

## **Missing Links in Quality Initiatives in Australian Manufacturing Industry - A System Dynamics Analysis**

**Purnendu Mandal**  
**School of Engineering and Technology**  
**Deakin University**  
**Geelong, Victoria, Australia.**

### **Abstract**

This paper emphasises on the question of how quality management initiatives influence business performance with particular emphasis to Australian manufacturing industries. The paper describes the findings of a pilot survey on quality conducted among manufacturing companies in the Geelong region of the Victoria state. The results of the survey have helped in understanding the transient nature of the quality management process. It transpires from the study that the industry managers have limited perception of the quality process. They fail to realise some of the important feedback loops of the quality management system. The paper attempts to identify the missing links and develop a comprehensive (and a more representative) causal model of quality management process.

### **1.0 Introduction**

Quality movement in Australian manufacturing industry gained momentum after the announcement of government policies on quality (Foley Report, 1987). The government introduced a number of incentive schemes and companies were quick to respond to those incentives. A number of studies have been conducted from time to time by academics and government bodies to assess the impact of quality initiatives in Australian companies (Sohal et al, 1992; Brown, 1995). These studies test empirically the effects of quality improvement methods on manufacturing and overall business performance. The studies reveal that quality programs have not been as successful as was anticipated at the beginning. The contributions of quality initiatives have been limited and, to a large extent, the quantification and measurement of benefits have been debatable.

A careful review of the published literature shows that the studies are primarily concerned with establishing whether there is any relationship between quality practices and the output of manufacturing processes. Considering the high level of competition among manufacturing economies, it is absolutely vital that we understand properly how interactions among forces in manufacturing and quality improvement systems shapes the long term behaviour of manufacturing industries. To this aspect the existing studies have failed miserably. Where ever models have been used, they are either over simplified or poorly represent the actual processes. It is vitally important from a long-term perspective that we enquire how quality management practices influence outputs of manufacturing processes, not whether there is any relationship.

In this paper we emphasise on the question of how quality management initiatives influence business performance with particular emphasis to Australian manufacturing industries.

The paper describes the findings of a pilot survey on quality. The results of the survey have helped in understanding the transient nature of the quality management process in the Geelong region of Victoria state. It transpires from the study that the industry managers have limited perception of the quality process. They fail to realise some of the important feedback loops in quality process. The paper attempts to identify the missing links and develop a comprehensive (and a more representative) causal model of quality management process.

## **2.0 The Survey**

A survey was conducted among manufacturing companies in the Geelong area within Victoria State to study different aspects of quality management practices. The companies were selected from the membership of Australian Chamber of Manufacturers (Geelong branch). 147 companies were identified for the survey and a questionnaire was sent to them during September 1994. In total 37 replies were received which amounted to 25 percent response rate. However, 34 responses (out of 37) could be used for analysis. A sample of the questions asked in the questionnaire are given in Appendix 1.

Some of the major results of the questionnaire are analysed and presented here.

### ***2.1 Aspects of Quality Management implemented***

Opinion were sought on five aspects of quality management implementation: active involvement of top management, on going training, workers participation, customer feedback, and supplier quality evaluation. It was observed that the respondents identified the active involvement of top management as the most important factor (in 82% cases) in implementation of quality management. The least consideration was given to supplier quality evaluation (in 47% cases). The other aspects ie. on going training, workers participation and customer feedback (scoring 79%, 76% and 73%, respectively) were considered very important by the companies in quality management implementation.

The implication of involvement of top level management in quality and its influences in long term behaviour in quality areas are discussed in the later part of the this paper.

### ***2.2 Manufacturing Management Philosophies***

The majority of the companies (58%) adopt total quality management (TQM) approach in manufacturing. JIT, Lean Manufacturing and benchmarking (scoring 35%, 35% and 29% respectively) are also important to manufacturing companies. MRP, MRPII and GT are either not applied or applied in very few companies.

Only 47% companies indicated that they have formal quality department. Again only 38% of the companies are accredited with national or international organisations. Majority of the companies (62%) do not have any type of certification. This may mean either the degree of formalism of quality in Australian manufacturing industries is still in infancy stage or the companies find no merit in obtaining certification. The later is more convincing. Terziowski et al (1995, p. 235) writes that 'the statistical analysis shows that ISO 9000 Certification does not have a significant effect on increased customer satisfaction, employee morale and increased sales.'

