TÜSİAD

TURKISH INDUSTRIALISTS' AND BUSINESSMEN'S ASSOCIATION

MOVING FORWARD

ASSESSMENT OF COMPETITIVE STRATEGIES AND BUSINESS EXCELLENCE IN THE TURKISH MANUFACTURING INDUSTRY: A BENCHMARKING STUDY

TÜSİAD COMPETITIVE STRATEGIES SERIES - 6

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FOREWORD

TÜSİAD (Turkish Industrialists' and Businessmen's Association), which was founded in 1971, according to the rules laid by the Constitution and in the Associations Act, is a non-governmental organisation working for the public interest. Committed to the universal principals of democracy and human rights, together with the freedoms of enterprise, belief and opinion, TÜSİAD tries to foster the development of a social structure which conforms to Atatürk's principals and reforms, and strives to fortify the concept of a democratic civil society and a secular state of law in Turkey, where the government primarily attends to its main functional duties.

TÜSİAD aims at establishing the legal and institutional framework of the market economy and ensuring the application of internationally accepted business ethics. TÜSİAD believes in and works for the idea of integration within the international economic system, by increasing the competitiveness of the Turkish industrial and services sectors, thereby assuring itself of a well-defined and permanent place in the economic arena.

TÜSİAD supports all the policies aimed at the establishment of a liberal economic system which uses human and natural resources more efficiently by means of latest technological innovations and which tries to create the proper conditions of for a permanent increase in productivity and quality, thus enhancing competitiveness.

TÜSİAD, in accordance with its mission and in the context of its activities, initiates public debate by communicating its position supported by scientific research on current issues.

In this content, in order to specify the competitveness of certain sectors in Turkey, TÜSİAD's Relations with Professional Associations Committee with the help of related Professional Associations, performed "Competitiveness Strategies and Business

Excellence" reports under the supervision of Prof. Dr. Gündüz Ulusoy at Sabancı University

This report is based on former studies on "Competitiveness Strategies and Business Excellence" studies jointly realized with Automotive Manufacturers Assocaiation (OSD), Turkish Electronics Industrialists Association (TESİD), Turkish Cement Manufacturers Association (TÇMB), White Goods Suppliers Association (BEYSAD) and Turkish Automotive Parts and Components Manufacturers Association (TAYSAD).

March 2000

BIOGRAPHY

Gündüz Ulusoy is currently with the Faculty of Engineering and Natural Sciences of Sabancı University, Istanbul. He received his BS in mechanical engineering from Robert College, Istanbul in 1970; MS in mechanical engineering from University of Rochester in 1972 and PhD in operations research from Virginia Tech in 1975. He served in the Department of Industrial Engineering, Boğaziçi University in Istanbul from 1976 till 1999 as faculty member and also as Head of Department. He also served as Vice President of Boğaziçi University. He worked for one year on leave from Boğaziçi University in industry as production engineer. His current research focuses on manufacturing and technology strategies and project management and scheduling. He has published research articles in *Interfaces, Operations Research, Journal of the Operational Research Society, European Journal of Operational Research, International Journal of Production Economics, International Journal of Production Research, IIE Transactions, International Journal of Production and Operations Management, Journal of Operations Management,* and *Computers & OR.* He is a member of the Editorial Board of the *European Journal of Operational Research* and of the *Transactions on Operational Research* and served as a Contributing Editor to the *International Abstracts in OR.* He served on the Boards of Turkish Scientific and Technical Research Council and Marmara Research Center. He is currently on the Board of Quality Association (KalDer) and chairs its Quality Award Committee.

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Moving Forward: Assessment of Competitive Strategies and Business Excellence in the Turkish Manufacturing Industry aims to explore the state of competitive strategies and business excellence in the manufacturing industry in Turkey and to draw some conclusions concerning possible near future developments. It is based on several sectoral benchmarking studies conducted in the manufacturing industries in Turkey.

Business excellence is about competition at the company level and thus needs to be studied in the context of competition. Among the various approaches used in the studies on competitiveness, the engineering approach provides a different means of describing and measuring competitiveness. It defines the companies' capacity to compete as their ability to search for, identify, and assimilate best practices. Best practices are defined as the industry, country, or worldwide practices related to customer focus, quality, flexibility, cost, innovation, and responsiveness that yield superior performance. The continous effort of seeking best practices should be intertwined with the building of competences. Competition for an enterprise is indeed about deciding upon and building the right set of competences. Sustainability of competitiveness depends on the company's success at developing its competences together with the skills and commitment of its staff.

Engineering approach assumes that the competitive ability of a country or region is the combination of competitive abilities of individual companies in that country or region. It is argued that, proliferation of best practices within the sector will improve the performance, and consequently the competitiveness of the sector as a whole. This study subscribes to the engineering approach.

A methodological question is how to measure and to assess the competitiveness of an enterprise. Competitiveness is measured usually in financial and economical terms. In as much as economic and financial data have a number of limitations in that they are at a high level of aggregation and often use proxies for managerial inputs and outputs, an alternative means of examining competitiveness is to study the drivers of competitiveness: the operational practices and outcomes of individual enterprises. This way of examining competitiveness

forms the methodological base for the sequence of sectoral benchmarking studies leading to this report.

The study of competition is an important issue not only for the companies but also for the governments. Creation of new employment is a primary socio-economic problem of governments in Turkey and elsewhere in the world. Not only is the population of Turkey relatively young and a large percentage of it is in the employment pool, but also the relatively fast urbanization process brings large and mostly unskilled persons into the labor market. Technological change is fast compared to social change, but both are faster than the political change. With the pace of technological change increasing, the consequences of this widening gap become even more alarming.

Moving Forward: Assessment of Competitive Strategies and Business Excellence in the Turkish Manufacturing Industry is based on the findings of two different kinds of exploratory studies conducted in Turkey. One is a series of sectoral benchmarking studies on competitive strategies and business excellence covering 82 companies in the electronics, cement, automotive, appliances part and component (p&c) manufacturing sectors. The second kind of studies look into the technology management and new product development processes in the electronics and automotive p&c manufacturing sectors covering 49 companies.

The sectoral benchmarking studies on competitive strategies and business excellence have been realized with the cooperation of the Turkish Industrialists' and Businessmen's Association (TÜSİAD), the Association of Turkish Electronics Industrialists (TESID), the Association of Turkish Cement Producers (TÇMB), the Association of Automotive Industrialists (OSD), the Association of White Goods Part and Component Suppliers (BEYSAD). The exploratory studies on technology management and new product development process have been conducted in cooperation with TÜSİAD, TESİD, Turkish Technology Development Foundation (TTGV), and Association of Automotive Part and Component Suppliers (TAYSAD).

Technology changes at an increasing pace and technology access gets easier in the global sense. All these make the technology arena one of the major battle fields for the companies. Due to the importance of technological innovation and new product development for competitiveness, the results of two further studies

covering these areas in two different sectors of the manufacturing industry and conducted in the same time frame (1997-1999) are also included in this study to support the sectoral benchmarking studies on business excellence. The objective of these studies is to investigate the technology management and new product development processes more closely in order to draw conclusions as to where the industry stands relative to global best practices.

Model Base And The Questionnaires

In this study, we have made use of data gathered through the implementation of three different questionnaires: Competitive strategies and business excellence questionnaire; Technology management questionnaire; and New product development capability assessment questionnaire. In the development phase of the questionnaires, three steps are followed: *preparation, testing,* and *finalization.* The prepared questionnaires are discussed with the surveyed companies to test the clarity, completeness and compliance of questions. Finally, they are revised in response to the feedback obtained.

Implementation of the Questionnaire

Two approaches have been employed for implementing the questionnaires. For the electronics, automotive, and cement sectors, the questionnaires have been distributed to a set of companies preselected jointly with te respective Association. Inquiries of the companies on certain items in the questionnaires were answered by phone and fax. A telephone traffic followed to ask the companies for the filled-in questionnaire forms. For this kind of implementation, we have achieved return rates of 60% for the electronics, 56% for the automotive and 64% for the cement sectors corresponding to 27, 10, and 25 companies respectively. Structured follow-up interviews and site visits have been made in several companies in each sector.

In the case of appliances p&c (20 companies) and automotive p&c sectors (21 companies), member companies preselected jointly with the respective Associations have been approached for their approval to join the study. To those companies who agreed, the questionnaire has been explained either by a site visit or in small group meetings of companies. Structured follow-up interviews and site visits have been conducted after the return of the filled-in questionnaire forms. *In hindsight, we can conclude that the second approach is the more effective one.*

In each case, a draft report is prepared and discussed at length with the respective *Industrial Advisory Board* organized for this purpose consisting of 6-9 members. The discusions led to the final report.

Competitive Manufacturing Strategies

Manufacturing strategy formulation process requires making three strategic choices: selection and implementation of *competitive priorities, manufacturing objectives* and *action plans*. Competitive priorities indicate the relative importance of competitive capabilities. Once the competitive priorities are set, measurable performance targets should be established. These targets refer to manufacturing objectives, which are identified to support the envisaged competitive priorities. To achieve the established set of manufacturing objectives, in turn, the management should develop improvement programs; in other words, action plans; to be implemented in near future. The ultimate outcome of this process is expected to be a positive contribution to the overall business performance.

Companies are asked about their competitive priorities, manufacturing objectives, and action plans which *will be valid for the company for the coming two years.*

For each sector, the companies ranked the first five competitive priorities out of a list of 15 candidate competitive priorities. The list is comprised to include various aspects of supply chain: product, production, marketing. It is customer focused in the sense that many of the competitive priorities in the list are marketplace related with some reflecting performance in the marketplace. Only a few of the priorities represent internal measures.

The companies have indicated their top five ranking manufacturing objectives from a complete list of 15 manufacturing objectives. The manufacturing objectives cover all components of the supply chain. Profitability and market share are included in the list to reflect the role manufacturing should play in the formulation of the business strategy. Care is taken to restrict the choice of manufacturing objectives to those whose associated attribute can be expressed in quantitative terms allowing the management for target setting.

The results of the ranking by the companies are indicated below.

Competitive Priorities	**Manufacturing Objectives**
Consistent quality level	Decrease unit cost
Reliable products	Increase market share
Low price	Increase conformance quality
Rapid design change /new product introduction	Decrease new product development time
Dependable deliveries.	Increase production rate

These competitive priorities are valid in general over all sectors. *Low price* does not imply cheap products but relatively lower prices compared to the roughly equivalent competing products in the market. This short list indeed reflects the rules of the game expected by the companies to become prevalent in the market in near future. You have to manufacture reliable products with not only good but consistent quality, to market them at relatively low prices, and to deliver them on time and meeting further requirements of the customer.

The fact that r*apid design change / new product introduction* has appeared as a competitive priority implies that companies to a large extent have come to understand importance of it as a competitive capability and the need to develop that capability. For some companies, especially for a large number of supplier companies, this process implies new product introduction into the product base of the company or a design change on an already existing design where the original design is provided by some outside source. For these companies, this process consists mainly of preparation for production and launching full scale production. Hence, it is closely related to rapid delivery.

➢ *An interpretation of the result stated above is that, in general, the manufacturing industry in Turkey bases its competition strategy on low price rather than product differentiation.*

The agenda of the manufacturing industries in Turkey is to be able to manufacture quality products at low costs. This requires the creation of an

environment by the management conducive to the mutual support of quality and productivity. *Learning* and *problem solving* should become two essential capabilities of companies operating in such an environment where best practices are not only sought for but also adopted and improved upon.

Growth is a primary target for many companies trying to establish themselves in the market place. The companies want to grow through increasing their sales by becoming more competitive. Increasing market share is expected to lead to further decreases in unit cost, which, in turn, will lead the companies to strengthen their competitiveness. *Increasing market share* implies that the companies will take a more aggressive position in the present and/or new markets with or without new products/models. In a study on the electronics sector in Turkey, a similar result has been obtained for success measures in new product introduction. For both large companies and SMEs, customer satisfaction is the top priority followed by market share and further by sale quantity and amount. Profitability follows next.

A follower of the above three manufacturing objectives is *decreasing new product development time*. This manufacturing objective is emphasized by those sectors which have stated *rapid design change / new product introduction* as a competitive priority. The manufacturing objective of *increasing production rate* is mainly related to the objectives of *decreasing unit cost* and *increasing market share*.

The companies have selected 10 action plans out of a list of 35 action plans. The list is comprised to include action plans in support of the 15 manufacturing objectives mentioned above. The list is kept rather broad in order to end up with a list general enough to be applicable to all sectors of industry.

Action Plans		
Quality	**Production**	**Organization**
TQM	Just-in-time production	Restructuring
Zero defect	Production automation	Employee empowerment
Quality certificates for products	Aligning customer needs and product development	
Quality improvement teams	Developing new processes for new products	

In general, the above action plans are along the lines of the competitive priorities and the manufacturing objectives stated above. The above ten most preferred action plans can be grouped in the general areas of *quality, production,* and *organization.* It is interesting to observe that the action plans in the top ten list show a balanced distribution among these areas.

Quality. *TQM* turned out to be by far the number one action plan preferred by the companies. *TQM* is defined as an action plan to produce and deliver commodity or service which are confirming with customers' needs or requirements by better, cheaper, faster, safer, easier processing than competitors with participation of all employees under top management leadership. As this definition implies, *TQM* is a broad program which has to be implemented concurrently with some other quality programs.

Aiming for *zero defect* should be seen as a supportive action plan for securing consistent quality levels. It reflects the desire of the companies to reduce variability in manufacturing processes and products.

Obtaining *quality certificates for products* is also stated among the preferred action plans. Almost all of these plans for obtaining quality certificates for products aim at international certificates (e.g., CE) for the purpose of facilitating the export of those products.

Quality improvement teams constitute an important indicator for how well TQM is diffused throughout a company. That this action program is part of the short list is an indication that some of the companies are aware of and want to alleviate the negative impact on quality of the low level of employee participation in current quality activities.

Production. *Just-in-time production* is emphasized by both automotive and consumer electronics sectors as part of the cost reduction schemes whereas for the cement sector it is a necessity due to the perishable nature of cement. Just-in-time production applied properly has a considerable impact on cost reduction by reducing the inventories at all stages of production. It can only be developed on a solid quality basis and thus is closely related to *TQM* efforts.

Production automation supports in a direct way the manufacturing objectives of increasing production rate, increasing direct labor productivity, and reducing

labour costs. It is also in line with the aspirations of the companies to increase their market share. Automation might require a significant amount of investment. In order to attain higher levels of capital productivity, automation needs to be built on a sound infrastructure so that sufficient benefits will be realized to balance the cost. Such an infrastructure is best provided by the emphasis on *TQM, training, employee empowerment,* and *quality improvement teams* already observed among the more popular action plans in this study.

The action plan of *aligning customer needs and product development* is associated with companies having some form of product design activity. Aligning customer needs and product development has a positive impact on the effectiveness and efficiency of new product design process and improves the chance for success of the new product in the market. Currently, the efforts to achieve such an alignment are not based on a formal procedure.

Not only in the electronics sector but in all sectors of the manufacturing industry the number of different products and models is proliferating. Hence, the number of new products handled by the companies might increase to keep up with this trend. Here, the term *new product* includes also the class of products that are not unique but simply *new for the company.* Manufacturing processes play a major role in securing high quality and low cost products. The search for the best feasible option of manufacturing the new product might lead to the development of new manufacturing processes. Thus, *developing new processes for new products* becomes the action plan to answer this need. This action plan is part of the efforts to achieve a smooth and efficient product initiation process preceding full scale production.

Organization. The fact that *restructuring* is strongly represented in the short list indicates the need for organizational innovation. There can be many different environments leading to the adoption of restructuring as a remedy. Some of this restructuring aims at decreasing the number of layers in the organization. Some of the restructuring, on the other hand, is meant to overcome the negative repercussions of fast growth of some of the companies. A major problem appears to be the dilemma faced by *family-owned companies.* Usually, such companies grow fast but they lack professional management and an organizational framework to respond to that challenge. These companies look a restructuring as a remedy for such deficiencies.

Employee empowerment is another organizational innovation that has been ranked relatively high among the action plans of the companies. Empowerment moves the responsibility down the layers of the organization. It helps to increase commitment and creativity among the employees. This item can be considered as being closely linked to *TQM.* Employee empowerment hints to the fundamental change in the attitude of management to the employees and in the practice of human resources management. Obviously, employee empowerment is also related to restructuring.

Best Practice Scorecard Of The Sample: The Leaders And The Laggards

The best practice scorecard is constructed to measure the proximity of the surveyed companies to best practice. The horizontal axis of the *best practice scorecard* shows the score on the *strategy & practices index,* and the vertical axis shows the score on the *operational outcomes index;* out of 100. *The strategy & practices index* allows an overall assessment of a company's adoption of the best manufacturing practices related to the *planning, focused strategies, factory operations, leadership, people management, customer focus, process and product quality, technology,* and *benchmarking.* The *operational outcomes index* allows assessment of the extent to which these practices has been converted into operational outcomes in terms of *cost, quality, flexibility, timeliness,* and *competitiveness.* Each of the 82 companies in the sample is plotted as a single point on the best practice scorecard after calculating their individual scores on these indices.

The companies are categorized into five groups according to their relative positions on the best practice scorecard. They are identified as *leader, laggard, medium-performer, promising,* or *won't go the distance* companies. A series of statistical analysis are carried out to demonstrate that the categories are in fact different from each other both in implementing best manufacturing practices and in achieving high operational outcomes. The *leader* companies are those that score high on both the *strategy & practices index* and the *operational outcomes index.* These companies not only have the practices in place but also have linked them effectively to achieve high outcomes. On the other hand, the *laggard* companies are those with low scores on both indices, which means that they neither have practices in place nor do they achieve high outcomes. The *won't go the distance* companies

achieve high scores on the *operational outcomes index,* but low scores on the *strategy & practices index.* According to the *Business Excellence Model,* such companies cannot achieve sustainable high outcomes in the long run without a focus on improvements in practices. On the other hand, although the *promising* companies achieve high scores on the *strategy & practices index,* they have not yet converted their improved practices into outcomes. This situation may simply reflect the time lag between the time the practices have been in place and the time they result in acceptable level of outcomes. The *promising* and the *won't go the distance* companies are considered as the outliers according to the *Business Excellence Model.* The 82 companies are divided among themselves as 10 *leaders,* 9 *laggards,* 3 *won't go the distance* companies, 7 *promising* companies, and 53 *medium performers.*

- *While 60% of the leaders are subsidiaries of parent or holding companies, 78% of the laggards are independent.*
- *Although in the overall sample, the ratio of companies with foreign capital is only 21%, this ratio is 50% for the leader and 11% for the laggard companies.*
- *While 50% of the leaders are large companies, all of the laggards are SMEs.*
- *The fraction of companies with export sales is 80% in the leaders, but 55% in the laggards.*
- *Half of the leader companies have annual total sales more than 100 million USD, compared with 67% of the laggard companies with annual total sales less than 10 million USD.*
- *Neither the implementation of best manufacturing practices nor the achievement of high operational outcomes are affected by the industrial sector the company is in.*
- *Company size affects the adoption of best practice. Large companies are better than medium ones both in implementing best manufacturing practices and achieving high operational outcomes. Medium and small companies do not differentiate themselves from each other.*

Best Practice Adoption Results In Higher Business Performance

- *The leaders in adopting best practice are rewarded by higher business*

performance. They have accomplished substantially higher values than the laggards in the measures of business performance; demonstrating that best practice adoption has a positive impact on business performance.

