complete poor quality cost picture than what has been available earlier, enabling a company to focus on the most important factors influencing customer satisfaction and loyalty, and thereby optimizes the resources used for quality improvement.

THE INTEGRATED FRAMEWORK

As is described in the remainder of the paper, the integration between the benchmarking wheel and the poor quality cost model can occur at several points of intersection. This is illustrated in Figure 3, portraying the integrated framework, and the following sections explain each point of intersection.

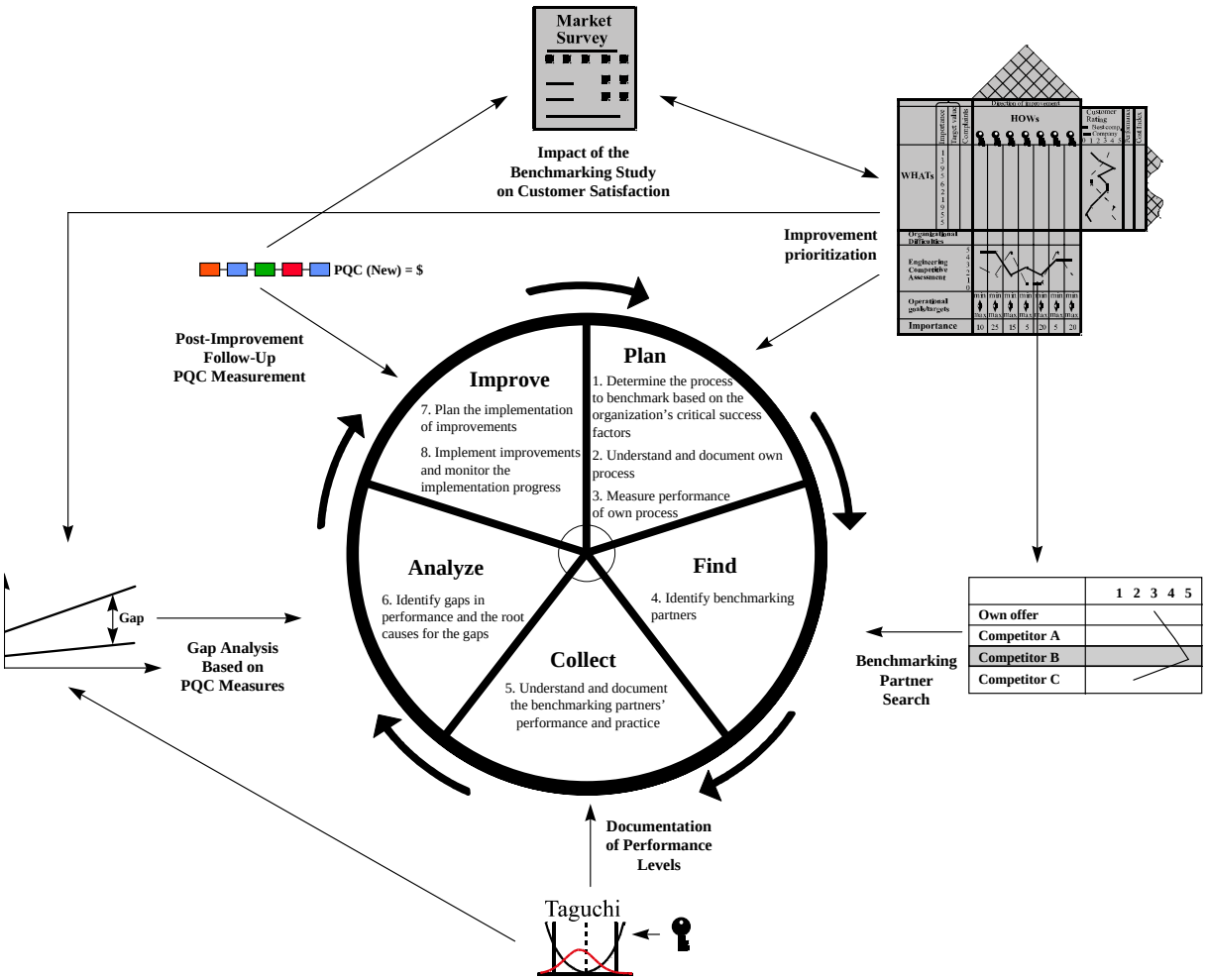


Figure 3 Integration Points of Benchmarking and Poor Quality Cost Measurement

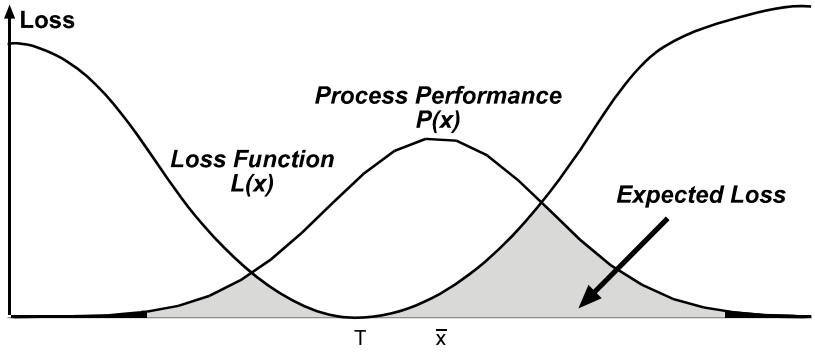
The planning phase

As a start, poor quality cost measurements can provide an effective means for prioritizing the improvement efforts in the planning phase of the benchmarking study. The most common approach to performance planning and improvement prioritization has so far been based on "gut feeling" and more subjectively based tools like the performance matrix and spider chart.

Customer requirements, needs, and expectations are used as input to the poor quality cost model. Requirements are determined through a market survey, which is analyzed through the QFD matrix. Every cost element is then linked to process performance, either by using the loss function or by estimating intangible costs through the QFD matrix. The overall poor quality cost for not fulfilling each customer requirement is then determined as the sum of each cost element, and serves as a measure of how well the company meets their customers' requirements, needs, and expectations. These measures are indicators of the company's critical success factors and serve as a quite accurate basis for benchmarking decisions. By

using the new poor quality cost model, where the loss function and the current performance curve are portrayed in one diagram to produce a monetary value for the poor quality costs, a far more accurate basis for decision is achieved. By comparing the loss values for potential processes in need of improvement, the process indicated by the customers to be important and with the highest savings potential can easily be identified.