**2.3 Problems in Implementing Quality Programs**

The cultural change is still the major hindrance in implementing quality related programs. 67% of the respondents recognise that this is a major problem area. Technical, managerial and financial factors are also significant to atleast 47%, 38% and 20% of the companies, respectively. Many studies on quality have shown the influences of cultural changes in the success of implementing quality initiatives. In the model building exercise in this paper we have attached a very high importance to human aspects (motivation, skill, training, etc).

**2.4 Cost vs Quality**

About 65% of the companies responded that the cost of products of their companies are similar to other domestic competitors. But more than 65% of the companies feel that their products are superior to domestic competitors. The opinion is very similar for foreign competitors. It seems that the Australian manufacturing companies perceive that they are providing products of better quality for the same price compared to their domestic (as well as international) competitors. The data in Table 1 indicate this message. The numbers in the table are the number of responses.

**Table 1: Responses for Cost and Quality of Products.**

Cost in relation to domestic and foreign competitors:

	Very High	High	Same	Low	Very Low
Domestic	3	2	22	6	1
Foreign	2	9	7	8	1

Quality in relation to domestic and foreign competitors:

	Very High	High	Same	Low	Very Low
Domestic	11	12	10	1	0
Foreign	12	11	6	1	0

Cost and quality are two important instruments for competition and their longterm behaviour determine the future for the business. The model proposed here determines the quality of products endogenously and also considers various components of costs to product and quality.

**2.5 Spread of Quality**

One major objective of the survey was to find out the extent of coverage of quality initiatives over the whole industry and in individual functional areas. Questions were asked to industry managers to give their judgement on the extent of coverage and the years in which quality initiatives were introduced in each functional area for the period 1980 to 1994. The extent of coverage is determined in terms of percentage of functional areas in which quality initiatives has already been applied. For example, if quality practices and awareness is prevalent in all functional areas in a year the extent of coverage for that particular year is assumed to be 100%. Similarly, if only two out of ten functional areas are covered in a year the extent of coverage is 20%.

Individual company responses were used to determine an overall curve for spread of quality in manufacturing industry. The spread of quality for overall manufacturing industry for a particular year is given by:

$$C_t = \frac{\sum_{i=1}^n c_{it}}{n \times 100}$$

where  $c_{it}$  is the spread response for  $i_{th}$  company in year  $t$ .  $n$  is the number of companies.

Figure 1 shows the spread of quality with time for manufacturing companies in Geelong area. This curve represents the percentage of functional areas in which quality concepts are in place taking all the manufacturing companies together. In 1988 the quality concepts was applied to only 35% of the functional areas, and that had spread to about 76% of the functional areas in 1994. The curve in Figure 1 is a growth curve and it is possible to use this curve to project the spread of quality in future years.

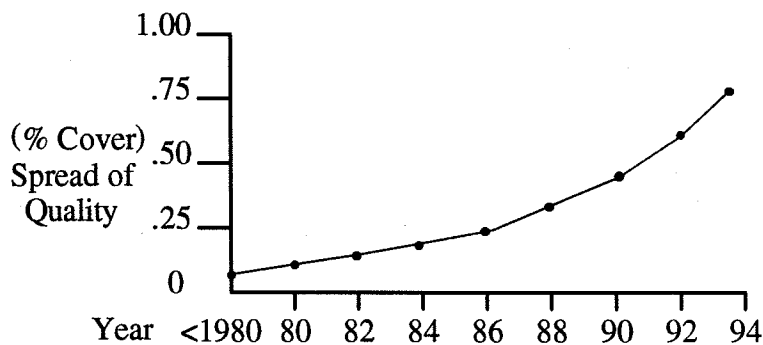


Figure 1: Spread of Quality in manufacturing Industry in Geelong area.

Figure 2 shows the spread of quality in individual functional areas over the years 1980 to 1994. There are two distinct phases of quality movement in manufacturing industry. A rapid growth in the introduction of quality in all functional areas is observed after 1986. Before 1986, quality concepts were existent primarily in the area of production; limitedly in the areas of design,

## Parallel Program

and sales and marketing. After 1986, the production and product design areas have experienced a massive surge in quality activities; other areas have also experienced increase in quality activities but not as high as former two areas.