- *The leaders have achieved 20% average annual growth in sales per employee in the last three years compared with 11% achieved by the laggards.*
- *The leaders have achieved 21% average annual growth in value-added per employee in the last three years compared with -1% obtained by the laggards.*
- *Majority of the leaders (75%) have increased their level of cash flow in the last two years compared with 33% of the laggards.*
- *More than half of the leaders (63%) have experienced positive pre-capital investment cash flows compared to only 11% of the laggards.*

Implemention Of Strategies And Practices

Here we assess the companies in terms of their manufacturing strategies and practices. Transforming an organization to achieve and sustain best practices requires an appropriate manufacturing strategy. Planning, focused strategies and factory operations constitute the strategies. Practices cover leadership, people practices, customer focus, product and process quality, benchmarking and technology.

Planning

- *There is a lack of alignment of manufacturing operations with the business mission, in general. Nevertheless, the leaders are more likely to achieve alignment.*
- *The leaders are performing better than the laggards in almost all aspects of planning.*

Focused Strategies

- *Focused strategy development and implementation appears to be an area open for improvement for the overall sample including the leaders and the laggards.*

Factory Operations

- *The leader companies, by far, performed better than the laggard companies in adopting best manufacturing practices related to factory operations.*
- *The most important result is that, while majority of the leaders have reported a significant or major contribution resulting from preventive maintenance and quality improvement teams, none of the laggards claimed they even applied these approaches.*

Leadership

- *Leadership is regarded highly in the industry. This is mainly due to the frequent crises faced by the industry as a whole, thus creating a need for strong leadership to secure the survival of the enterprise. Another reason could be the lack of systems not yet put in place in the companies, thus requiring strong leadership to compansate for this deficiency.*
- *The leader companies, to a great extent, performed better than the laggards did, on the average. Particularly, there are significant differences observed between the leaders and the laggards in the effective use of team spirit and motivation, and in the assurance of unity of purpose throughout the organization.*

People Practices

- *Two areas of major weakness are the lack of a formal and regular process for the measurement of employee satisfaction and the lack of an organization-wide training and development process, including career path planning.*
- *The leaders are significantly better than the laggards in almost all aspects of people management. Another significant difference between the leaders and the laggards is observed in relation to the extent organization-wide training and development, and career path planning are employed by these companies. However, the leaders fail to differentiate themselves from the laggards in the practice of developing human resources plans that focus on*

the core skills and competencies required to manufacture competitive products.

Customer Focus

- *In general, there is a widespread and keen awareness of the importance of customer focus.*
- *Almost all of the companies, which claimed that they have effective processes for resolving customer complaints, are using customer complaints effectively to initiate improvements in current processes. On the other hand, less than half of the companies systematically and regularly measure customer satisfaction.*

Product and Process Quality

- *Almost all of the companies in the sample have site-wide standardized and documented operating procedures, and methods to measure the quality of their products and services. This can be attributed to the diffusion of ISO 9000 certification in the industry since these practices constitute the essentials of certification process.*
- *The percentage of companies with one or more quality certificate such as ISO 9000 is 60 in the leaders and 22 in the laggards.*
- *Majority of the companies, be a leader or a laggard, claimed that all of their employees believed that quality is their responsibility.*
- *All of the leader companies stated that their employees had a clear understanding of internal customer concept compared to a very small percentage of the laggards who can make such a claim.*
- *The lowest scores are in the areas of quality improvement teams, statistical process control, warehouse management, and machine set-up time reduction indicating these areas to be clearly open for improvement.*
- *The leaders performed far better than the laggards in working closely with their suppliers in product or process development but their performance cannot be judged as satisfactory either. Thus this point is open to improvement for all companies.*

➢ *One of the more importing findings of the analysis is that the companies in the sample have poor supplier relations. While majority of companies recognized a strong customer focus is essential, far fewer attached importance to relationships with their suppliers.*

Benchmarking

➢ *Despite the fact that benchmarking is reported as widely practiced, interviews demonstrated that the concept is far from being uniformly understood. Furthermore, majority of companies they practice benchmarking, do so at the simplest possible level. These findings suggest that practice of higher levels of benchmarking is not diffused among the companies in the sample.*

Technology

➢ *The leaders are much better than the laggards in that their core manufacturing technology is appropriate to their business needs and that they utilize their manufacturing technology to its maximum potential.*

Assesment Of Operational Outcomes

The companies' operational performance is assessed in terms of cost, quality, flexibility, timeliness, and competitiveness. Assessment of operational performance is conducted in terms of *customer satisfaction, employee morale, process changeover time, productivity, technological competitiveness, delivery full on time, proportion of production operators involved in process improvement or problem solving teams,* and *proportion of quality control inspectors to direct operators.*

➢ *Meeting customers' requirements and expectations is a broad indicator of customer satisfaction. However, more than half of the companies in the overall sample declared that they occasionally fail to meet customer expectations. Though, the leaders differentiate themselves from the laggards in that respect, it is deemed to be unsatisfactory.*

➢ *Employee morale is an indicator of employee satisfaction. Less than half of the companies in the overall sample reported high levels of employee morale. All of the leader companies reported high level of employee morale compared with the one-tenth of the laggards.*

- *Value-added per employee is a widely-used indicator of productivity. All of the leader companies reported that their level of productivity is consistently improving and they gained significant benefits, compared with one-third of the laggards. In the overall sample, quite a large number companies stated that their level of productivity needs improvement to some extent.*

- *Average process changeover time is one of the indicators of flexibility. It is the time required to change a specific machine, work center, or line from making the very last piece of product to the very first piece of another different product. It may include the run and inspection time for the first piece. Two-thirds of the companies in the overall sample argued that their average process changeover time needs improvement to some extent. Although, the leaders are much better than the laggards in that respect, still 40% reported a need for improvement.*

- *Committing to remain technologically competitive is a necessity for manufacturing companies to ensure continuous improvement in their production systems. All of the leader companies reported that they have advantages over competitors or that they are technologically leaders, compared with only one-tenth of the laggards. In the overall sample, 45 per cent of the companies believed that their relative level of technological competitiveness is on par or behind competitors.*

- *Four-fifth of the companies in the overall sample reported that more than 90% of the time, they deliver orders full and on time, which is a success. The leaders far outperform the laggards in that respect.*

- *One-fourth of the companies in the overall sample reported the ratio of quality control inspectors to direct production operators as between 10% and 20%, which is quite high. Despite the fact that, the leaders are far better than the laggards in employing less quality control inspectors, this ratio needs to be decreased further.*

- *Half of companies in the overall sample reported ratio of production operators involved in process improvement or problem solving teams as less than 5%, which is very low. The leaders are clearly separated from the laggards in that respect.*

➢ *In general, despite good intentions and long term initiatives in implementing best manufacturing practices, companies are not yet very successful in converting their practices into improved operational outcomes.*

Comparison With Competitors

Competitiveness is relative in the sense that your competitiveness is not only determined by your own performance but also by the performance of your competitors. A careful analysis of the advantages and disadvantages relative to competitors constitutes an essential part of competitive strategy formulation process. The results of such an analysis is deemed to be very useful in assessing a company's competitive position relative to its competitors.

In the study, companies are required to assess their performance on some competitive factors relative to their *domestic* and *foreign competitors, considering the Turkish market.* While competitors having manufacturing sites in Turkey are called domestic competitors, competitors having manufacturing sites outside Turkey are called foreign competitors.

Against foreign competitors

➢ *Relative to foreign competitors, although there are some factors on which companies rate themselves as advantageous or on par, they generally consider themselves in a disadvantageous position.*

➢ *Relative to foreign competitors, ability to adopt product and/or volume changes rapidly remains as the key advantage. The companies consider themselves more flexible in the above sense relative to their foreign competitors.*

➢ *Customer service is considered as an advantage relative to foreign competitors. Since the comparison is made considering the Turkish market, being close to the customers might be the primary reason for the relative advantageous situation with respect to foreign competitors.*

➢ *In general, order to delivery cycle time is not considered to be a point of superiority. Relative to foreign competitors, 60% of the leaders reported lower cycle times, compared with 33% of the laggards. Moreover, the leaders are performing far better than the laggards in comparison to their competitors.*

- *A notable finding is that the traditionally held view of having low unit production cost as an advantage seems to be unfounded. In the overall sample, 51% of the companies reported lower total cost per unit of product relative to their foreign competitors. While more than half of the leaders thought that they had cost advantage relative to their foreign competitors, the laggards thought that they had cost advantage especially relative to foreign competitors.*

- *In the overall sample, only 21% of the companies reported that their finished product defect rate is lower than that of foreign competitors, which implies the admission of a gap. It seems to be a valid gap also for the leaders. Yet, larger percentage of the leader companies think that they are more advantageous relative to their competitors*

- *Companies rate themselves to be in a disadvantageous position particularly in lost capacity due to production downtime against their foreign competitors. However, this is the single performance outcome that most clearly separated the leaders from the laggards.*

Against domestic competitors

- *In general, companies assess their level of performance as either on par or above their domestic competitors.*

- *Companies assess their level of performance almost equal to their domestic competitors on lost capacity due to production downtime and on order to delivery time. They consider themselves slightly advantageous in finished product defect rate and slightly disadvantageous in unit cost of product.*

- *Customer service is considered as an advantage relative to their domestic competitors.*

- *In the overall sample, 38% of the companies reported lower total cost per unit of product relative to their domestic competitors. While more than half of the leaders thought that they had cost advantage relative to their domestic competitors, the laggards thought that they had cost advantage relative to their domestic competitors.*

Regardless of industrial sector, the companies seem to have problems mainly in the areas of:

- ➢ *New product development,*
- ➢ *Marketing capability,*
- ➢ *Logistics.(Warehousing, ability to access incoming materials, production planning and control, material management are thought to be the four disadvantageous factors in the area of logistics.)*

Total Quality Management - TQM

The companies have specified quality as the outcome having the biggest impact on their success. Quality turns out to be the most important supplier selection criterion for manufacturers. The survey results, on the other hand, indicate to areas in need of considerable improvement in the quality domain. The companies seem to be aware of this situation. When shaping their strategies, policies and plans for the near future, they have specified *consistent quality level* as the top competitive priority, *increasing conformance quality* as the third manufacturing objective, and *TQM* by far the most popular action plan with several other quality tools included in the list of action plans to be adopted.

- ➢ *All the above observations lead to the conclusion that the manufacturing companies in Turkey are aware of the fact that quality is a fundamental requirement for their existence in the market.*

This basic strategy of manufacturing companies in Turkey are consistent with the *sand cone model* of operations management. Sand cone model puts the approach to business excellence into perspective. According to the sand cone model, a certain capability is not necessarily enhanced at the expense of another capability. Capabilities can be developed in a cumulative fashion. Ferdows and De Meyer state: "To build cumulative and lasting capability, management attention and resources should go first toward enhancing quality, then –while the efforts to enhance quality are further expanded- attention should be paid to improve the dependability of the production system, then –and again while efforts on the previous two are further enhanced- production flexibility (or reaction speed)

should also be improved, and finally, while all these efforts are further enlarged, direct attention can be paid to cost efficiency."

- *Sand cone model indeed appears to be of great relevance to the manufacturing industries in Turkey. Thus we can say that, in general, the manufacturing companies are in the process of enlarging the ground layer of the sand cone for further improvement in dependability, flexibility and cost.*

Diffusion of TQM concepts on the shop floor and employee involvement

- *Employee involvement in quality improvement activities is still a recent issue for the surveyed companies. To become a world-class company, it is essential to involve employees in the pursuit of improvement goals.*

Use of the self-assessment tool

- *Use of the self-assessment tool is not widely diffused among the companies. Companies need to employ this tool as an important monitoring and feedback mechanism for success in their TQM journey.*

Supply Chain Management

The domain of supply chain management is the extended enterprise. It includes suppliers, purchasing, production, distribution, and customers. It oversees the material flow from the suppliers and through the company to the customers; and directs the information flow in both directions on this chain. Supply chain management is built upon strategic relationships, the application of time-based competitive strategies, and information technology. The relatively high share of material cost and inventory holding cost in the distribution of manufacturing costs indicate to the great possibilities supply chain management can provide for *decreasing unit cost* – number one manufacturing objective adopted by the companies.

Supplier relations

- *Conformance to technical specs is a qualifier for the supplier companies and so is delivery performance to some extent. Price apparently is the order winning criterion. The capability to deliver, on the other hand, is tried to be*

secured by technical competence and experience, production capacity, and ISO 9000 or some form of certification.

- *A very large percentage of suppliers agrees that certification and training programs of the manufacturers have improved their process and product quality and their delivery performance.*
- *Almost half of the suppliers reported important savings in their costs as a result of such certification and training programs.*
- *The suppliers request from the manufacturers to continue with these programs but with an enlarged scope and increased effectiveness.*
- *Relatively larger suppliers have initiated their own certification and training programs for their own suppliers, thus disseminating the positive results down the tier structure.*

Delivery performance

- *Four-fifth of the companies in the overall sample reported that more than 90% of the time, they deliver orders full and on time, which is a success.*
- *Leaving aside the cement sector due to the different nature of its inputs, we can say that for the remaining sectors one cannot speak of just-in-time procurement. The results indicate to a relatively high incoming goods inventory level which reflects itself into the cost of manufactured goods.*
- *Both the incoming material and the finished goods inventories of the supplier companies seem to have swollen after the introduction of just-in-time delivery by the purchasing companies.*
- *If one of the major reasons for this result is the inability of the supplier companies to adopt themselves to the new environment through operational improvements, the other is obviously the lack of any stability in the purchasing plans of the manufacturing companies and the very frequent changes in their orders with very short lead times.*
- *The practice of just-in-time delivery is becoming more common. This puts continuous pressure on the delivery performance of the supplier companies. Thus, delivery performance being a crucial area for the success of supplier companies, needs to be continuously improved through innovative measures.*

An Urgent Task: Building The Extended Enterprise

The results reported above have demonstrated the weakness of the interaction among the companies, particularly between the manufacturers and the suppliers. There is evidence that strategic partnership is diffusing among manufacturing companies in Turkey but there is still a long way to go to approach the understanding of an extended enterprise where a group of companies, both manufacturers and suppliers, work together towards providing a product or a service by forming a network of companies.

In an extended enterprise, companies contribute and benefit through their set of core competences. Thus it becomes imperative for Turkish manufacturing companies to define and foster their core competences, which, according to our experience, is not a common practice.

Leadership is expected from large companies in Turkey for pursuing policies aimed at becoming a production base for the world markets in their field so as to give the suppliers in Turkey the benefit of proximity and the opportunity to become part of global networks.

Human Resources Management

An uncountable number of sources discuss the importance of human resources for competitiveness and conclude that human resources is at the center of global competition.

The Issue of Mutual Trust

A fundamental contribution to achieving profits and to the long term survival of the company is the way it manages its human resources. A basic element is *mutual trust* between the parties involved. Mutual trust is a resource requiring years to build up.

- *A major blow on mutual trust on the side of employees is the employee shedding usually becoming a policy measure taken when the company faces an economic crisis. Another source of loss of jobs for the employees is the introduction into the companies of rationalization measures and of automation leading to structural unemployment.*
- *From the point of view of the company, these might be unavoidable policies to increase productivity and capacity. Both the employers and the trade*

unions have to devise schemes jointly to reduce the need for and the impact of the implementation of such policies. Obviously, lifetime employment is not a solution but a different concept called lifetime employability can have fundamental impact on the well-being of the employees.

- *Such measures as the importance given and resources allocated by the management to employee participation, training and development of the personnel, improving occupational health and safety conditions support the trust building process.*

Training and Development of Employees

The rapid pace of change in technology, products, and markets makes training a necessity for the companies. Organizations need to invest more in developing their own people since it is indeed difficult to recruit good quality personnel.

- *In general, the activities of training and development of employees in the manufacturing companies in Turkey expressed in terms of the annual number of training hours and the annual cost of training as a percentage of the employee payroll are relatively low. The issue of training and development of employees is indeed an area open for improvement.*

- *Not only the amount of resources allocated but also how effectively these resources are employed is decisive on the outcome. It is interesting to observe that instructor led classroom training is declining and learning technology is taking over in more developed countries.*

- *A major weakness in the area of training and development results from the lack of an organization-wide training and development process, including career path planning. The resources should be sought for, allocated and implemented according to a plan supporting the training and development process.*

Employee relations

- *Companies need to introduce some formal mechanism for measuring employee satisfaction.*

Innovation management

- *The observations made during this study lead us to the conclusion that innovation management is yet to be organized in the manufacturing*

industry in Turkey. It requires the full attention and the leadership of top management.

Perceived Barriers To Success

Financial Factors

- *High financing cost of machinery and equipment investment.*
- *High financing cost for working capital.*
- *Fluctuations in currency rates.*
- *High national infrastructure costs (especially energy costs).*

Structural Factors

- *Lack of organizational learning and transfer of knowledge.*

Further barriers to success stated by a relatively smaller number of companies are lack of common vision and resistance to change due to company culture and values.

Marketing

- *Difficulty of reaching global markets.*

The Need To Grow

Increasing market share is the second top manufacturing objective of the companies that took part in this study. Growth is a very crucial problem particularly for the SMEs. Their sizes are small and the domestic market is small. This leads them to accept almost any order from the manufacturers causing loss of focus. With the global trend of company mergers, the relative size of also the large manufacturing companies in Turkey decreases with respect to their competitors.

- *The Turkish manufacturing companies, besides trying to become export oriented and trying to become part of extended enterprises, need to look for all different possible modalities to join their resources together with other companies (through joint ventures, mergers, IPOs, etc.) domestic or foreign so as to reach sizes with more chance for sustainable competition.*

Such moves can also alleviate some of the financial, structural, and marketing barriers in front of them.

Reaching Global Markets

Increasing access to world markets is not only a means of securing healthy growth and improved cash flow, but it also has positive impact on the operations of the company as is reported in this study.