An important step in the benchmarking process is to understand and document own processes, and also to measure the performance of these processes. For this purpose, poor quality cost measurement offers a much better solution than the previously used simple performance measures in benchmarking. In poor quality cost measurement, the process analysis is based on a thorough breakdown of each activity required to regain acceptable performance of a characteristic, and the costs are allocated through each activity's resource consumption. These costs are used to construct loss functions with target values determined through the QFD process (Figure 4). Each loss function represents expected costs at different levels of performance, and by integrating actual process performance, a good performance indicator is attained. This indicator also displays how sensitive the process is to variation. Since poor quality cost data have been collected, these are readily available as one major element in this respect.



$$E[\bar{L}] = \int_{-\infty}^{\infty} L(x)g(x)dx$$

Figure 4 Expected Loss

The finding phase

When the processes are defined in the first phase of the poor quality cost model, a neutral benchmarking along with a prioritization of the external customer requirements is performed. This is accomplished by a comparison of both how well the company meets customer requirements compared to chief competitors and the performance of key processes. Both require an initial benchmarking study that will identify areas where the company's performance is inadequate or areas where a competitive advantage can be achieved. This initial benchmarking can be utilized in the second phase of the benchmarking study: the search for benchmarking partners. From experience, this is usually one of the most difficult tasks in the entire benchmarking study and is often started completely from scratch. Being able to start from these initial comparison results offers valuable support for the find phase in the benchmarking wheel.

The collection phase

The third phase of the benchmarking study entails an observation of the benchmarking partners. During the observation, both the performance level of the benchmarking partners' processes and how those processes are carried out, i.e. the practice, are documented. The poor

quality cost measurement breakdown of activities and allocation of costs can be used to understand and document the benchmarking partners' processes. By using poor quality costs as at least part of the complete process performance picture, poor quality cost again provides a foundation for the benchmarking. Since poor quality cost measures already have been collected for the company's own process, a coherent set of comparable data is assured.