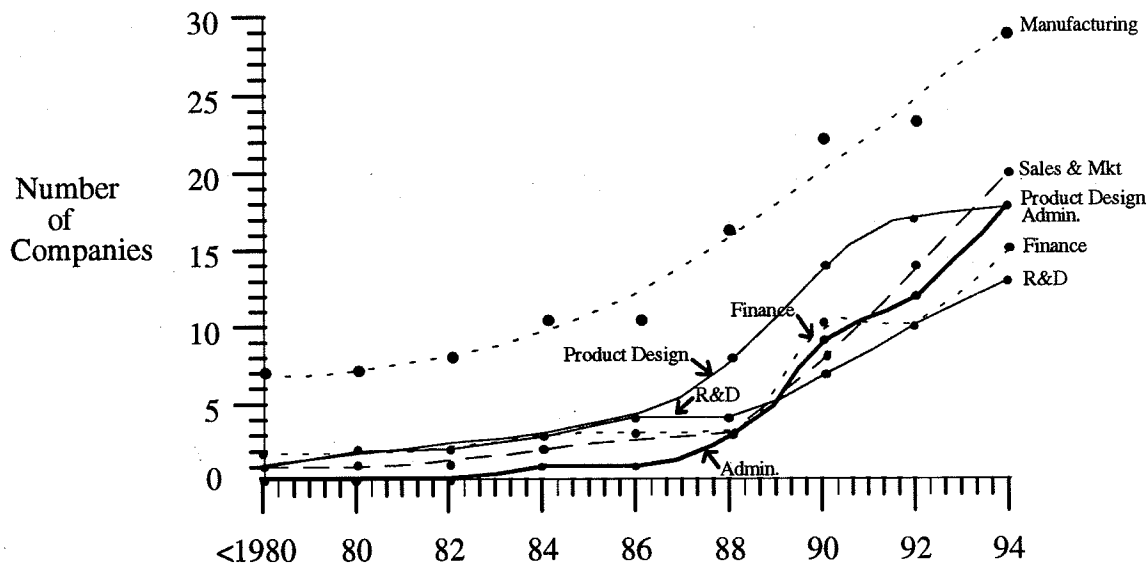


Figure 2: Spread of Quality in Functional Areas.

### 3.0 Missing Informations

The analysis in section 2 provides some important insights on quality initiatives in Australian manufacturing industry. For example, we know:

- the importance of involvement of top level management;
- adoption of TQM philosophy in manufacturing;
- irrelevance of quality certification;
- existence of cultural change problems in quality implementation;
- complacency among industry leaders with regard to cost and quality;
- the extent of coverage of quality.

Equally, there are a number of missing information which either industry managers could not provide or was outside of the scope of this survey. For example, how quality initiatives benefited companies? Most of the respondents were silent in this question. The answer was expected in terms of reduction of rejects, increase in revenue or in reduction of labour disputes. Another aspect where the information is unclear is the provision of training for quality. Most of the companies have provision for training budget; but a budget distinction between training for quality and overall company training is rare.

A very important area which was not covered in the survey was the strategic considerations of quality policies. Recent studies indicate that the quality management initiatives

in Australian manufacturing companies are piece-meal and ad-hoc. The policies for quality improvement are rarely linked to strategic considerations. For example, investments in quality initiatives are largely influenced by the availability of government subsidies rather than the genuine need for improvement in operations and services.

In the subsequent sections a model for quality planning and analysis is described. The development of the model is based on the understanding of the information gained from the survey and discussions with experts in quality.

#### 4.0 A Limited View of Quality Process

On a qualitative scale the survey indicated that the managers did not have a clear idea how the quality initiatives affected the company performances. Quantification of potential benefits of quality initiatives as such is very difficult and it has been so for manufacturing companies in Geelong region. Preliminary discussions with industry leaders (and also this survey) confirm that industry managers have an open loop perception of quality processes. Which means the industry managers can perceive the likely effects of a quality initiative, but are unable to perceive the impacts of the effects (generated previously by quality initiatives) on the initiatives enforced earlier. The open loop perception of quality process is shown in Figure 3.