Increasing access to world markets is an issue of not only individual companies but there are also measures to be taken by *Governments* to facilitate it. As Turkish companies try to enter into world markets with *Made in Turkey* products, they face difficulties not only due to the quality and performance level of Turkish industrial products as perceived by the foreign customers and consumers, but also due to Turkey's image particularly in Europe – the largest industrial trade partner and the largest and the closest market for Turkey. This is an issue that the Government has to deal with to a great extent. But companies can also play a role to improve the situation. Adhering to high business best practices and ethics can make a difference in that regard.

The Associations also have an important role to play by guiding and supporting companies in their efforts to reach global markets.

It is interesting to note that Turkish industry has yet to create a *world brand name.* Although some Turkish companies have reached capacities at global scale, apparently some further characteristics, and strategies and policies are needed to create a world brand name which hopefully will appear soon.

Becoming an actor in the global market also helps in reaching production quantities where more economic production can be realized leading to reduced costs. This is particularly true for suppliers. Global markets provide the opportunity of reaching high production quantities also to companies operating in niche markets.

- *An immense opportunity arising for reaching markets is e-business. Any concrete application by manufacturing companies in Turkey in e-business is almost non-existent. A fast and coordinated attack needs to be made in this area. E-business might provide the gate into global markets that the*

Turkish manufacturing companies are looking for. The Associations might play a leading role in the case of SMEs.

Innovation And Knowledge Management

Innovation covers a broad range from products and services to production, supply, and distribution and further to management, work organization, and working conditions and skills of the workforce. Innovation can be conceived as a creative process aiming to change the statusquo in the targeted domain. Innovation and knowledge are the two most powerful tools together with a committed workforce to initiate change.

Innovation management deals with the creation of an environment which facilitates innovation. Commitment and motivation of the workforce leadership employee empowerment employee participation An environment that is conducive to change is essential. Such an environment is a learning environment.

Innovation management is closely linked to *change management* since implanting anything new results in a change in the environment, big or small, leading to a resistance, if not properly managed.

Knowledge management deals with the operation of a process consisting of the phases of identification, documentation, presentation, usage, valuation, protection and scrapping. Note that this is quite similar to the process model we have employed in our technology management survey.

The innovation and knowledge management processes need an owner which can be a person or a team. In the Turkish manufacturing companies these processes do not exist in an explicit fashion and there is no declared ownership. Companies should develop more explicit and concrete policies towards the creation, continuous improvement and active participation of their most valuable asset, namely their creative and knowledgeable employees.

Product Innovation: A Yet Untapped Source

Product innovation appears to be an area that has been neglected considerably in contrast to process innovation. Several reasons can be cited to explain this situation. One reason is that major manufacturers have worked under

license and thus did not need to develop their product design capability. This, of course, has also affected their suppliers. Companies mostly operated as blue print applicators and/or resorted to reverse engineering. But still there are successful examples of product design and co-design among the SMEs in Turkey working with Turkish and foreign companies.

In an era where products manufactured in Turkey are subject to global competition also in the Turkish market with the import barriers coming down, product innovation is a means for long term survival. Product innovation is a must for being able to switch from low cost to product differentiation strategy increasing the added value of the products manufactured.

Again, leadership is expected from large companies in Turkey for the for the diffusion of product innovation. Increasing product innovation capability of the large companies will definitely have an impact over time on the product innovation capabilities of their suppliers at least through co-design projects.

➢ *For the facilitation of product design improvement, one can easily see the crucial nature of the ownership of design. That a company doesn't own the design can be a major hindering block in front of product design improvement, which then also hinders the competitive capability of the company.*

Technical And Organizational Support For Product Design

We have observed that the technical support environment for product design is weak in most of the manufacturing companies in Turkey. Methods to be employed for achieving improved designs such as quality function deployment, simulation, and Taguchi methods are relatively less known and employed.

In order to reach the level of an international design partner, there are certain infrastructure requirements to be met. An integrated concurrent design environment should be aimed in order to reach the world standards in time to market. Modelling and simulation are further tools to support the design process.

The organizational support for product design process requires personnel well trained in team work and teaming. Multidisciplinary project teams including members from production, marketing, and R&D / engineering departments is a best practice well understood by Turkish manufacturing companies. What needs further improvement is the inclusion of suppliers and customers into the design process.

There are two disciplines that are still at their infancy in Turkey that have a direct impact on the level and quality of design activities. One is *ergonomics* and the other is *industrial design*. In both of these areas, particularly in ergonomics, the human resources in the country are not yet at a level to provide support to the design activities in industry. There is an urgent need of collaboration with the higher education institutions to expand and improve their activities in these areas.

Building The Knowledge Supply Chain

- *While trade fairs and conferences stand out as the major technology source, university laboratories and R&D institutions are distinctively not utilized.*
- *The comparison of R&D expenditures with external equipment and technology purchasing expenditures reveals a great dependence on external technology.*
- *The intensity of activities for technology acquisition as well as for technology transfer is relatively low.*
- *At the national level, on the other hand, R&D expenditures as a percent of GDP is almost stuck at levels approaching 0.5% for years.*

Knowledge supply chain is a concept to be introduced to the Turkish industry, universities, schools and associations. Knowledge supply chain aims at improving the supply and dissemination of knowledge in manufacturing companies. It tries to make use of the experience gained in supply chain management. This time it is not material but knowledge. This is a rational consequence of knowledge being a factor of production and a primary source of competitive advantage. The knowledge supply process is modelled as a pull system providing for the needs of the customer, ie., the manufacturing company. Obviously, knowledge supply chain requires knowledge management which is treated above under a separate heading.

Knowledge supply chains can include international entities. Turkish manufacturing companies should systematically strive to become part of global knowledge supply chains. International R&D and product development activities imply partnership possibilities in these areas. Similar strategies to becoming part of global extended enterprises can be implemented for becoming part of the global knowledge supply chains. Developing information technology increasingly supports international R&D and product development activities.

The potential impact of correct Government policies on building knowledge supply chains cannot be emphasized enough. The design, building and coordination of a *National Innovation Infrastructure* by the Government can contribute immensely through knowledge supply chains to the competitive power of the manufacturing companies in Turkey.

- *The National Innovation Infrastructure should be considered as a major component of the structural competitiveness of Turkey.*
- *All the results of the study indicate that more investment into the knowledge supply chain is required.*

A Paradigm Shift In Manufacturing: From Product To Total Solution

The concepts of lean enterprise and concentration on core competences leading to the wider and more innovative practices of outsourcing, all have contributed, among others, to the institutional customer's expectation for a *total solution* rather than a product. With the increasing complexity of everyday life, individual consumers are also inclined to prefer total solutions. Thus, there is a need for understanding and translating customer needs into total solutions presented as *integrated packages of products and services.*

The switch from product to total solution changes the whole nature of customer relationships. A total solution implies a relatively longer interaction time with the customer -a kind of partnership- resulting in a stream of revenues distributed over time.

Total solution requires the contribution of several core competences and as such can only be a product of an extended enterprise. Since we consider becoming part of extended enterprises as a must for the manufacturing companies in Turkey, this implies the importance of focusing and nurturing the core competence(s) of the company. *Distribution* and *service* are two such core competences which constitute basic competitive advantage for the Turkish manufacturing companies in their struggle against their foreign competitors operating in Turkey.

CHAPTER 1

INTRODUCTION

I. INTRODUCTION

Moving Forward: Assessment of Competitive Strategies and Business Excellence in the Turkish Manufacturing Industry aims to explore the current competitive strategies and the state of business excellence in the manufacturing industry in Turkey and to draw some conclusions concerning possible near future developments. It is based on several sectoral benchmarking studies conducted in the manufacturing industries in Turkey.

Business excellence is about competition at the company level and thus needs to be studied in the context of competition. Competitiveness, a widely-used term, has been attached various meanings in different contexts. Globalization has imparted competition a new perspective and altered its content. One of the main difficulties in defining and measuring competitiveness is that it has differing objectives depending on whether it is used with reference to firms, industrial sectors, regions, nations, or unions of nations. Competitiveness at the national level, for example, aims to maintain and improve the living standards of the citizens. Therefore, for a nation, competitiveness is defined as the capacity of a nation's goods and services to meet the test of international markets while maintaining or boosting the real incomes of its citizens. In the case of competitiveness for an enterprise, the objective of competition is to deal successfully with the competitors so as to make profits and to survive in the market place. Competitiveness is shaped around the customer and is defined as the ability of a firm to ensure customers prefer its products and services against alternatives on a sustainable basis. A competitive enterprise is defined as the one that develops and achieves high profitability in the market as a result of the greater efficiency of its production system and its capacity for innovation. Even though competitiveness is discussed at various levels, it is a concept that applies primarily to enterprises (European Commission, 1997).

Among the various approaches used in the studies on competitiveness, the engineering approach (Hatzichronoglou, 1996) provides a different means of describing and measuring competitiveness. It defines the companies' capacity to compete as their ability to search for, identify, and assimilate best practices. Best practices are defined as the industry, country, or worldwide practices related to customer focus, quality, flexibility, cost, innovation, and responsiveness that yield superior performance. The continuous effort of seeking best practices should be

intertwined with the building of competences. Competition for an enterprise is indeed about deciding upon and building the right set of competences. Sustainability of competitiveness depends on the company's success at developing its competences together with the skills and commitment of its staff.

Engineering approach assumes that the competitive ability of a country or region is the combination of competitive abilities of individual companies in that country or region. It is argued that, proliferation of best practices within the sector will improve the performance, and consequently the competitiveness of the sector as a whole. This study subscribes to the engineering approach.

A methodological question is how to measure and to assess the competitiveness of an enterprise. Competitiveness is measured usually in financial and economical terms. In as much as economic and financial data have a number of limitations in that they are at a high level of aggregation and often use proxies for managerial inputs and outputs, an alternative means of examining competitiveness is to study the drivers of competitiveness: the operational practices and outcomes of individual enterprises (Voss *et al.*, 1995). This way of examining competitiveness forms the methodological base for the sequence of sectoral benchmarking studies leading to this report.

Competitiveness is relative in the sense that a company's competitiveness is determined largely by the competitiveness of its competitors. Therefore it is important to be aware of the current and the expected state of the business and tchnology environment for developing successful competitive strategies. Furthermore, in order to assess the competitiveness of a company, one needs to have a fair idea of the competitiveness of its competitors. Such an assessment, therefore, is relative and is only as good as the knowledge base it is based on.

The study of competition is an important issue not only for the companies but also for the governments. Creation of new employment is a primary socio-economic problem of governments in Turkey and elsewhere in the world. Not only is the population of Turkey relatively young and a large percentage of it is in the employment pool, but also the relatively fast urbanization process brings large and mostly unskilled persons into the labor market. Technological change is fast compared to social change, but both are faster than the political change. With the

pace of technological change increasing, the consequences of this widening gap become even more alarming.

Moving Forward: Assessment of Competitive Strategies and Business Excellence in the Turkish Manufacturing Industry is based on the findings of two different kinds of exploratory studies conducted in Turkey. One is a series of sectoral benchmarking studies on competitive strategies and business excellence covering 82 companies in the electronics, cement, automotive, appliances part and component (p&c) manufacturing sectors. The second kind of studies look into the technology management and new product development processes in the electronics and automotive p&c manufacturing sectors covering 49 companies.

The sectoral benchmarking studies on competitive strategies and business excellence have been realized with the cooperation of the Turkish Industrialists' and Businessmen's Association (TÜSİAD), the Association of Turkish Electronics Industrialists (TESID), the Association of Turkish Cement Producers (TÇMB), the Association of Automotive Industrialists (OSD), the Association of White Goods Part and Component Suppliers (BEYSAD). The exploratory studies on technology management and new product development process have been conducted in cooperation with TÜSİAD, TESİD, Turkish Technology Development Foundation (TTGV), and Association of Automotive Part and Component Suppliers (TAYSAD).

1.1. The Study Objectives

Moving Forward: Assessment of Competitive Strategies and Business Excellence in the Turkish Manufacturing Industry is an attempt to quantify how well companies operating in the electronics, cement, automotive, and appliances p&c suppliers sectors of the Turkish industry match up to best practice, both in the practices they implement and in the operational outcomes that result, and to quantify the impact of this match up on the overall business performance. Moreover, it aims to identify the competitive manufacturing strategies of these companies in terms of their competitive priorities, manufacturing objectives, and action plans envisaged for the next two years. In this respect, it is a study along the lines of studies performed earlier in various countries and different sectors of industry (e.g., De Meyer, *et al.*, 1992, 1996a, 1996b; Kim *et al.*, 1996; Voss *et al.*, 1993, 1994, 1995, 1996; Australian Manufacturing Council, 1994; Whybark *et al.*, 1993).

Technology changes at an increasing pace and access to technology gets easier in the global sense. All these make the technology arena a battlefield for the companies. Due to the importance of product and process innovation and new product development for competitiveness, the results of two further studies covering these areas in two different sectors of the manufacturing industry and conducted in the same time frame (1997-1999) are also included in this study to support the sectoral benchmarking studies on business excellence. The objective of these studies is to investigate the technology management and new product development processes more closely in order to draw conclusions as to where the industry stands relative to global best practices.

These studies have two further practical outcomes. First, the results of these studies create a comprehensive benchmark of the practices and performances of the surveyed companies, and this can be employed by others for assessing themselves to discover their relative strengths and weaknesses. Second, the questionnaires developed and implemented can be employed by the companies as a tool for self-assessment.

1.2. Model Base And The Questionnaires

In this study, we have made use of data gathered through the implementation of three different questionnaires: Competitive strategies and business excellence questionnaire; Technology management questionnaire; and New product development capability assessment questionnaire.

In the development phase of the questionnaires, three steps are followed: preparation, testing, and finalization. The prepared questionnaires are discussed with the surveyed companies to test the clarity, completeness and compliance of questions. Finally, they are revised in response to the feedback obtained.

1.2.1. Competitive Strategies and Business Excellence

Four questionnaires are prepared for the Turkish electronics, cement, and automotive industries, and the appliance p&c suppliers. They are almost identical, yet, some questions are customized, added or removed to accomodate the differences between the sectors studied. The responses given to the survey questions are validated by a number of site visits and during a number of meetings on the preliminary findings. The questionnaire is structured in such a way that

allows the analysis of competitive strategies and the relationship between the practices and the resulting outcomes of the surveyed companies. It has four main modules: competitive strategy, manufacturing strategy, practices, and performance/outcomes. The first module is designed along the lines of a process model of manufacturing strategy proposed by Kim and Arnold (1996) given in Figure 1.1. The last three modules are based on the EFQM *Business Excellence Model* (Figure 1.2).

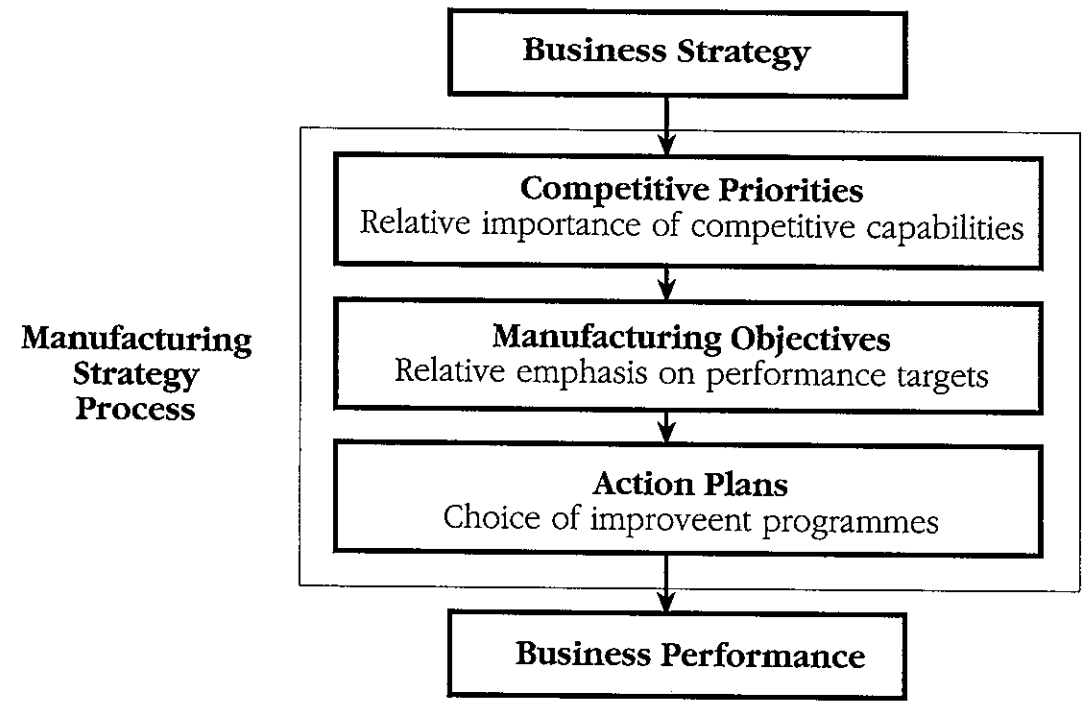

Figure 1.1. The process model of manufacturing strategy
(Kim and Arnold, 1996)

Competitive strategy module aims to assess the competitive strategies of the companies by addressing their competitive priorities, manufacturing objectives and action plans.

Manufacturing strategy module aims to capture the strategic management decisions reflected in the planning function and in the alignment of manufacturing operations with the central business mission, by focusing on aspects of *planning, manufacturing structure and factory operations.*

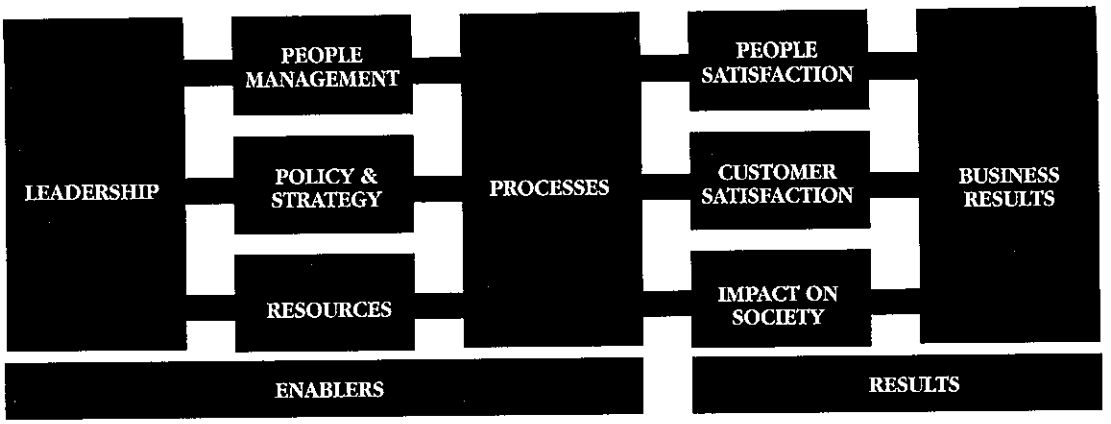

Figure 1.2. EFQM business excellence model

Practices module tries to identify the range of practices companies translate into action. It addresses six areas of practices: *leadership, people management, customer focus, process and product quality, benchmarking, and technology.*

Performance and outcomes module aims to identify the outcomes of the practices and the resulting business performance. Outcomes refer to the operational measures of performance in the areas of *cost, quality, flexibility* and *timeliness*. Business performance refers to financial measures such as *cash flow, sales per employee* and *value-added per employee.*

1.2.2. Technology Management

The process model proposed by Probert and Gregory (1995) for organizing technology management activities is taken here as the core model around which the questionnaire is built (Figure 1.3). It is indeed appealing to employ a process model since it is expected that in near future, process-based organizations will become widespread (Pandra, *et al.*, 1997). The model considers technology management as a process including the subprocesses of *identifying, selecting, acquiring, protecting, exploiting,* and *abandoning technologies*. Although the model might appear to be linear, it is not meant to be linear. There are different feedback mechanisms and interactions among the different subprocesses.