The analysis phase

The collected data, both with regard to performance levels and practices, collected for both the company's own and the benchmarking partners' processes, are brought forward to the analysis phase. Due to its inherent simplicity being represented by very easily comprehensible monetary values, the gap analysis of this phase is made very easy when performance is measured through poor quality costs. Differences in performance can be portrayed as differences in poor quality costs measured by the loss function. Identification of gaps in performance and priorities for improvement can be made very tangible by analyzing the data in the QFD matrix, see Figure 5. Performance gaps with regard to how well customer requirements are met are weighted by the customers' attached importance to each requirement, enabling the company to focus their improvement efforts to gain maximum benefit for their customers. This is also the most profitable solution to the company, since the poor quality costs are minimized.

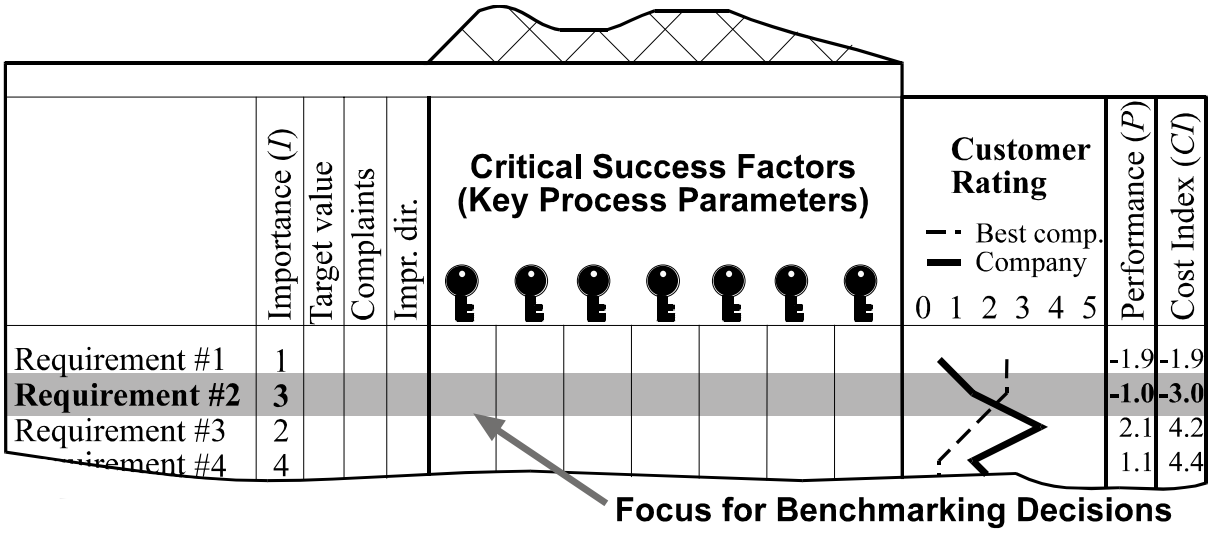


Figure 5 Gap Analysis Using the QFD Matrix

The implementation phase

The final stage of the benchmarking study will give new updated information back to the poor quality cost model and close the loop. This stage enables the company to verify the effects of the benchmarking study and document the financial savings due to the improvement efforts. A successfully performed and implemented benchmarking study should result in higher ratings of the company compared to chief competitors for the most important customer requirements. A new customer survey will result in other priorities for improvement and form the basis for new benchmarking studies to bring the company even further forward. In this way the benchmarking wheel is set into motion based on crucial input from the poor quality cost measurements and will form a continuous journey of improvement.