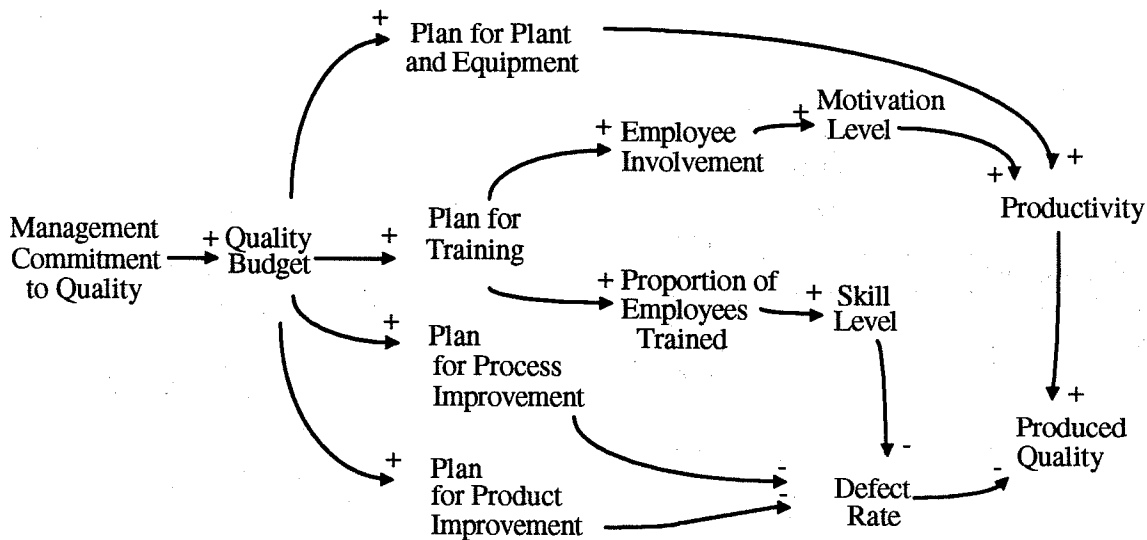


Figure 3: Open Loop Process of Quality.

As indicated by this survey, in majority of the companies (82%) the top management lend active support to quality management. The commitment of top management is reflected in framing a budget for quality. The budget for quality primarily comprises budget plans for training, quality plan for plant and equipments, process improvement and product improvement.

The training for quality increases the skill level of workers which reduces the defect rate. Again the training for quality improves the motivation of workers which ultimately increases the productivity of workers. The plans for quality in process improvement and in product

improvement together with improved skill reduce the defect rate of products. Productivity (determined by both motivation and quality plans for plants and equipments) and defect rate determines the overall quality of produced goods.

From the diagram in Figure 3 one can easily identify how the final quality of goods and services (produced quality) behaves with management commitment to quality. If the management commitment to quality is high the produced quality will also be high. This is the traditional view of management to quality policy. But, can the produced quality change or influence management commitment to quality? How the outputs change the input decisions? A study at MIT (Brown and Tse, 1992) described how management commitment gradually shifted away from quality to other areas of operation due to both internal and external pressures on business.

### 5.0 A Comprehensive Model for Quality Planning

Figure 4 shows the overall causal loop diagram of the proposed quality planning model. This model incorporates a number of information feedback loops to the open loop model as described in section 4.