Technology management questionnaire is applied in the automotive p&c manufacturing sector (Ulusoy *et al.*, 1999b). It consists of the following modules.

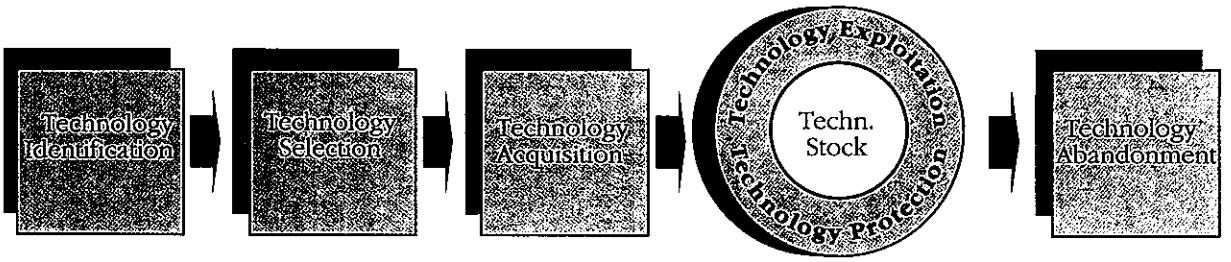

Figure 1.3. Technology management process model

Business strategy. This module aims to explore the business strategies of the companies particularly in relation to technology.

Technology identification. This module looks into the ways companies determine their needs for technology information, their choices of technology information sources, the way they collect and process technology information, and diffuse technology information in the company; and the way they organize themselves for effective technology identification.

Technology selection. The impact of the infrastructure both in the company and in the country, product and market characteristics, methods employed for benefit/cost analysis, and critical factors in technology selection are investigated in this module.

Technology acquisition. This module aims to determine the decision making structure for and means of technology acquisition both internal and external.

Technology exploitation and transfer. Given the current technology stock of the company, how effectively this technology stock is being exploited including technology transfer to other companies constitutes the topic explored in this module.

Technology protection. Here, methods employed by companies for protecting their product and process technologies are investigated.

Technology abandonment. In this module, the conditions under which product and process technologies are abandoned by the company are questioned.

Introduction of products new for the company. In this module, the existence of capabilities and competences needed for the introduction of a product into the company's product portfolio for the first time are explored. In this

case, all the engineering specifications including design are provided by the manufacturer. A very large portion of the orders to suppliers in Turkey are put by the manufacturers this way.

New product development. Sources of new product ideas, organization and tools employed for and realization levels for some performance measures associated with new product development are the topics covered in this module.

1.2.3. New Product Development Capability Assessment

The questionnaire on new product development capability assessment is prepared for and implemented in the electronics sector in Turkey (Payzın *et al.*, 1998). The questionnaire is based on the new product development process model given in Figure 1.4. The model consists of three main phases: (i). Pre-development phase, (ii). Development phase, and (iii). Testing, verification and launching production. The phases consist of 12, 10, and 6 activities, respectively. The model is along the lines of similar models applied elsewhere (see, e.g., Cooper, 1994).

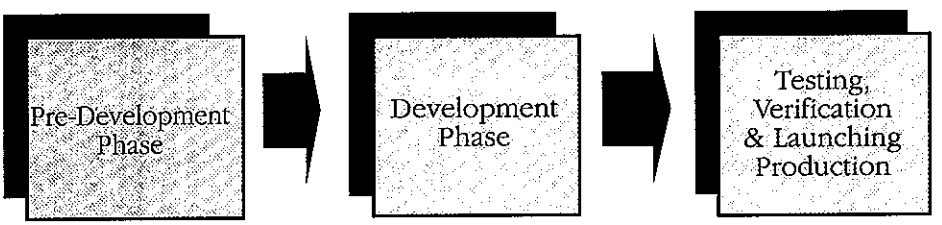

Figure 1.4. New product development process model

Business strategies, markets, and competition. Business strategies, the characteristics of the markets and the competitive environments the companies are operating in are investigated in this module.

New product development strategies. Strategies concerning the positioning of the new product in the market, product technology selection, technology acquisition and transfer are questioned in this module.

The means and resources. This module aims at securing information on product development personnel and the information technology infrastructure in the company supporting the design process.

Human resources. Certain aspects of human resources policies and management for product development personnel including training are investigated in this module.

Management of new product development process. This module contains questions concerning the types of organization employed for new product development, project management, methods and techniques used for product development, and a detailed evaluation of the execution of the process represented in 28 steps.

Interaction and communication. Interaction and communication among product development personnel and also between them and the rest of the company, particularly the marketing and production departments are the subject of this module.

1.2.4. Implementation of the Questionnaire

Two approaches have been employed for implementing the questionnaires. For the electronics, automotive, and cement sectors, the questionnaires have been distributed to a set of companies preselected jointly with te respective Association. Inquiries of the companies on certain items in the questionnaires were answered by phone and fax. A telephone traffic followed to ask the companies for the filled-in questionnaire forms. For this kind of implementation, we have achieved return rates of 60% for the electronics, 56% for the automotive and 64% for the cement sectors. Structured follow-up interviews and site visits have been made in several companies in each sector.

In the case of appliances p&c and automotive p&c sectors, member companies preselected jointly wth the respective Association have been approached for their approval to join the study. To those companies who agreed, the questionnaire has been explained either by a site visit or in small group meetings of companies. Structured follow-up interviews and site visits have been conducted after the return of the filled-in questionnaire forms.

In hindsight, we can conclude that the second approach is the more effective one.

In ec case, a draft report is prepared and discussed at length with the respective Industrial Advisory Board organized for this purpose consisting of 6-9 members. The discussions lead to the final report.

1.3. The Company Profiles

1.3.1. The Sample for the Business Excellence Study

The analyses and results of the business excellence study are based on the data of 82 companies in Turkey in four different sectors (Figure 1.5). The data are gathered by conducting a survey in 1997 and 1998 using a questionnaire supported by some follow-up interviews. In 1997, the questionnaire is implemented in 27 member companies of the Association of Turkish Electronics Industrialists (Ulusoy *et al.*, 1997a), 25 member companies of the Association of Turkish Cement Producers (Ulusoy *et al.*, 1997b), and 10 member companies of the the Association of Automotive Industrialists (Ulusoy *et al.*, 1997c). In mid-1998, it is applied to 20 member companies of the Association of White Goods Part and Component Suppliers (Ulusoy *et al.*, 1998a).

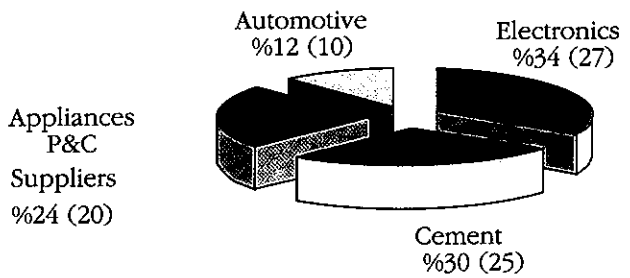

Figure 1.5. The sample for business excellence study by industrial sector

The electronics companies of the sample represent various subsectors of the electronics industry: 33% belongs to the professional and industrial apparatus, 26% belongs to the telecommunications, 22% belongs to the components, and 19% belongs to the consumer electronics subsector. All of the cement companies of the sample are cement producers, some of which are also producing ready mix concrete. The automotive companies of the sample are operating in the following subsectors of the industry: 10% in automobiles, 20% in tractors, and 70% in commercial vehicles. The appliances p&c supplier companies are spread across a wide range of operating areas. The range of products they are producing includes the parts and components of ovens, refrigerators, washing machines, and dishwashing machines such as engines and components, cables, glasses, shock absorbers and compressor parts.

The business profile of the survey sample including the nature of their business, availability of foreign investment, employment levels, sales, and exports are presented in Table 1.1.

TABLE 1.1. The business profile of the sample

Industrial sector	Percentage of Companies That are		
	Independent	Operating Unit	Subsidiary
Electronics	70	7	22
Cement	64	8	28
Automotive	30	10	60
Appliances p&c suppliers	70	5	25
Overall Sample	64	7	29

Industrial sector	Percentage of Companies with Foreign Capital	Average Percentage of Foreign Capital
Electronics	19	49
Cement	24	44
Automotive	60	46
Appliances p&c suppliers	0	0
Overall Sample	21	46

Industrial sector	Percentage of Companies That are		
	Small	Medium	Large
Electronics	52	26	22
Cement	8	84	8
Automotive	0	30	70
Appliances p&c suppliers	30	55	15
Overall Sample	23	48	29

Industrial sector	Percentage of Companies with Total Sales (million USD)			
	Less than 10	10 - 50	50 - 100	More than 100
Electronics	63	11	4	22
Cement	12	60	16	12
Automotive	0	0	20	80
Appliances p&c suppliers	75	15	0	10
Overall Sample	42	26	9	23

Industrial sector	Percentage of Companies with Export Sales (million USD)				
	0	Less than 1	1 - 10	10 - 20	More than 20
Electronics	41	22	19	0	19
Cement	52	12	16	16	4
Automotive	0	0	50	40	10
Appliances p&c suppliers	30	40	15	0	15
Overall Sample	36	21	21	10	12

In the overall sample, 64% of the companies are independent. Although the business nature distributions of the electronics, cement, and appliances p&c supplier companies are similar to the distribution of the overall sample, the automotive companies exhibit a different pattern. While 60% of the automotive companies are subsidiaries of parent or holding companies, 30% are independent.

Majority (79%) of the companies in the overall sample have domestic capital only. The fraction of companies with foreign capital is 21%, and the foreign capital averages 46%. The fraction of companies with foreign capital differs from industry to industry. While 60% of the automotive companies have foreign capital at variable levels, all of the appliances p&c supplier companies are operating with domestic capital.

In the classification of the sample by company size, a widely accepted scale is used. According to that scale, companies with total number of employees less than 100, between 100 and 499, and 500 or more are considered to be small, medium, and large companies, respectively. In the overall sample, 71% of the sample consists of small and medium enterprises (SMEs). The distribution of companies with respect to their total number of employees differs across the industrial sectors. While, for example, 92% of the cement companies are SMEs, 70% of the automotive companies are large.

With respect to their annual total sales, 42% of the companies have total sales less than 10 million USD and 23% have more than 100 million USD. Moreover, the automotive companies are the largest (80% have total sales more than 100 million USD) and the appliances p&c supplier companies are the smallest (75% have total annual sales less than 10 million USD) ones in the sample. Across the sample, the figure for sales from production does not differ much from that of total sales indicating that almost all the companies' sales are their own manufactured goods.

The classification of the surveyed companies with respect to their annual export sales demonstrated that in the overall sample, 36% of the companies have no export sales and only 12% have export sales more than 20 million USD. The automotive companies are more export-oriented than the rest of the sample. While half of the automotive companies of the sample have export sales more than 10 million USD, more than half of the electronics, cement, and appliances supplier companies have either no export sales or have export sales less than one million USD.

1.3.2. The Sample for the Technology and New Product Development Studies

As is stated earlier, the sample for technology and new product development studies includes 49 companies from the electronics and automotive p&c manufacturing sectors. But since the results from the two different studies will be reported separately, the samples of these studies are also not aggregated and thus will be presented separately.

First, we will deal with the sample of the study in the automotive p&c suppliers (Ulusoy *et al.*, 1999b), which includes 21 companies. The average values on sales, added values, and employment of the companies in the sample together with some ratios are provided in Table 1.2. Sales from production implies the sales achieved through the company's own production and excludes those sales, for example, of imported products.

TABLE 1.2. Profiles of the companies in the sample for technology management study in the automotive p&c suppliers

	1995	*1996*	*1997*
Sales (million USD)	33.6	37.8	41.2
Exports (million USD)	15.5	17.8	18.1
Sales from Production (million USD)	31.9	35.3	38.2
Added Value (million USD)	9.7	8.7	10.8
Added Value/Sales from Production (%)	30.4	27.2	28.4
Number of Employees	491	571	610
Direct Workers	340	364	439
Sales from Production per Employee (USD)	64,890	61,756	62,541
Exports per Employee (USD)	31,515	31,220	29,663
Added Value per Employee (USD)	19,744	16,773	17,766

The sample is evenly distributed among the three groups determined by the range of the number of employees: Seven companies in Group 1 (number of employees < 250), seven companies in Group 2 (250 <number of employees < 500) and seven companies in Group 3 (number of employees >500). Thus, 2/3 of the companies in the sample belong to the class of SMEs and 1/3 to the class of large companies.

TABLE 1.3. Profile of the companies in the sample for new product development capability study in the electronics sector (1996)

	Large Companies	SMEs	Total
Sales (million USD)	104.816	2.974	46.175
Exports (million USD)	28.570	0.266	11.598
Sales from Prod. (million USD)	93.516	2.220	39.019
Per cent of Exporting Firms	90	50	64
Number of Employees	743	65	332
Sales per Employee (USD)	141,037	45,444	139,210
Exports per Employee (USD)	38,443	4,058	34,966
Export/Sales (%)	27.3	8.9	25.1

The second study is conducted in the electronics sector on a sample of 28 companies focusing on new product development capability (Payzın *et al.*, 1998). Some basic statistics concerning that sample are provided in Table 1.3. In this sample, there are 8 SMEs and 20 large companies.

CHAPTER 2

ASSESSING COMPETITIVE MANUACTURING STRATEGIES

II. ASSESSING COMPETITIVE MANUFACTURING STRATEGIES

For a manufacturing company, the manufacturing function plays a fundamental role in its pursuit of competitiveness. It is therefore critical to formulate an appropriate manufacturing strategy that will enable the manufacturing function to contribute to the company's long-term competitiveness. The primary function of manufacturing strategy is to guide the business in putting together the set of manufacturing capabilities that will enable it to pursue its chosen competitive strategy over the long term (Hayes and Wheelwright, 1984). This requires the alignment of manufacturing strategy with company's business strategy. To attain the alignment, manufacturing strategy should not solely be based on developing capabilities in the areas such as cost, quality, timeliness, and flexibility, but it should also focus on goals such as increasing market share and profitability.

In this chapter, we aim to provide some insights on the *competitive manufacturing strategies* to be adopted by the companies as part of their overall business strategies. Manufacturing strategy formulation process requires making three strategic choices: selection and implementation of *competitive priorities, manufacturing objectives and action plans* (Kim and Arnold, 1996). Competitive priorities indicate the relative importance of competitive capabilities. Once the competitive priorities are set, measurable performance targets should be established. These targets refer to manufacturing objectives, which are identified to support the envisaged competitive priorities. To achieve the established set of manufacturing objectives, in turn, the management should develop improvement programs; in other words, action plans; to be implemented in near future. The ultimate outcome of this process is expected to be a positive contribution to the overall business performance.

In order to better interpret the results reported below, certain characteristics of the sectors involved should be recalled. Automotive sector involves large companies manufacturing products for end users, mainly commercial vehicles. As the name implies, appliances p&c suppliers are supplier companies, mostly SMEs. The electronics sector will be represented here not as an entity but rather will be investigated at the level of its subsectors since they show differences among themselves which cannot be ignored. These subsectors are: (i) Components, (ii) Professional and industrial (P&I) equipment, (iii) Telecommunication, and (iv)

Consumer electronics. The cement sector will be represented by two groups since they have their own distinct characteristics which should not be overlooked. These are (i). large cement companies and (ii). small cement companies. But this time the distinguishing parameter is not anymore the number of employees but level of sales. Cement companies with more than 1,000,000 tons of sales in 1996 are designated as large companies and the others as small companies.

The analysis below will be complemented by some results from a similar study in automotive p&c suppliers (Ulusoy *et al.*, 1999b).

2.1. Competitive Priorities

The ranking of competitive priorities is displayed in Table 2.1. For each sector, the companies ranked the first five competitive priorities out of a list of 15 candidate competitive priorities. The complete list of competitive priorities is given in *Appendix I.* The list is comprised to include various aspects of supply chain: product, production, marketing. It is customer focused in the sense that many of the competitive priorities in the list are marketplace related with some reflecting performance in the marketplace. Only a few of the priorities represent internal measures.

The results of the rankings by the companies in various sectors are indicated in Table 2.1. The first five competitive priorities selected are the following:

i. Consistent quality level.

ii. Reliable products.

iii. Low price.

iv. Rapid design change / new product introduction

v. Dependable deliveries.

These competitive priorities are valid in general over all sectors. *Low price* does not imply cheap products but relatively lower prices compared to the roughly equivalent competing products in the market. This short list indeed reflects the rules of the game expected by the companies to become prevalent in the market in near future. You have to manufacture reliable products with not only good but consistent quality, to market them at relatively low prices, and to deliver them on time and meeting further requirements of the customer.

TABLE 2.1. Competitive priorities for the next two years

INDUSTRIAL SECTOR							
Appliances P&C Suppliers	**Automotive**	**Electronics**				**Cement**	
		Components	**P&I Equipment**	**Telecom**	**Consumer**	**Large**	**Small**
Consistent quality level	Reliable products	Consistent quality level	Consistent quality level	Rapid design changes	Consistent quality level	Consistent quality level	Consistent quality level
Low price	Consistent quality level	Reliable products	Reliable products	High performance prod	Low price	Reliable products	Reliable products
Rapid deliveries	After sale service	Rapid design changes	After sale service	Low price	After sale service	Low price	Dependable deliveries
Dependable deliveries	Rapid design changes	Customize products	Low price	Consistent quality level	Reliable products	Dependable deliveries	Low price
Reliable products	Low price	Rapid deliveries	Rapid design changes	Customize products	Rapid design changes	Brand/image	Rapid deliveries

The fact that *rapid design change / new product introduction* has appeared as a competitive priority implies that companies to a large extent have come to understand the importance of it as a competitive capability and the need to develop that capability. For some companies, especially for a large number of supplier companies, this process implies the introduction of a product into the product base of the company which is new for the company; or a design change on an already existing design where the original design is provided by some external source. For these companies, this process consists mainly of preparation for production and launching full scale production. Hence, it is closely related to rapid delivery.