THE INTEGRATED FRAMEWORK IN A LARGER ORGANIZATIONAL CONTEXT

As mentioned a few times in the paper, this integrated framework of benchmarking and poor quality cost measurements will support the general quality management work in the organization. However, the framework will serve several different purposes when applied in a company:

- As we have described through the cycle of the benchmarking wheel, the framework will provide decision-support for and one specific way of undertaking improvement work in the organization. It will help decide where to target the improvements and find better solutions.
- The framework will also form one key basis for a continuous monitoring of the organization's performance by undertaking regular measurements. This monitoring will both ensure that the organization meets the most important customer requirements and also enables comparison of the performance with key competitors.
- Furthermore, through providing input and insight into the development of customer preferences and how the company's products and services satisfy these compared with its competitors, a use of the framework will aid the long-term strategic planning. Based on this input, the company can adjust its future development to the areas where the customer requirements are strong and which coincides with the strengths of the company.
- Finally, but certainly not least important, applying the framework will turn it into a tool for organizational integration between many different departments. To use the framework the marketing department must carry out the market survey, product development and manufacturing must implement changes based on the survey results, this might in turn involve procurement, personnel, etc. All in all, many different parts of the organization will have to cooperate and learn how the others think and work. This generates valuable integration and cross-departmental understanding.

CONCLUSIONS

Integrating these two models provides large improvements and additional benefits to both concepts. The poor quality cost model relies on initial benchmarking data as input, at the same time as the complete benchmarking study provides a mean to verify that improvements have resulted in increased performance and customer satisfaction. The benchmarking model benefits from the structured activity analysis and the overall cost and performance picture visualized through the loss function. The process of identifying processes to benchmark becomes more tangible and the results of the study more measurable.

If this integrated framework is promoted as a standard element in quality management and the TQM toolbox, we believe that both benchmarking and poor quality cost will achieve higher recognition and generate better improvement results.

REFERENCES

American Productivity & Quality Center (1993) *The Benchmarking Management Guide*, Productivity Press, Cambridge, MA, USA.

Andersen, Bjørn (1995) *The Results of Benchmarking and a Benchmarking Process Model*, Ph.D. Dissertation, Norwegian Institute of Technology, Trondheim, Norway.

Balm, Gerald J (1992) *Benchmarking: A Practitioner's Guide for Becoming and Staying Best of the Best*, QPMA Press, Schaumburg, IL, USA.

Bogan, Christopher E. and English, Michael J. (1994) *Benchmarking for Best Practices: Winning Through Innovative Adaptation*, McGraw-Hill, New York, USA.

Camp, Robert C. (1992) Learning from the Best Leads to Superior Performance, *Journal of Business Strategy*, May/June, p. 3-6.

Diallo, Alahassane, Khan, Zafar U., CMA and Vail, Curtis F. (1995) Cost of Quality In the New Manufacturing Environment, *Management Accounting*, vol. 77, no. 2, p 21- 25.

Ernst & Young and American Quality Foundation (1992) *Best Practices Report: An Analysis of Management Practices that Impact Performance*, Cleveland, OH, USA.

Foster, Thomas A. (1992) Logistics Benchmarking: Searching for the Best, *Distribution*, vol. 91, no. 3, p. 30-36.

Feigenbaum, Armand V. (1956). Total Quality Control. *Harvard Business Review*. vol. 34, Nov-Dec, p. 93-101.

Godfrey, Blanton A. (1993) Ten Areas for Future Research in Total Quality Management, *Quality Management Journal*, October, p. 47-65.

International Academy for Quality (IAQ) (1995**)** *The Best on Quality Volume 6, Chapter 10: Considerations Concerning Quality-Related Cost*, ASQC Quality Press, Milwaukee, Wisconsin, USA.

Juran, Joseph M. (1951) *Quality Control Handbook*. McGraw-Hill, Inc., USA.

Mittelstaedt, Robert E. (1992) Benchmarking: How to Learn from Best-In-Class Practices, *National Productivity Review*, Summer, p. 301-315.

Moen, Rune Magnus (1997) *Customer and Process Focused Poor Quality Cost Model Used as a Strategic Decision-Making Tool*, Ph.D. Dissertation, Norwegian University of Science and Technology, Trondheim, Norway.

O'Dell, Carla (1992) Benchmarking: America Looks to the Customer and Best Practices, *Continuous Journey*, October/November, p. 6-7.

Porter, Leslie J. and Rayner, Paul (1992) Quality costing for total quality management, *International Journal of Production Economics*, vol. 27, no. 1, p 69-81.

Watson, Gregory H. (1993) *Strategic Benchmarking: How to Rate Your Company's Performance against the World's best*, John Wiley & Sons, New York, USA.