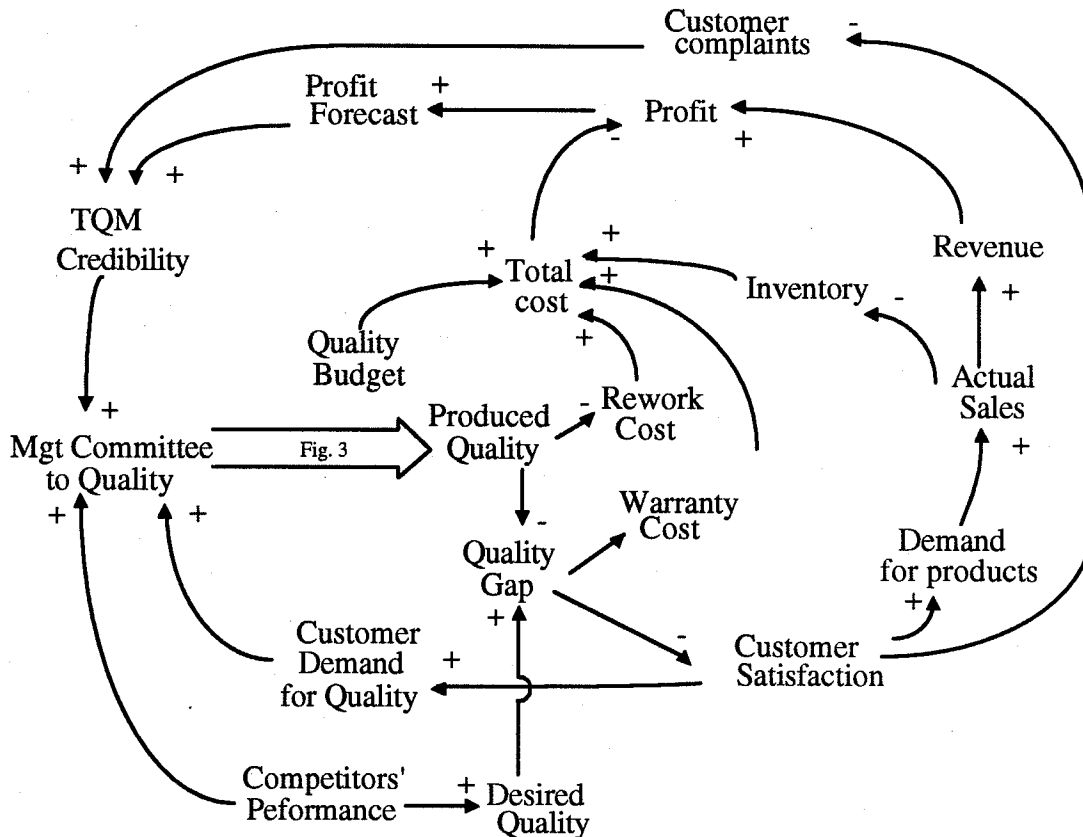


Figure 4: Overall Causal Loop Diagram of Quality Model.

The major areas of concerns for quality included in this diagram are:

- quality costs (rework cost, warranty cost, etc);
- customer satisfaction and its influences to product demand, complaints and demand for quality;

- financial performances in terms of profit (and costs) and its influences to TQM credibility.
- competitors' performance and its effect on management commitment to quality.

A computer model has been developed for the relationships. The model represents a hypothetical company. The parameter values are taken from the survey and in some cases from actual company data.

The model has been simulated for 60 months and the behaviour of four major variables (produced quality, quality budget, total costs and customer satisfaction) are shown in Figure 5. The model generates the plausible behaviour. The customer satisfaction behaves in same way with quality. The total cost has gone down with the increase in quality meaning that the rework costs and warranty costs have reduced. The quality budget has been influenced by the actual quality.