➢ *An interpretation of the result stated above is that, in general, the manufacturing industry in Turkey bases its competition strategy on low price rather than product differentiation.*

A comparison of adoption of these pure strategies between the overall and top most dynamic 500 European manufacturing companies is reported in Figure 2.1 (European Commission, 1997). It is observed that most of the more successful manufacturing companies in EU opt for the *product differentiation* strategy.

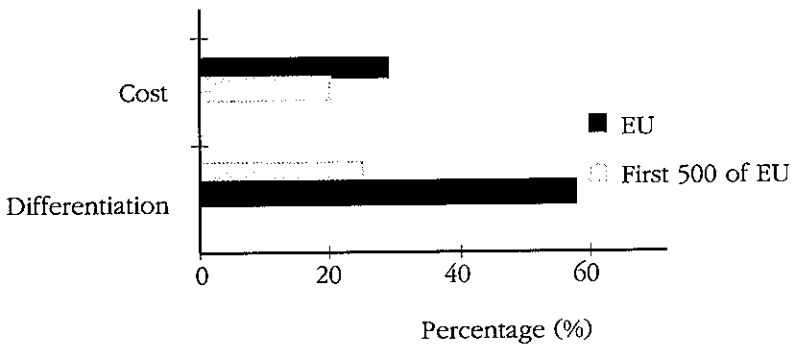

Figure 2.1. Cost and product differentiation strategies among EU manufacturing companies (European Commission, 1997)

It is interesting to note that in a similar study for the manufacturing industries in Sweden reported rather early (Hörte *et al.*, 1987), the following are observed: "A high level of innovation and development of new products for new and existing markets are stressed. The Swedish manufacturing business units are to a high degree trying to compete with high quality and high performance products. Dependable deliveries are also important for competition. The ability to offer low prices is considered to be a lesser competitive weapon".

A similar study investigating the manufacturing strategies adopted by the large Spanish manufaturing companies in the period 1992-1993 has concluded the following (Avella, 1999): "A clear balance has been observed between both options, given that half of the companies claim to compete in cost and the other half in differentiation. This fact is proof that exclusive competition in costs is ceasing to be the only competitive priority of the large Spanish industrial companies, with differentiation or the combination of low cost and differentiation gaining importance."

The selection of competitive priorities by different sectors and their ranking are displayed in Table 2.1 reflecting the market environment of different sectors.

2.1.1. Sectoral Analysis

For sectoral analysis, we will concentrate on the differences of each sector from the aggregate results.

Electronics sector. Rapid design changes /new product introduction is considered as an important competitive priority by all the subsectors of the electronics sector. The electronics sector manufactures goods with a relatively short life cycle and thus rapid design change and new product introduction are crucial capabilities contributing to the success of electronics companies in the market place. Thus this capability appears in the short list of all subsectors; particularly being the number one competitive priority for the telecommunication subsector.

Both the P&I equipment and the consumer electronics subsectors manufacture end-use products making *after sale service* a crucial competitive capability for them to secure consumer satisfaction. This competitive priority appears in the list of both subsectors in line with its importance.

High performance products and customize products appear in the list of the telecommunication subsector in line with the special characteristics of the product. That consistent quality level has received a relatively low ranking can be interpreted as a result of the distance covered already by this subsector in quality related issues.

Customize products and rapid delivery appear in the list of competitive priorities of the component subsector. This is mainly due to the fact that the companies in this subsector act as suppliers.

Automotive sector. After sale service is included in the short list of competitive priorities of the automotive sector due to the nature of the product and the market characteristics. *Low price* is at the end of the short list. This can be interpreted as an indication that the automotive sector will adopt in the near future a more product and service oriented competitive strategy based on differentiation rather than on low price.

Cement sector. Large companies in the cement sector have the first three competitive priorities in the same order as the overall ranking reported above. *Dependable deliveries* follows the first three. *Brand / image building* as a competitive priority aims among other things at increasing market share and getting established in the market.

Besides the first three competitive priorities stated above, small companies in the cement sector emphasize *dependable deliveries* and *rapid deliveries.*

TABLE 2.2. Competitive priorities of automotive p&c suppliers

Competitive Priority	Point*
1. Delivery	
Delivery in required quantity	61
Delivery at required time	60
Delivery at required location	58
2. Quality	
Conformance quality	60
Reliability	58
Durability	55
Customer services	54
Brand / Image	52
Design quality	51
3. Flexibility	
Product flexibility	58
Process flexibility	53
4. Low price	43

**Points reflect the importance attached to each attribute by the companies*

Appliances p&c suppliers. The short list of competitive priorities for the appliance P&C sector is a typical ranking for supplier companies. The ranking of competitive priorities for a different supplier sector namely for the automotive P&C suppliers is given in Table 2.2 (Ulusoy *et al.*, 1999b). For both supplier sectors, as would be expected, the list overlaps in general with the supplier selection criteria of the manufacturing companies in that sector. The results indicate that *conformance to quality* is a qualifying criterion and to some extent, so is delivery. *Low price,* on the other hand, is an order winning criterion.

2.2. Manufactures Objectives

The ranking of manufacturing objectives is given in Table 2.3 for different sectors. Table 2.3 has been prepared similar to Table 2.1. The complete list of 15 manufacturing objectives out of which companies have indicated their top five ranking manufacturing objectives, is given in the *Appendix I.* The objectives are stated in terms of direction as decreasing (↘) or increasing (↗). The manufacturing objectives cover all components of the supply chain. Profitability and market share are included in the list of manufacturing objectives. They are meant to reflect the role manufacturing should play in the formulation of the business strategy. Care is taken to restrict the choice of manufacturing objectives to those whose associated attribute can be expressed in quantitative terms allowing the management for target setting.

The following manufacturing objectives are the top five singled out from the complete set by the companies:

i. Decrease unit cost.

ii. Increase market share.

iii. Increase conformance quality.

iv. Decrease new product development time.

v. Increase production rate

These manufacturing objectives support the competitive priorities in the short list stated above. Combining competitive priorties and manufacturing objectives stated above, one reaches the following conclusions.

TABLE 2.3. Manufacturing objectives for the next two years

INDUSTRIAL SECTOR							
Appliances P&C Suppliers	Automotive	Electronics				Cement	
		Components	P&I Equipment	Telecom	Consumer	Large	Small
↘ Unit cost	↗ Conformance quality	↘ Unit cost	↗ Market share	↘ Unit cost	↘ Unit cost	↘ Unit cost	↘ Unit cost
↗ Market share	↘ Unit cost	↗ Conformance quality	↘ Unit cost	↘ New prod dev time	↘ New prod dev time	↗ Market share	↗ Market share
↗ Conformance quality	↗ Market share	↗ Market share	↗ Conformance quality	↗ Market share	↗ Profitability	↘ Breakdowns & stops	↘ Breakdowns & stops
↗ Profitability	↘ New prod dev time	↗ Production rate	↘ New prod dev time	↗ Delivery rate	↗ Conformance quality	↗ Profitability	↗ Conformance quality
↗ Production rate	↗ Direct labor prod	↗ Delivery reliability	↗ Production rate	↗ Conformance quality	↗ Market share	↗ Conformance quality	↗ Production rate

The agenda of the manufacturing industries in Turkey is to be able to manufacure quality products at low costs. This requires the creation of an environment by the management conducive to the mutual support of quality and productivity. *Learning* and *problem solving* should become two essential capabilities of companies operating in such an environment where best practices are not only sought for but also adopted and improved upon.

Growth is a primary target for many companies trying to establish themselves in the market place. The companies want to grow through increasing their sales by becoming more competitive. Increasing market share is expected to lead to further decreases in unit cost, which, in turn, will lead the companies to strengthen their competitiveness. Increasing market share implies that the companies will take a more aggressive position in the present and/or new markets with or without new products/models. When automotive p&c suppliers are asked for their business strategies in the last three years and for the next three years, the results clearly indicate to an increasing trend toward increasing market share vs. increasing profit (Figure 2.2). Interestingly, those companies opting for increasing market share are mostly companies with domestic capital.

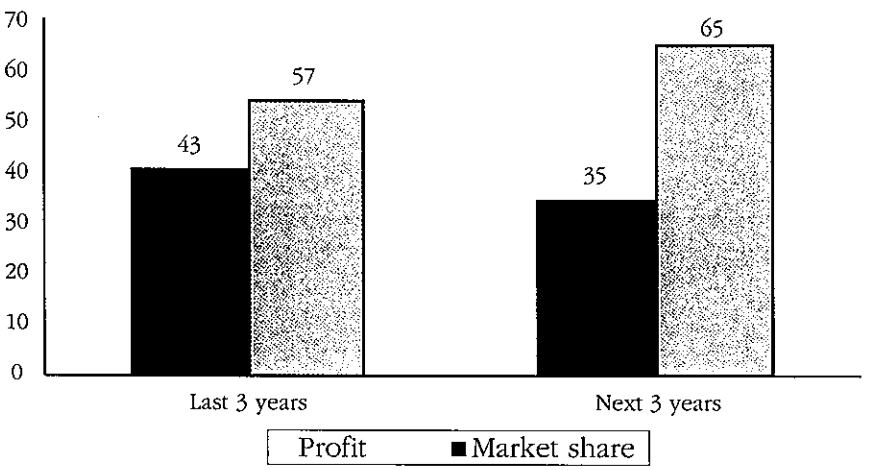

Figure 2.2. Profit and market share strategies among the automotive p&c suppliers

In a study on the electronics sector in Turkey (Payzın *et al.*, 1998), a similar result has been obtained for success measures in new product introduction. For both large companies and SMEs, *customer satisfaction* is the top priority followed by market share and further by sale quantity and amount. *Profitability* follows next.

A recent study made in North America (European Commission, 1996) examined the relationship between quality, market share, and profitability (Figure 2.3). The study revealed that, regardless of the market being mature or emerging, a company with a large market share is expected to generate higher profits with respect to its competitors offering similar quality levels. Moreover, as expected, higher levels of quality is another factor increasing the profitability regardless of the size of the market share. The competitive priorities and the manufacturing objectives of the surveyed companies are consistent with results of this study.

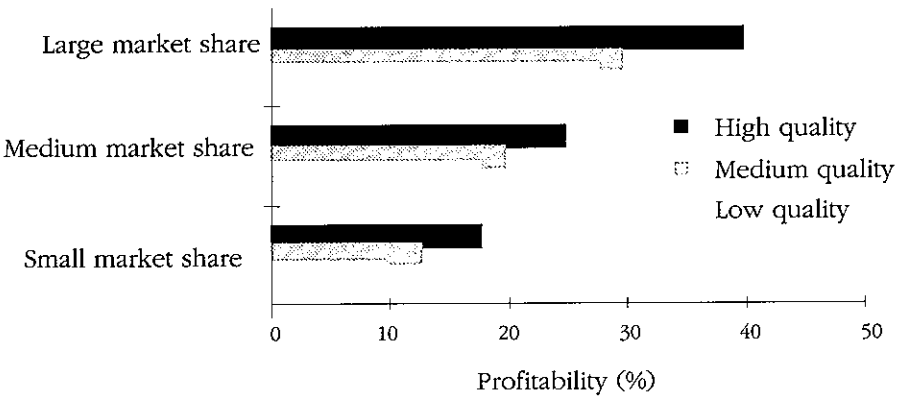

Figure 2.3. Relationship between quality, market share, and profitability (European Commission, 1996)

A follower of the above three manufacturing objectives is decreasing new product development time. This manufacturing objective is emphasized by those sectors which have stated rapid design change / new product introduction as a competitive priority.

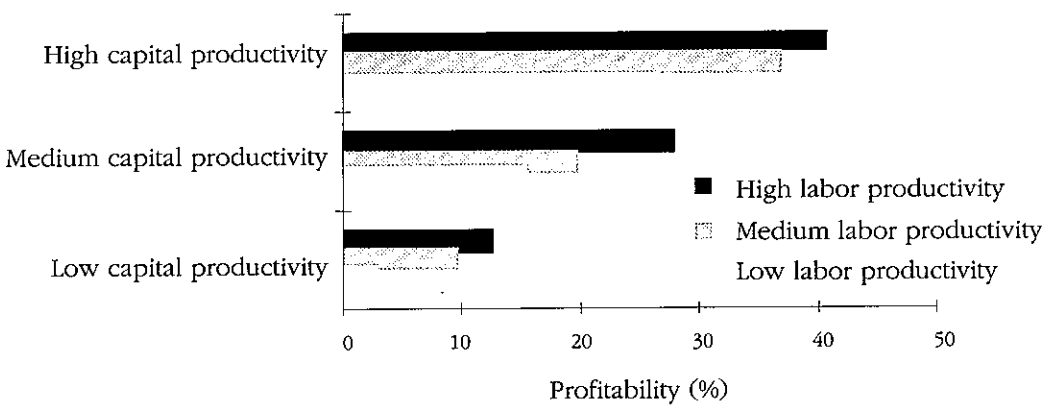

Figure 2.4. Relationship between capital productivity, labor productivity and profitability (European Commission, 1996)

The manufacturing objective of increasing production rate is mainly related to the objectives of decreasing unit cost and increasing market share. Increasing production rate is also associated with the improvement of capital and labor productivity. In order to increase production rate, the existing manufacturing facilities have to be used more productively. Also, with this same purpose, the manufacturing facilities can be improved by new additions and/or modifications. Similarly, labor needs to be used more productively. The relationship between profitability and capital and labor productivities is investigated for the European manufacturing industry (European Commission, 1997). The result is depicted in Figure 2.4 indicating the strong relationship between capital and labor productivities in creating profit. As can be deduced from Figure 2.4, capital productivity has a relatively higher impact on productivity than labor productivity.

2.2.1. Sectoral Analysis

Electronics sector. The short list of the components subsector differs only by the inclusion of the manufacturing objective *increasing delivery reliability.* Being a subsector consisting mostly of supplier companies, this is an expected result.

The short list of the P&I equipment subsector differs from the short list of the overall sample only in the order of the manufacturing objectives.

The short list of the telecommunications subsector differs only by the manufacturing objective of *increasing delivery rate.* Considering the largely make-to-order type of operation of this subsector, the importance attached to this manufacturing objective is justified.

The manufacturing objective of *increasing profitability* implies in this study the manufacturing of higher value-added products. In this sense, this manufacturing objective is directly related to product differentiation offering customers high value-added products. For the consumer electronics subsector, *increasing profitability* has the third rank following *decreasing unit cost and decreasing new product introduction time.* Considering that *rapid design change / new product introduction* is in the short list of competitive priorities of this subsector, the rate of new product/model in consumer electronics would be expected to increase in near future.

Automotive sector. The only differing manufacturing objective in the short list of the automative sector is increasing direct labor productivity. The interaction of several of the action plans listed in the short list of this sector leads to an improved direct labor productivity with *just-in-time production* being number one on this short list. An important characteristic of the domestic automotive market, namely the sporadic nature of demand makes production planning and workload balancing very difficult reducing not only labor productivity but also capital productivity. The detrimental effect of this situation on profitability is shown in Figure 2.4.

Cement sector. Interestingly, decreasing breakdowns & stops appears in the short list of manufacturing objectives only for the the cement sector indicating the relative importance of decreasing breakdowns & stops to the cement sector. This is mainly due to the fact that cement production is a process type production achieved under rough operating conditions.

For large cement companies, increasing profitability appears high in the short list of manufacturing objectives. This indeed reflects a strategy for this group of companies of promoting the substitution of a few conventional cement types by a broader range of cement types with higher added value. This manufacturing objective can be considered in conjunction with brand / image stated as a competitive priority in the short list of this subsector.

Appliances p&c sector. The only differing manufacturing objective in the short list of this sector is increasing profitability. Two reasons can be attributed to have led to this choice. A steadily decreasing unit price is dictated by their customers to most of these companies. Some of the companies cannot decrease their operating costs accordingly and thus their profit margins are eroding. This deficiency is in more direct relation to the number one manufacturing objective, namely decreasing cost. The second contribution to the promotion of this manufacturing objective is the aspiration of the companies to manufacture higher value- added products.

2.3. Action Plans

The complete list consisting of 35 action plans is given in the Appendix I. The list is comprised to include action plans in support of the 15 manufacturing objectives mentioned above. Note that in order to end up with a list general

enough to be applicable to all sectors of industry, the list is kept rather broad. The ranking of the action plans by different sectors is displayed in Table 2.4. The action plans with the same ranking are shown as a group.

The top ranking action plans to be employed by the companies in the near future are ranked by the companies as follows:

i. TQM.

ii. Restructuring.

iii . Just-in-time production.

iv. Production automation.

v. Employee empowerment.

vi. Zero defect.

vii. Aligning customer needs and product development.

viii. Developing new processes for new products.

xi. Quality certificates for products.

x. Quality improvement teams.

In general, the above action plans are along the lines of the competitive priorities and the manufacturing objectives stated above. The above ten most preferred action plans can be grouped in the general areas of *quality, production,* and *organization.* It is interesting to observe that the action plans in the top ten list show a balanced distribution among these areas. In the following, we will comment on these action plans under these headings.

Quality. TQM turned out to be by far the number one action plan preferred by the companies. TQM is defined as an action plan to produce and deliver commodity or service which are confirming with customers' needs or requirements by better, cheaper, faster, safer, easier processing than competitors with participation of all employees under top management leadership. As this definition implies, TQM is a broad program which has to be implemented concurrently with some other quality programs.

Aiming for zero defect should be seen as a supportive action plan for securing consistent quality levels. It reflects the desire of the companies to reduce variability in manufacturing processes and products.

TABLE 2.4. Action plans for the next two years

INDUSTRIAL SECTOR							
Appliances P&C Suppliers	**Automotive**	**Electronics**				**Cement**	
		Components	**P&I Equipment**	**Telecom**	**Consumer**	**Large**	**Small**
Total Quality Management	JIT production	Improvement of QC lab facilities	Total Quality Management	Total Quality Management	JIT procurement	Energy saving	Conformance to environmental standarts
Employee empowerment	Aligning customer needs with prod dev	Production automation	Production automation	Developing new processes for new prod	Restructuring	Preventive maintenance	Energy saving
Zero defect	Quality certificates for environment protection	Total Quality Management	Quality certificates for products	Aligning customer needs with prod dev	JIT production	Total Qualityt Managemen	Production automation
Restructuring	Integration of manufacturing systems	JIT production /	Developing new processes for new prod	Activity Based Costing	Quality certificates for products	JIT production	Training of managers
Quality improvement teams	Improvement of facility layout	Activity Based Costing/	Quality certificates for processes & mgmt	Restructuring	Zero defect	Restructuring	Preventive mintenance
Statiscal process control	Restructuring	Employee emprowerment/	Aligning customer needs with prod dev	Statistical Process control	Quality certificates for processes & mgmt	Employee emporwerment/	Improvement of QC lab facilities
Developing nej processes for nej prod	Improvement of supplier relations/	Automation of prod& inventory control sys/	Employee empoverment	Training of employees (excluding managers)	Total Quality Manager	Quality improvement teams /	Quality improvement teams /
	Zera defect/ Employee empowerment	Zero defect				Training of managers	JIT productions

Obtaining *quality certificates for products* is also stated among the preferred action plans. Almost all of these plans for obtaining quality certificates for products aim at *international certificates (e.g., CE)* for the purpose of facilitating the export of those products.

Quality improvement teams constitute an important indicator for how well TQM is diffused throughout a company. That this action program is part of the short list is an indication that some of the companies are aware of that and want to alleviate the negative impact on quality of the low level of employee participation in current quality activities.

Production. *Just-in-time production* is emphasized by both automotive and consumer electronics sectors as part of the cost reduction schemes whereas for the cement sector it is a necessity due to the perishable nature of cement. Just-in-time production applied properly has a considerable impact on cost reduction by reducing the inventories at all stages of production. It can only be developed on a solid quality infrastructure and is thus closely related to TQM efforts.

Production automation supports in a direct way the manufacturing objectives of increasing production rate, increasing direct labor productivity, and reducing labour costs. It is also in line with the aspirations of the companies to increase their market share. Automation might require a significant amount of investment. In after simplification of system and procedures and order to attain higher levels of capital productivity, automation needs to be built on a sound infrastructure so that sufficient benefits will be realized to balance the cost. Such an infrastructure is best provided by the emphasis on TQM, training, employee empowerment, and quality improvement teams already observed among the more popular action plans in this study.

The action plan of *aligning customer needs and product development is* associated with companies having some form of product design activity. *Aligning customer needs and product development* has a positive impact on the effectiveness and efficiency of new product design process and improves the chance for success of the new product in the market. Currently, the efforts to achieve such an alignment are not based on a formal procedure. The basic technique for securing the alignment of customer needs and product development is Quality Function Deployment (QFD), which should thus be included in the training programs of these companies and practiced by their employees.

Not only in the electronics sector but in all sectors of the manufacturing industry the number of different products and models is proliferating. Hence, the number of new products handled by the companies might increase to keep up with this trend. Here, the term *new product* includes also the class of products that are only *new for the company*. Manufacturing processes play a major role in securing high quality and low cost products. The search for the best feasible option of manufacturing the new product might lead to the development of new manufacturing processes. Thus, *developing new processes for new products* becomes the action plan to answer this need. This action plan is part of the efforts to achieve a smooth and efficient product initiation process preceding full scale production.

Organization. The fact that restructuring is strongly represented in the short list indicates the need for organizational innovation. There can be many different environments leading to the adoption of restructuring as a remedy. Some of this restructuring aims at decreasing the number of layers in the organization. Some of the restructuring, on the other hand, is meant to overcome the negative repurcussions of fast growth of some of the companies. A major problem appears to be the dilemma faced by *family-owned companies*. Usually, such companies grow fast but they lack professional management and an organizational framework to respond to that challenge. These companies look to restructuring as a remedy for such deficiencies.

Employee empowerment is another organizational innovation that has been ranked relatively high among the action plans of the companies. Empowerment moves the responsibility down the layers of the organization. It helps to increase commitment and creativity among the employees. This item can be considered as being closely linked to TQM. Employee empowerment hints to the fundamental change in the attitude of management to the employees and in the practice of human resources management. Obviously, employee empowerment is also related to restructuring.

It should be emphasized that the success of both restructuring and employee empowerment depend, among other things, on providing the proper information systems and training to the employees involved.

2.3.1. Sectoral Analysis

The action plans selected show some interesting differences among the various sectors. This results mainly from the different nature of the various sectors as well as different levels of current achievement in relation to those action plans.

Electronics sector. *Just-in-time procurement* appears to be of interest only to the consumer electronics sector which mainly assembles the end product and thus purchases most of its parts and components. It is also interesting that both *just-in-time production* and *just-in-time procurement* are in the short list of action plans of this subsector reflecting the emphasis put on controlling and keeping at minimum all the inventories throughout the production facility.

Improvement of QC lab facilities is number one action plan for the components subsector. This is particularly relevant since the component subsector supplies the building blocks for further manufacturing.

Quality certificates for processes and management appears as an action plan for both P&I equipment and consumer electronics subsectors preferred by the SMEs.

A choice particular to components and telecommunication subsectors is *activity based costing*. This action plan, if properly implemented, would lead to a better understanding of product costs and would provide decision support to pricing and marketing. Furthermore, activity based costing is a cost accounting system built on the basis of activities. Thus it provides the cost data base for process management.

Training of employees (excluding managers) is stated as an action plan in the short list of the telecommunication subsector. This can be taken as a response to the challenge of the sophisticated manufacturing environment existing in this subsector. The relatively high educational background of the employees is an indication of such an environment.

Automotive sector. The automotive sector has a large number of action plans in their short list which does not overlap with that of the overall sample.

The automotive sector which is in the same position as the consumer electronics sector, does not emphasize *just-in-time procurement* but emphasizes a more fundamental action plan, namely *improvement of supplier relations*.

Cement sector. It appears that *energy saving* is an action plan strongly emphasized by the cement sector due to the high share of energy cost within its manufacturing cost.

Although large cement factories claim to have taken necessary precautions regarding *conformance to environmental standarts,* small factories consider it as their number one action plan for near future.

Preventive maintenance appears in the short list of action plans only for the the cement sector just as *decrease breakdowns & stops* in the case of manufacturing objectives. Obviously, *preventive maintenance* is considered by the cement sector as an action plan implemented for reducing breakdowns and stops.

The cement sector is also unique with its emphasis on *training of managers.* This can be explained by the relatively high ratio of white collar personnel in this sector.

Appliances p&c suppliers. The only differing action plan from the overall short list is *statistical process control.* Statistical process control, which is a tool to control the process and its variability providing the necessary alarms to correct the process parameters, can contribute to the reduction of defective products, if properly employed.

CHAPTER 3

PRACTICES AND OPERATIONAL PERFORMANCE

III. PRACTICES AND OPERATIONAL PERFORMANCE

In this chapter, we aim to provide some insights on the practices and operational performance observed during the studies in the various sectors of the manufacturing industry in Turkey. The impact of the items covered in the practices and operational performance on the competitiveness of a company is self evident. With the increasing competition, intangible aspects of a product, such as quality, reliability, design, delivery time become even more accentuated. The diffusing and generally accepted concept of product life cycle cost brings about these intangible aspects further into the forefront. The shares of knowledge and service within the total value of a manufactured product are increasing. All these trends are supported by the so-called soft technologies such as business, manufacturing and technology strategies, design, quality and logistics, production management, human resources management, knowledge management, business and technology intelligence. In this chapter, the state and impact of some of these soft technologies with reference to operations and practices are discussed.

3.1. Practices And Outcomes In Relation To Company Success

In the surveys, companies are given five practices and five outcomes and are asked to rank them in relation to their success considering the last two years. Figures 3.1 and 3.2 display the average ranks of the practices and outcomes for each sector respectively. The ranking of the practices reflects the perceived effectiveness of these practices on the success of the company considering the last two years. The ranking of the outcomes, on the other hand, reflects the perceived contribution of these outcomes on the success of the company in the last two years.

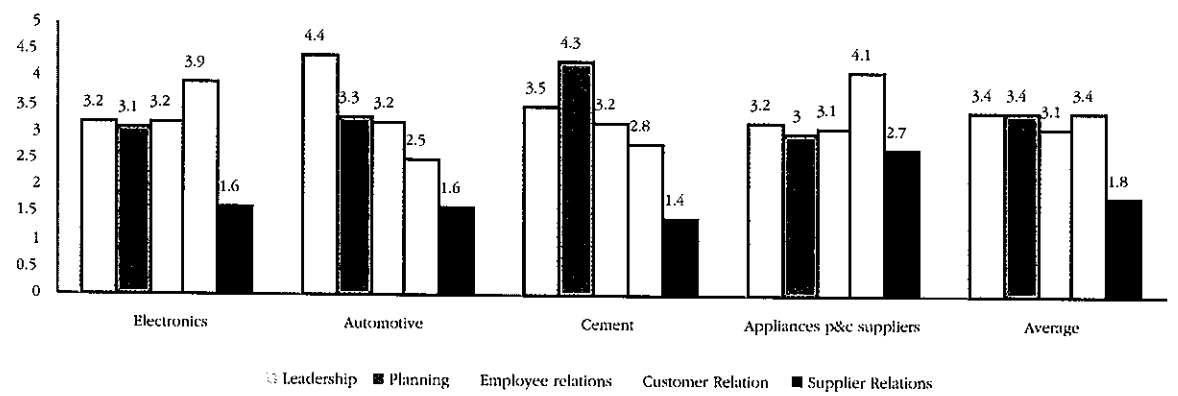

Figure 3.1. The ranking of the practices in relation to their impact on the recent success of the company

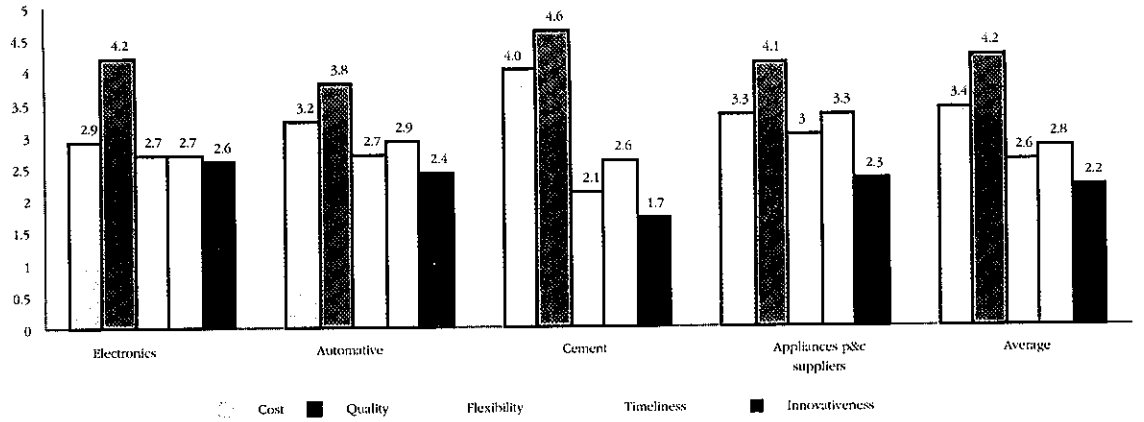

Figure 3.2. The ranking of the outcomes in relation to their impact on the recent success of the company

As shown in Figure 3.1, out of five practices, leadership, customer relations and planning are considered to be the more effective practices in relation to their current success. Employee relations follows rather closely. On the other hand, supplier relations has received a relatively low ranking among these five practices. Recently though, developing new supplier management practices and forging stronger relationships with the suppliers take on paramount importance for continuous improvement throughout the supply chain.

Among the five outcomes, quality is ranked by far as the key factor contributing to their success and cost follows from a distance as the second. Timeliness and flexibility are ranked rather close to each other and they follow cost as the third and fourth outcomes to shape the success of the company. As expected, innovativeness is considered as the outcome that has the least contribution to the success of the company in recent past (Figure 3.2).

➢ *The above results can be evaluated as an indirect evaluation of the emphasis companies have put on different kinds of outcomes to achieve success and the practices which they thought would result in those outcomes.*

3.2. Implementation Of Strategies And Practices

In this section we assess the companies in terms of their manufacturing strategies and practices. Transforming an organization to achieve and sustain best

practices requires an appropriate manufacturing strategy. While the scores on planning, focused strategies and factory operations contribute to the strategy part, the scores on leadership, people practices, customer focus, product and process quality, benchmarking and technology contribute to the practices part of the index. Figure 3.3 exhibits in a spider diagram the positions of the overall sample on different components of the strategy & practices index.

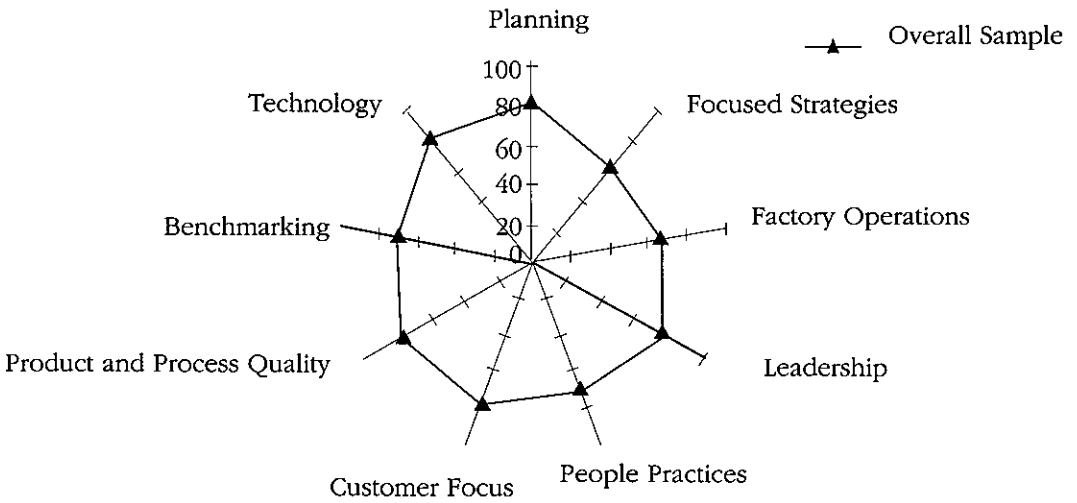

Figure 3.3. Components of strategy & practices index

Planning. In any organization, the first step in a planning process should be the development of a clear and shared mission. A mission statement is a declaration of the organization's purpose, explaining what the organization stands for. The mission statement should be supported by a comprehensive and structured planning process, which regularly sets and reviews short- and long-term goals. In developing business plans, it is critical to incorporate the concerns and requirements of customers, suppliers and other stakeholders, including the community because it allows a company to adjust its strategic position. These plans should focus on the achievement of best practices to attain superior performance. A company's business strategy should also cover its all manufacturing operations. Moreover, manufacturing operations should be effectively aligned with the business mission. The capability of manufacturing function is central to success of a manufacturing company. The analyses demonstrated that:

- *There is a lack of alignment of manufacturing operations with the business mission, in general.*

Focused strategies. In manufacturing management, focused strategies constitute an important item and has been the topic of extensive research all stressing the need for focused strategies. For example, it is found that successful North American manufacturing firms concentrate their efforts on a few critical factors, and systematically avoid others (Roth and Miller, 1992).

Considering the level achieved in this component, it appears that companies in general try to make too many products, try to address several different markets with different competitive priorities and having too many technologies to develop and/or install and maintain. For many companies the market size is rather restricted. Growth being their basic business strategy, such companies usually adopt a policy of diversifying in products, markets, and technologies in order to secure orders. Other policies such as bringing their resources together in some form and/or becoming part of a global network are relatively less common.

➢ *Focused strategy development and implementation appears to be an area open for improvement.*

Factory operations. In the survey, companies are asked to indicate whether they have applied the factors listed below and if they did, to what extent these factors have contributed to their factory operations. The factors are just in time production, just in time procurement, machine set-up time reduction, warehouse management, materials management, production planning and control, statistical process control, total quality management, preventive maintenance, housekeeping, working with suppliers, quality improvement teams, and employee empowerment. The analyses demonstrate that:

➢ *The lowest scores are in the areas of quality improvement teams, statistical process control, warehouse management, and machine set-up time reduction indicating these areas to be clearly open for improvement.*

Leadership. The achievement of high performance requires continuous improvement both in the products and processes. Continuous improvement should be considered a way of life in the turbulent business environment of today. Continuous improvement needs the constant attention of top management. Committed and visionary leadership becomes the key success factor. The objective is to create a learning organization able to adapt quickly to changes in the environment. Leadership is defined as one of the primary roles of the chief

executive and senior managers to shape, maintain and develop the cultural values and attitudes that prevail within the organization. Active encouragement of change by senior management, high degree of unity of purpose, effective use of motivation, pursuit of continuous improvement rather than fire fighting, and active use of ideas from production operators are the aspects of leadership inquired in the survey. The analyses demonstrate that:

➢ *Leadership is regarded highly in the industry. This is mainly due to the frequent crises faced by the industry as a whole, thus creating a need for strong leadership to secure the survival of the enterprise. Another reason could be the lack of systems not yet put in place in the companies, thus requiring strong leadership to compansate for this deficiency.*

People practices. People are the most valuable assets of a company, the development of which is viewed as the key to high performance and sustainable competitiveness. In the survey, various aspects of human resources management are addressed, inclusing the issues such as communication, employee satisfaction, organization-wide training and career path planning, and the integration of comprehensive occupational health and safety policies into daily operations. The analyses demonstrate that:

➢ *Two areas of major weakness are the lack of a formal and regular process for the measurement of employee satisfaction and the lack of an organization-wide training and development process, including career path planning.*

Customer focus. Customer focus is an integral part of the effective pursuit of best practice. From the viewpoint of enterprises, competitiveness is generally shaped around the customer, leading to the operational definition of competitiveness as the ability to ensure that customers prefer company's products and services against alternatives on a sustainable basis. Global competitive pressures are forcing today's manufacturing companies to become more customer focused in terms of offering quality products and services, and shorter order to delivery cycle times. Customers are more discriminating and competition is much more sophisticated. Successful enterprises of today are characterized by being flexible, adaptive, innovative, and responsive. They are focused on customer needs. Customer satisfaction is higly correlated with improved performance. Customer relationships are recognized to be the key to long-term profitability.

In a highly globalized competitive market, the voice of the customer takes on paramount importance. Customer requests are considered a primary basis for developing new products and services more frequently than are internally generated observations of competitors or market analysis. Feedback from current customers, customer visits, and personnel contact through customer surveys are some of the methods used to generate innovative ideas.

Understanding customers' current and future requirements and disseminating them throughout the organization is essential to ensure that customer expectations are correctly translated into designs for new products and services.

From the viewpoint of a customer-focused company, customer complaints are the basic measure of process improvement. Customer-focused companies have effective processes for resolving customer complaints, and they use customer complaints to initiate improvements in their current processes. The primary purpose of process improvement techniques such as capability studies, value analysis, cycle time analysis, and process simplification is to increase the quality and value of the products and services perceived by the customers. What is measured is managed. Hence, instead of waiting the customers to communicate their complaints, measuring customer satisfaction is a more proactive practice.