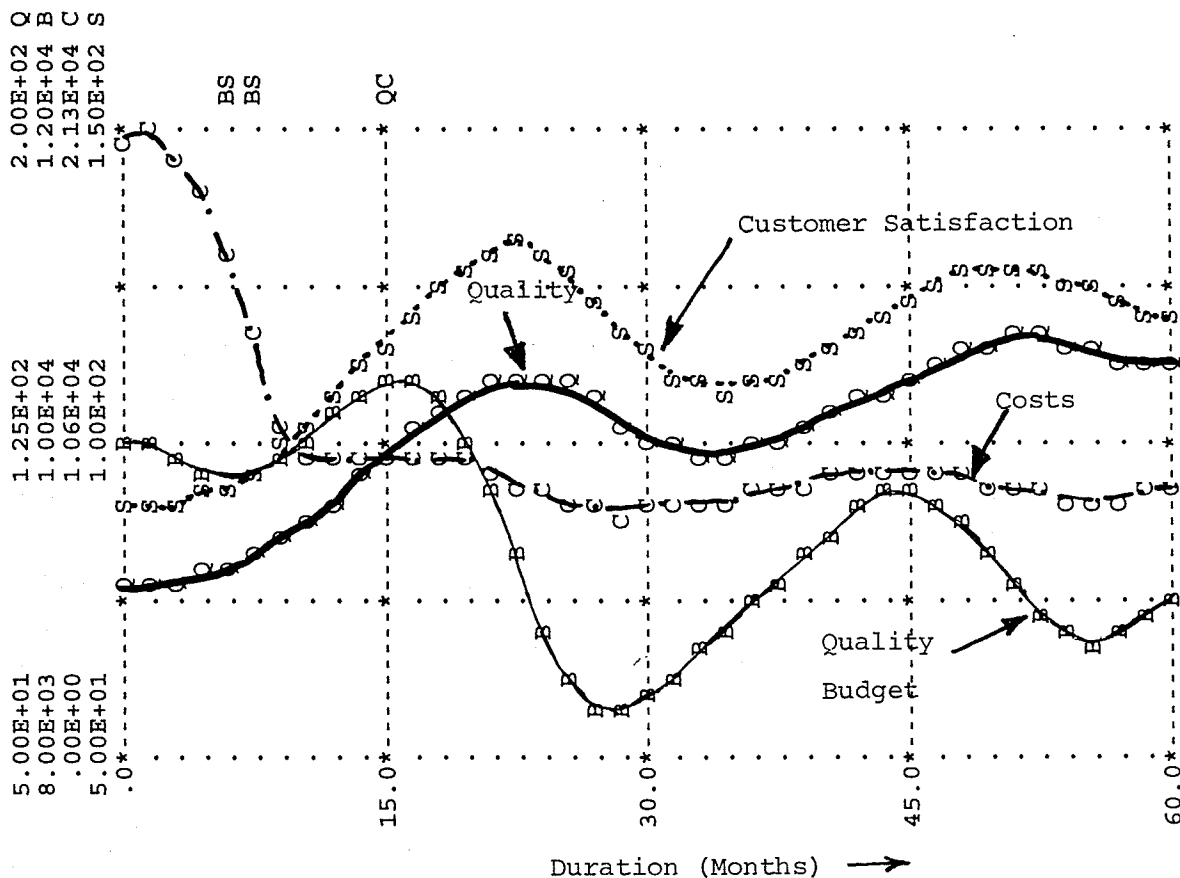


Figure 5: Behaviour of Quality, Cost, Budget and Customer Satisfaction.



## 6.0 Discussion

A model for policy analysis in quality management area has been described in this paper. The model considers cause-effect relationships for quality investment decisions, quality and cost outputs, customer satisfaction, competitors' performances, etc. The model is based on an initial understanding of quality management practices gained through a questionnaire survey among manufacturing companies.

The paper has highlighted the limitations of the present quality management practices. Particularly, attention has been drawn on to the inability of managers in understanding the quality system in its totality. A comprehensive model for quality has been developed by incorporating information feedback loops. The model has been simulated to test its ability in generating possible longterm behaviour of major variables.

At the moment, the model is a hypothetical one and it requires further development and validation. When developed fully the model would be used to test alternative quality policies.

## 7.0 Acknowledgments

The financial support for this work was provided by Deakin University. Dr Narendra Deshpande and Mr Demitrio Elgueta assisted in designing the questionnaire for the survey. Secretarial and drafting support was provided by Mrs Colleen Caldwell.

## 8.0 References

- Brown, A. 1995. Industry Experience with ISO 9000, *Proceedings -2nd national Research Conference on Quality Management*. pp. 147-159.
- Brown, J. and Tse, S. 1992. *A System Dynamics Analysis of Total Quality Management Implementation False Starts*. MSc Thesis, MIT.
- Foley Report. 1987. *Report of the Committee of Review of Standards, Accreditation Quality Control and Assurance*. DITAC, Canberra.
- Sohal, A.S., Ramsay, L. and Samson, D. 1992. Quality Management Practices in Australian Industries. *Total Quality Management*. 3(3): 283-299.
- Terziovski, M., Samson, D. and Dow, D. 1995. The Value of ISO 9000 Certification in Australian and New Zealand Manufacturing. *Proceedings - 2nd National Research Conference on Quality Management*. pp. 235-248.

## Appendix 1: A Sample of Questions in the Survey Questionnaire.

---

- Type of industry as per ABS classification.
- Does company export?
- Approximate sales of the company for the last financial year.
- How many people are employed by the company?
- How many people are employed in production?
- How much is the net asset in plants and equipments as per last financial report?

- Which aspects of Quality Management are implemented in the organisation?
  - Which manufacturing management philosophies are adopted in the company?
  - Is there a formal Quality Department?
  - How many people are involved on full time basis in quality related activities?
  - Is the company accredited with any national or international organisation?
  - How long the accreditation process took?
  - The types of problems encountered when implementing quality programs.
  - How does the cost of the company products relate to domestic and foreign competitors?
  - How does the quality of the company products relate to domestic and foreign competitors?
  - How employee training is organised in the company?
  - In which years the quality management initiatives were introduced in the company?
  - To what extent quality practices/awareness has spread in the company.
  - What are the major functional areas in which quality improvement initiatives were/are practiced actively?
  - How much the company spend on quality improvement initiatives? (in % of revenue).
  - What is the extent of benefit? (in relation to % improvement in quality of product/services, % cost savings, % increase in revenue.)
-