The survey addresses customer focus in terms of various aspects related to the usage of customer requirements and measurement of customer satisfaction. The analyses demonstrated that:

- *Almost all of the companies, which claimed that they have effective processes for resolving customer complaints, are using customer complaints effectively to initiate improvements in current processes. On the other hand, less than half of the companies systematically and regularly measure customer satisfaction.*

Product and process quality. Over the recent years, quality-oriented programs have often been the first initiative for many companies seeking to undertake an improvement programme. Half of the companies surveyed have a quality certificate from ISO 9000 series and some have also ISO 14000 environmental management certificate. Considering that 68% of the companies without a certificate indicated they are working towards obtaining one, one can foresee that within one year, all of the companies will have a quality certificate for processes. Obtaining these certificates becomes a standard practice in industry.

The aspects of quality inquired in the survey includes the availability of site-wide standardized and documented operating procedures, the availability of well established methods to measure the quality of products and services, instilling in all their employees the belief that quality is ultimately an individual's responsibility, rather than a job requirement for a group of quality inspectors, prevalence of the internal customer concept, working closely with suppliers to improve each others processes, and having suppliers with an effective system for measuring the quality of materials they deliver. The analyses demonstrated that:

- *Almost all of the companies in the sample have site-wide standardized and documented operating procedures, and methods to measure the quality of their products and services. This can be attributed to the diffusion of ISO 9000 certification in the industry since these practices constitute the essentials of certification process.*

- *Majority of the companies claimed that all of their employees believed that quality is their responsibility.*

- *One of the more importing findings of the analysis is that the companies in the sample have poor supplier relations. While majority of companies recognized a strong customer focus is essential, far fewer attached importance to relationships with their suppliers.*

- *The overall sample is not successful in neither working closely with their suppliers in product or process development, nor having suppliers with an effective system for measuring the quality of the materials they send to them.*

Technology. Being technologically competitive is crucial in achieving sustainable competitiveness. Technology should be considered as an integral part of manufacturing to ensure continuous improvement in production systems. The core technology should be appropriate for the competitive needs of the business, should allow the company to be competitive in its market place, and should be utilized to its maximum potential to obtain optimal benefits. The analyses demonstrated that:

- *The appropriateness and usage of technology does not seem to be an obstacle for the companies in the overall sample.*

Benchmarking. The main objective of a benchmarking practice is to learn through sharing experience. In the survey, benchmarking was defined as an ongoing and systematic process to search for best practices that produce superior performance when adopted and implemented. The search may be focused on products, services, or the business processes of competitors, or those organizations recognized as leaders in the industry or in specific business processes. The foregoing implies the types of best practices benchmarking which is widely applied in learning organizations. Benchmarking has become increasingly popular as a key means of improving organizational performance and has been seen as a quality improvement concept in today's business environment. The rise of benchmarking as a quality improvement concept is reinforced as more emphasis is put on benchmarking in TQM practice. The analyses demonstrated that:

- *Despite the fact that benchmarking is reported as widely practiced, interviews demonstrated that the concept is far from being uniformly understood. Furthermore, majority of companies they practice benchmarking, do so at the simplest possible level. That is, most of the benchmarking applications are ad hoc observations of competitors' products and services mostly by means of attending trade shows and site visits or are comparisons of the performance with the previous year. Information needed for benchmarking against a competitor is generally obtained from the customers. These findings suggest that practice of higher levels of benchmarking is not diffused among the companies in the sample.*

3.3. Assessment Of Operational Outcomes

This section reports on the assessment of the companies' operational performance in terms of cost, quality, flexibility, timeliness, and competitiveness. Assessment of operational performance is conducted in terms of customer satisfaction, employee morale, process changeover time, productivity, technological competitiveness, delivery full on time, proportion of production operators involved in process improvement or problem solving teams, and proportion of quality control inspectors to direct operators. Figure 3.4 exhibits the assessment in a spider diagram. The values in the spider diagram corresponding to delivery full on time to customers, transfer of quality control work to operators, and employee involvement in quality activities are obtained from the responses to the questions requiring objective assessments of operational outcomes in ratio of deliveries to customers that are full and on time, ratio of quality control inspectors

to direct production operators, and the ratio of production operators involved in process improvement or problem solving teams, respectively.

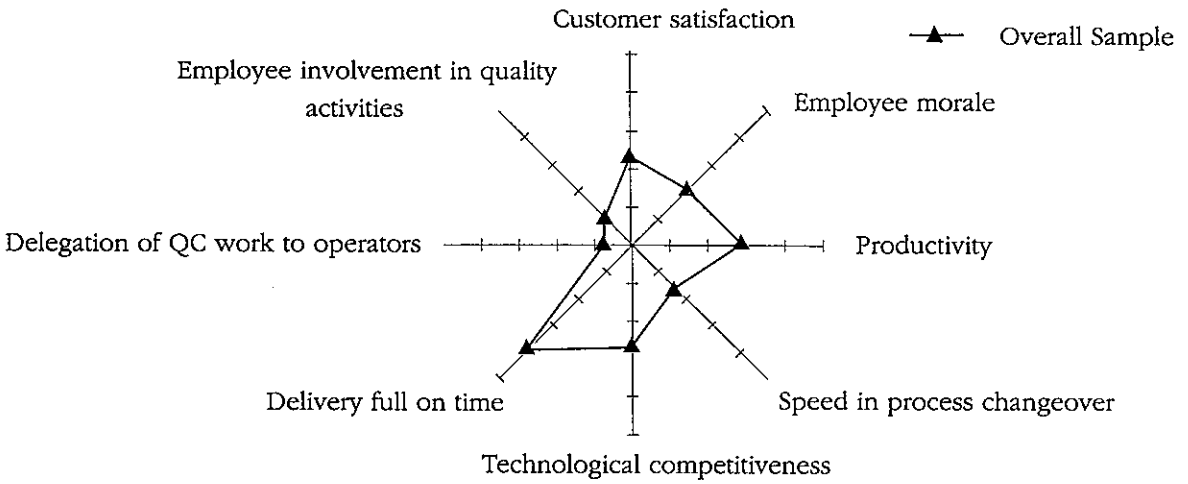

Figure 3.4. Assessment of operational performance

The values in the spider diagram indicate the percentages of companies in the specified categories that achieve high outcomes in each operational performance attribute or indicator. The results on the operational attributes reveal that:

- *Meeting customers' requirements and expectations is a broad indicator of customer satisfaction. However, more than half of the companies in the overall sample declared that they occasionally fail to meet customer expectations.*

- *Employee morale is an indicator of employee satisfaction. Less than half of the companies in the overall sample reported high levels of employee morale.*

- *Value-added per employee is a widely-used indicator of productivity. In the overall sample, quite a large number companies stated that their level of productivity needs improvement to some extent.*

- *Average process changeover time is one of the indicators of flexibility. It is the time required to change a specific machine, work center, or line from making the very last piece of product to the very first piece of another different product. It may include the run and inspection time for the first piece. Two-thirds of the companies in the overall sample argued that their average process changeover time needs improvement to some extent.*

➢ *Committing to remain technologically competitive is a necessity for manufacturing companies to ensure continuous improvement in their production systems. In the overall sample, 45 per cent of the companies believed that their relative level of technological competitiveness is on par or behind competitors.*

➢ *In general, despite good intentions and long term initiatives in implementing best manufacturing practices, companies are not yet very successful in converting their practices into improved operational outcomes.*

3.4. Comparison With Competitors

Competitiveness is relative in the sense that your competitiveness is not only determined by your own performance but also by the performance of your competitors. A careful analysis of the advantages and disadvantages relative to competitors constitutes an essential part of competitive strategy formulation process. The results of such an analysis is deemed to be very useful in assessing a company's competitive position relative to its competitors.

In the study, companies are required to assess their performance on some competitive factors relative to their domestic and foreign competitors, considering the Turkish market. While competitors having manufacturing sites in Turkey are called *domestic competitors*, competitors having manufacturing sites outside Turkey are called *foreign competitors*.

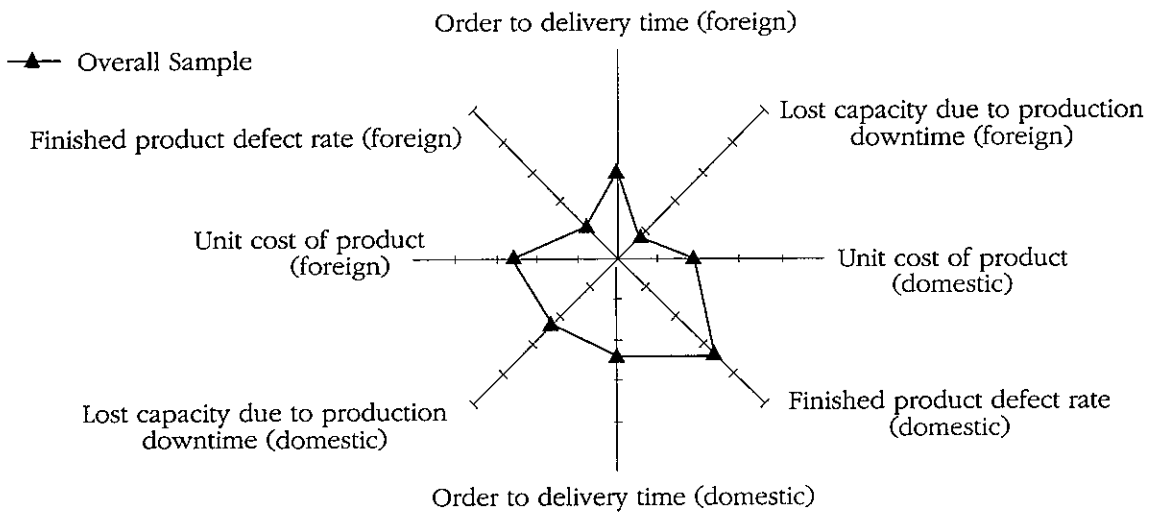

Figure 3.5. Comparison with the best results achieved by the competitors

The spider diagram in Figure 3.5. represents the self-comparison of the companies on four operational measures with their domestic and foreign competitors.

- ➢ *Companies assess their level of performance almost equal to their domestic competitors on lost capacity due to production downtime and on order to delivery time. They consider themselves slightly advantageous in finished product defect rate and slightly disadvantageous in unit cost of product.*

- ➢ *Companies assess their level of performance relatively disadvantageous compared to their foreign competitors in all accounts except in unit cost of product where 51% of the companies consider themselves to have lower unit costs compared to their foreign competitors.*

- ➢ *Companies rate themselves to be in a disadvantageous position particularly in lost capacity due to production downtime and in finished product defect rate. Only 21% of the companies reported that their finished product defect rate is lower than that of foreign competitors, which implies the existence of a gap. This result is consistent with the observation reported in Factory Operations above that statistical process control is an area open for improvement.*

Relative advantages and disadvantages of the surveyed companies are analyzed against their domestic and foreign competitors on a complementary list of factors to those above (Table 3.1). The key results of the analysis concerning the information in Table 3.1 are as follows:

- ➢ *In general, companies assess their level of performance as either on par or above their domestic competitors. The factors on which they consider themselves as advantageous are employee skills and abilities, customer service, quality policy and procedures, rapid adoption to product and/or volume changes, and supplier relations.*

- ➢ *Relative to foreign competitors, although there are some factors on which companies rate themselves as advantageous or on par, they generally consider themselves in a disadvantageous position.*

- ➢ *Relative to foreign competitors, ability to adopt product and/or volume changes rapidly remains as the key advantage. The companies consider*

themselves more flexible in the above sense relative to their foreign competitors.

- *Customer service is considered as an advantage relative to both domestic and foreign competitors. Since the comparison is made considering the Turkish market, being close to the customers might be the primary reason for the relative advantageous situation with respect to foreign competitors.*
- *Regardless of industrial sector, the companies seem to have problems mainly in the areas of:*
- *New product development,*
- *Marketing capability,*
- *Logistics.(Warehousing, ability to access incoming materials, production planning and control, material management are thought to be the four disadvantageous factors in the area of logistics.)*

TABLE 3.1. Relative advantages and disadvantages in comparison to domestic and foreign competitors (Turkish market)

KEY *DNA:* Data Not Available ✔ Relative Advantage Dom. : Domestic Competitors X : Relative Disadvantage For. : Foreign Competitors	INDUSTRIAL SECTOR													
	Appliances P&C Suppliers		Automotive		Electronics								Cement	
					Components		P&I Equipment		Telecom		Consumer Electronics		Large	Small
Factor	Dom.	For.	Dom.	For.	Dom.	For.	Dom.	For.	Dom.	For.	Dom.	For.	Dom.	Dom.
Access to incoming materials		X			✔	X		X		X		X		
Employee skills & abilities	✔				✔		✔		✔				✔	✔
Customer services			DNA	DNA	✔		✔	✔	✔	✔	✔		✔	
Finished product distribution			DNA	DNA	✔					X	✔			
Marketing capability		X	DNA	DNA		X			✔	X			✔	
Material management					✔	X		X				X		
New product development		X	✔	X				X	✔	X		X	DNA	DNA
Production technology	✔			X	✔			X						
Production planning & control	✔		✔			X		X		X			✔	✔
Quality policy & procedures	✔				✔		✔			✔	✔	✔	✔	✔
Rapid adoption to product changes	✔	✔	✔	✔	✔	✔	✔				✔			
Rapid adoption to volume changes	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
Size		X	✔		✔		✔	X	✔		✔		✔	X
Supplier relations			✔		✔		✔	X	✔	X			✔	
Unit production cost			✔	✔	✔	✔	X		X	X		X	✔	
Warehousing		X		X		X		X			✔	X		

3.5. Total Quality Management - TQM

The companies have specified quality as the outcome having the biggest impact on their success. Quality turns out to be the most important supplier selection criterion for manufacturers. The survey results, on the other hand, indicate to areas in need of considerable improvement in the quality domain. The companies seem to be aware of this situation. When shaping their strategies, policies and plans for the near future, they have specified consistent quality level as the top competitive priority, increasing conformance quality as the third manufacturing objective, and TQM by far the most popular action plan with several other quality tools included in the list of action plans to be adopted.

➢ *All the above observations lead to the conclusion that the manufacturing companies in Turkey are aware of the fact that quality is a fundamental requirement for their existence in the market.*

This basic strategy of manufacturing companies in Turkey are consistent with the sand cone model of operations management. Sand cone model puts the approach to business excellence into perspective (Ferdows and De Meyer, 1990; Corbett and Van Wassenhove, 1993). Sand cone model has been put forward to replace under certain contingencies the trade-off model of manufacturing strategy set forth by Skinner (1966) and others following where one capability is improved at the expense of the other. According to the sand cone model, a certain capability is not necessarily enhanced at the expense of another capability. Capabilities can be developed in a cumulative fashion. Ferdows and De Meyer state: "Moreover, when a capability is developed in this way, it is likely to be more lasting and less fragile than if it were developed at the expense of other capabilities.... To build cumulative and lasting capability, management attention and resources should go first toward enhancing quality, then –while the efforts to enhance quality are further expanded- attention should be paid to improve the dependability of the production system, then –and again while efforts on the previous two are further enhanced- production flexibility (or reaction speed) should also be improved, and finally, while all these efforts are further enlarged, direct attention can be paid to cost efficiency." Empirical evidence for the sand cone model is provided by Roth and Miller (1992) who state that: "In sum, US business unit leaders are competing on a number of competitive capabilities

simultaneously, deriving visible synergies from their combined strength. For the Leaders, our study does not provide empirical support for the trade-off theory of manufacturing strategy."

➢ *Sand cone model indeed appears to be of great relevance to the manufacturing industries in Turkey. Thus we can say that, in general, the manufacturing companies are in the process of enlarging the ground layer of the sand cone for further improvement in dependability, flexibility and cost.*

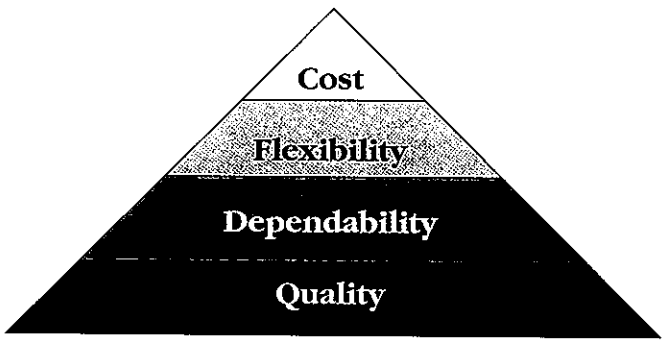

Figure 3.6. Sand cone model

Diffusion of TQM concepts on the shop floor and employee involvement. A high percentage of the direct workers seem to believe that quality is their job. They are also aware of the notion of internal customer. These are concepts contributing to the reduction of QC inspectors at the shop floor. Lean production approach and TQM advocate lowering of the number of quality inspectors and delegation of quality related responsibilities to production operators. In a study made by Rommel *et al.* (1994) among the automotive suppliers both in Europe and Japan, the following results were obtained concerning the percentage of QC personnel to total company employees (Table 3.2).

TABLE 3.2. Benchmark. Percentage of QC personnel to total company employees (Rommel et al, 1994)

Quality Level of the Company	Min (%)	Ave (%)	Max (%)
High	1.7	4.5	9.8
Low	2.2	6.3	13.7

TABLE 3.3. Percentage of QC inspectors to direct production operators

Industrial Sector	Percentage of companies that have percentage of QC inspectors to direct production operators in the range				
	Less than 1.0%	1.0 – 2.0%	2.1 – 10.0%	10.1 – 20.0%	More than 20.0%
Electronics	18	4	52	26	0
Cement	0	4	50	38	8
Automotive	0	20	70	10	0
Appliances p&c suppliers	32	15	53	0	0
Overall sample	7	7	57	24	4

The values in Table 3.3 demonstrate that:

➢ *One-fourth of the companies in the overall sample reported the percentage of quality control inspectors to direct production operators as between 10% and 20%, which is quite high and needs to be decreased further.*

TABLE 3.4. Percentage of production operators involved in process improvement teams

Industrial Sector	Percentage of companies that have percentage of production operators involved in process improvement teams in the range				
	Less than 5.0%	5.0 – 9.9%	10.0 – 19.9%	20.0 – 50.0%	More than 50.0%
Electronics	36	18	27	9	9
Cement	56	13	13	6	13
Automotive	22	11	11	22	33
Appliances p&c suppliers	40	5	35	10	10
Overall sample	52	9	20	9	11

Quality advocates have long stressed employee involvement as an important key to turning quality strategies into demonstrable quality performance. Rommel *et al.* (1994) report that 78% of the production workers participated in *kaizen* activities, whereas this figure was 43% for higher quality European companies and 8% for lower quality European companies.

The values in Table 3.4 demonstrate that:

- *Half of the companies in the overall sample reported percentage of production operators involved in process improvement or problem solving teams as less than 5%, which is very low.*
- *Employee involvement in quality improvement activities is still a recent issue for the surveyed companies. To become a world-class company, it is essential to involve employees in the pursuit of improvement goals.*

Defective end products. A relatively high level of defective end products is an indication of the dominance of product quality control over process control. Defects discovered closer to the end of the production process cost more. Thus defective end products are the worst in that respect. A benchmark is provided by Rommel *et al.* (1994) given in Table 3.5.

TABLE 3.5. Benchmark. Defective end products (Rommel et al., 1994)

	Rework(%)	Scrap (%)	Products Returned by the Manufacturer (ppm)
Japanese companies	1.9	0.95	25
European companies	2.6	3.3	1965

TABLE 3.6. Defective end products

Percentage of companies that have defective end products in the range					
Industrial Sector	Less than 0.1%	0.1 – 0.49%	0.50 – 1.99%	2.0 – 5.0%	More than 5.0%
Electronics	22	22	33	1	4
Cement	91	9	-	-	-
Appliances p&c suppliers	20	15	30	20	15

➢ *The results in Table 3.6 demonstrate that emphasis on TQM and process control by the companies are well founded and should be pursued diligently.*

Use of the self-assessment tool. Self-assessment is an important tool for continuous and effective improvement. The data base it provides can be used by the managers for goal setting. But beyond that, it contributes to the accumulation of a knowledge base on which a learning organization can be built.

➢ *Use of the self-assessment tool is not widely diffused among the companies. Companies need to employ this tool as an important monitoring and feedback mechanism for success in their TQM journey.*

3.6. Supply Chain Management

The domain of supply chain management is the extended enterprise. It includes suppliers, purchasing, production, distribution, and customers. It oversees the material flow from the suppliers and through the company to the customers; and directs the information flow in both directions on this chain. Supply chain management is built upon strategic relationships, the application of time-based competitive strategies, and information technology.

Material cost and inventory holding cost indicate to the great possibilities supply chain management can provide for decreasing unit cost – number one manufacturing objective adopted by the companies. The distribution of manufacturing costs within different sectors of material cost is given in Table 3.7. The relatively high share of material cost attests to the importance of the purchasing and logistics functions for the companies trying to reduce the unit cost of manufacturing.

TABLE 3.7. The distribution of manufacturing costs

	Manufacturing Cost Component		
Industrial Sector	Material Costs	Labor Costs	Overhead Cost
Components	60 %	25 %	15 %
P&I equipment	56 %	24 %	20 %
Telecommunications	74 %	16 %	11 %
Consumer electronics	72 %	10 %	18 %
Automotive	87 %	5 %	8 %
Appliances p&c suppliers	61 %	18 %	21 %

3.6.1. Supplier Relations: An Evolution towards Strategic Partnerships

Suppliers can be broken into at least two groups as strategic suppliers and non-strategic suppliers. Non-strategic suppliers provide mostly shelf items whereas the strategic suppliers provide parts and components critical for the company. In this section, we will deal with strategic suppliers only.

Manufacturers try to cultivate more than one source for critical items in order to secure continuous supply and to introduce price competition among these suppliers. But as time progresses, the relationship with the suppliers is evolving to modalities beyond these. Some manufacturers have come to understand that purchasing costs can be reduced by collaborating with the suppliers to improve their operations. It is not only the purchasing price that is reduced but all the other quality costs incurred due to defective parts and components being purchased and used in the manufacturing process. With improved supplier quality, incoming inspection can be relaxed or totally eliminated.

Manufacturers aware of such advantages have started certification and training programs for their suppliers (Ulusoy *et al.*, 1999a).

- *A very large percentage of suppliers agrees that certification and training programs of the manufacturers have improved their process and product quality and their delivery performance.*
- *Almost half of the suppliers reported important savings in their costs as a result of such certification and training programs.*
- *The suppliers request from the manufacturers to continue with these programs but with an enlarged scope and increased effectiveness.*
- *Relatively larger suppliers have initiated their own certification and training programs for their own suppliers, thus disseminating the positive results down the tier structure.*

Supplier selection criteria. The supplier selection criteria employed by the manufacturing companies are displayed in Table 3.8.

TABLE 3.8. Supplier selection criteria

Electronics	Automotive	Cement	Appliances P&C Suppliers	Automotive P&C Suppliers
Price	Conformance to technical specs	Conformance to technical specs	Conformance to technical specs	Conformance to technical specs
Conformance to technical specs	Price	Price	Price	Price
Delivery lead time and frequency	Delivery lead time and frequency	Delivery lead time and frequency	Delivery lead time and frequency	Delivery lead time and frequency
Communication and Ease of transport.	Tech. competence and experience	ISO 9000	Tech. competence and experience	Tech. competence and experience
ISO 9000	ISO 9000	Production capacity	Production capacity	Production capacity

Conformance to technical specs is a qualifier for the supplier companies and so is delivery performance to some extent. Price apparently is the order winning criterion. The capability to deliver, on the other hand, is tried to be secured by technical competence and experience, production capacity, and ISO 9000 or some form of certification.

The above ranking is based on the statements by the manufacturing companies. *But how do the suppliers perceive this ranking ?* The answer is provided in Figure 3.7. The supplier companies seem to believe that the manufacturing companies have price on top of their list. This difference in opinion can be considered as an indication of lack of communication and mutual understanding.

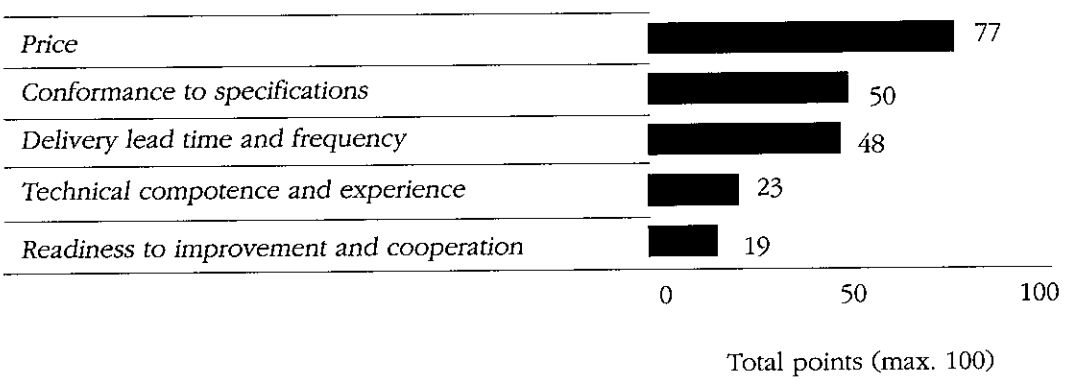

Figure 3.7. The ordering of supplier selection criteria as perceived by the appliances p&c suppliers

Reduction of the number of suppliers. A trend observed worldwide is the reduction of the number of suppliers. An example of this trend is provided by Rommel *et al.* (1995) as shown in Figure 3.8. Their study among the machinery and component manufacturers has shown that successful companies have half the number of suppliers per DM 100 million purchasing volume as compared to the less successful companies. This trend of reducing the number of suppliers is also observed in the manufacturing companies in Turkey. Manufacturers are seeking system suppliers rather than individual part and component suppliers. The trend towards system suppliers represents another policy of the manufacturers for reducing their manufacturing costs. But for suppliers to become a system supplier, they need to develop their own design capability as well as organizational/ managerial capabilities. It forces the suppliers to become part of a network.

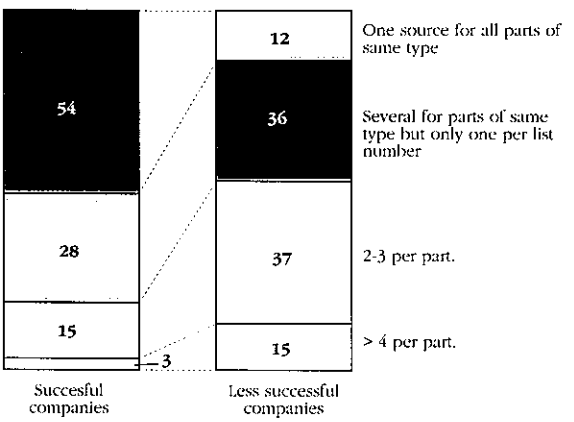

Figure 3.8. Sources of supply as percent of purchasing volume
(Rommel et al., 1995)

Strategic partnerships. The evolution of strategies adopted for manufacturer-supplier relationships over time is given in Table 3.9. The strategy most popular in the last two years (and earlier, of course) is stated to be bid evaluation. Bids went almost always to the supplier making the lowest bid. Currently, it appears that strategies shift from bid evaluation to joint value generation concept trying to generate win-win situation for both the manufacturer and the supplier. What is expected for the near future is that strategic partnerships will be the dominating modality in manufacturer-supplier relations. Strategic partnerships involve long term relations based on mutual trust. Sharing of knowledge is important to build trust among the manufacturer and the supplier. The following results are obtained looking into appliances p&c suppliers in Turkey (Table 3.10).

TABLE 3.9. Evolution of strategies adopted for manufacturer-supplier relationships over time

	Time Frame		
Strategy Adopted	Last Two Years (%)	Current (%)	Next Two Years (%)
Order evaluation		15	15
Technological competence			5
Joint value generation	5		
Strategic partnership	10	15	

TABLE 3.10. Information sharing

Type of Information	Companies Sharing this Information with all/some of their Customers (%)
Customer's demand forecasts	35
Customer's production plans/schedules	25
Customer's sales data	5
Customer's inventory data	10
Supplier's inventory data	20
Supplier's production plans/schedules	20
Supplier's manufacturing cost structure	15

A form of strategic alliance to be emphasized here is one where the alliance is based on complementary knowledge and capabilities leading to supply of systems. Such partnerships can answer the need of reducing the number of suppliers and thus the complexity of the purchasing process for the purchasing company. Such partnerships aimed at the end product can increase the added value and the sales for such products.

3.6.2. Logistics

As has been mentioned earlier, logistics is found to be an area for further improvement especially against foreign competitors. The companies, in general, are not comfortable with respect to their ability to access incoming materials, production planning and control, material management, and warehousing. These are thought to be the four disadvantageous factors in the area of logistics.

Ability to access incoming materials takes on paramount importance in gaining competitive advantage through timely and low cost deliveries. Electronics and appliances p&c suppliers consider their ability to access incoming materials as a disadvantage, which might stem from having a high ratio of suppliers based abroad (Table 3.11). This ratio is 45% for the electronics companies, and 24% for the appliances p&c suppliers. Besides, for a considerable number of companies surveyed (other than cement companies), the value of incoming materials supplied from abroad is higher than one third of the total value. For instance, in the average, appliances p&c supplier companies supply 24% of their total value of incoming materials items from abroad.

TABLE 3.11. Distribution of suppliers with respect to their geographic locations

	Geographic Location		
Industrial Sector	Within 200km in Turkey	Elsewhere in Turkey	Abroad
Electronics	30 %	25 %	45 %
Cement	59 %	37 %	10 %
Automotive	50 %	32 %	18 %
Appliances p&c suppliers	54 %	22 %	24 %

Geographic location of suppliers also has a significant effect on timely and dependable deliveries of incoming materials. The study reveals that the mean time between two consecutive supplies is more than 2 weeks for 66% of incoming material items in electronics companies, 40% for appliances p&c suppliers, and 30% for automotive companies (Table 3.12).

TABLE 3.12. Distribution of incoming material items with respect to supply cycle time

	Supply Cycle Time				
Industrial sector	1 day	2-3 days	4-7 days	8-14 days	> 14 days
Electronics	2%	8%	10%	14 %	66 %
Cement	37%	22%	9%	13 %	19 %
Automotive	1%	7%	29%	33 %	30 %
Appliances p&c suppliers*	12%		26 %	22 %	40 %

** The ranges are: 1-2 days; 3-7 days; 8-15 days; > 15 days.*

➢ *Leaving aside the cement sector due to the different nature of its inputs, we can say that for the remaining sectors one cannot speak of just-in-time procurement. Table 3.12 also indicates to a relatively high incoming goods inventory level which reflects itself into the cost of manufactured goods.*

The figures reflected in Table 3.11 and Table 3.12 might explain the disadvantageous situation faced by electronics companies and appliances p&c suppliers when they compare their performance in access to incoming materials especially with their foreign competitors. In as much they substantially differ from other companies surveyed in their relationship with suppliers, the automotive companies consider access to incoming materials neither as an advantage nor as a disadvantage.

Production planning and control. This is indeed an area in need of improvement. For the suppliers, major complaint arises from the instability of the production orders they receive from the manufacturers. These production orders change quite frequently and with fairly small lead times. The manufacturers, on the other hand, put the blame on the volatility of the markets in Turkey. Usually the burden is pushed over onto the supplier and the suppliers accept it in the name of flexibility. But nobody seems to calculate the cost of flexibility in this sense. Companies exporting large portion of their production have much less problems in this aspect.

Material management. Although all the companies have some form of computerized inventory control software running, this does not solve the problem. The deficiency in material management arises mainly from the abrupt fluctuations in aggregate production plans.

Warehousing. The design and management of warehouses within the factory bounds for storing incoming material and the outgoing products are in need of further improvement. Data acquisition and material handling systems in general do not reflect the state of the art in the current practice.

3.6.3. Delivery Performance

Delivery full on time is the most widely used performance indicator in measuring delivery performance. It is defined as the percentage of time a company delivers the orders at the right quantities and at the right time to its customers. The values in Table 3.13 demonstrate that:

➢ *Four-fifth of the companies in the overall sample reported that more than 90% of the time, they deliver orders full and on time, which is a success.*

TABLE 3.13. Ratio of deliveries to customers that are full and on time

	Percentage of companies that have				
Industrial Sector	Less than 50%	50 – 80%	81 – 90%	91 – 96%	More than 96%
Electronics	4	15	19	26	37
Cement	4	0	0	33	63
Automotive	0	0	20	70	10
Appliances p&c suppliers	0	0	15	35	50
Overall Sample	4	5	12	35	44

This result is indeed a success but a word of caution is needed. The studies made into two different supplier sectors, namely, the automotive and the appliances p&c suppliers have resulted in the following observations (Ulusoy *et al.*, 1999a, Ulusoy *et al.*, 1999b).

- *Manufacturing companies shift the burden of keeping inventories onto their suppliers during the process of just-in-time delivery.*
- *Both the incoming material and the finished goods inventories of the supplier companies seem to have swollen after the introduction of just-in-time delivery by the purchasing companies.*
- *If one of the major reasons for this result is the inability of the supplier companies to adopt themselves to the new environment through operational improvements, the other is obviously the lack of any stability in the purchasing plans of the manufacturing companies and the very frequent changes in their orders with very short lead times.*
- *The practice of just-in-time delivery is becoming more common. This puts continuous pressure on the delivery performance of the supplier companies. Thus, delivery performance being a crucial area for the success of supplier companies, needs to be continuously improved through innovative measures.*

TABLE 3.14. The effects of just-in-time delivery on appliances p&c suppliers

Factor	Companies Reporting Increase/Extreme Increase	Average Change (1-5)*
Finished goods inventory	56	2.50
Product quality	45	2.50
Delivery performance	66	2.11
Costs	39	2.89

**1: Extreme increase – 5: Extreme decrease.*

3.7. Human Resources Management

An uncountable number of sources discuss the importance of human resources for competitiveness and conclude that human resources is at the center of global competition. The Competitiveness Advisory Group (1999) states, for example, that

the most radical change in the competitive environment and the structure of the firm, in Europe and worldwide, is the shift in paradigm toward the centrality of knowledge and intellectual capital. Key words like problem solving organization and learning organization are cited frequently, and all have the human factor at the center. The sustainability of different competitive advantage factors reported in Table 3.15 also indicates to the central nature of human resources (IPTS and ECJRC, 1999).

TABLE 3.15. Sustainability of different competitive advantage factors (IPTS and ECJRC, 1999).

Factor	Reaction Time of Competitors
Lower price	2 months
Publicity campaign	1 year
New product	2 years
New production process	3 years
Distribution network	4 years
Human resources	7 years

In this section, we will concentrate on issues of mutual trust, training and development of employees, and employee satisfaction.

3.7.1. The Issue of Mutual Trust

A fundamental contribution to achieving profits and to the long term survival of the company is the way it manages its human resources. A basic element is trust between the parties involved. Mutual trust is a resource requiring years to build up. It rests on shared experience and requires time for dialogue and reflection on lessons from that experience. It is an interactive process (Competitiveness Advisory Group, 1999).

A major blow on mutual trust on the side of employees is the employee shedding usually becoming a policy measure taken when the company faces an economic crisis. Another source of loss of jobs for the employees is the introduction into the companies of rationalization measures and of automation leading to structural unemployment. From the point of view of the company, these might be unavoidable policies to increase productivity and capacity. Both the

employers and the trade unions have to devise schemes jointly to reduce the need for and the impact of the implementation of such policies. Obviously, lifetime employment is not a solution but a different concept called *lifetime employability* can have fundamental impact on the well-being of the employees. Lifetime employability is indeed an concept around which the relationship between the employer and the employee can be built. Lifetime employability implies that both the employer and the employee share the responsibility of providing the resources and the effort for continual development of the employee so as to provide the employee with the necessary competences to secure a satisfactory job (Competitiveness Advisory Group, 1999).

- *Such measures as the importance given and the resources allocated by the management to employee participation, to training and development of the personnel, and to improving occupational health and safety conditions support the trust building process.*

3.7.2. Training and Development of Employees

The rapid pace of change in technology, products, and markets makes training a necessity for the companies. Organizations need to invest more in developing their own people since it is indeed difficult to recruit good quality personnel. For example, in a study on the electronics sector in Turkey, among the barriers to success in new product development has been suggested to be lack of skilled employees (Payzın *et al.*, 1998). Similarly, in a study of technology companies throughout Europe, eight out of ten organisations reported that they are finding it difficult to recruit staff *(http://www.pwcglobal.com)*.

Performance measures employed for evaluating training activities in companies are several. We will consider two such measures here: (i). Number of hours of training per employee annually. (ii). The annual cost of training as a percentage of the employee payroll. The second performance measure needs precise definition in order to be employed as a benchmark. For example, the payroll cost of the hours spent by the employees in training is not included in the cost of training. Also, whenever training is performed by company employees other than the trainers on the payroll of the company, no trainer cost is added to the cost of training. But still this performance measure provides useful insight. The average number of training

hours and the annual cost of training as a percentage of payroll data for different manufacturing sectors in Turkey are provided in Tables 3.16 and 3.17 respectively.

TABLE 3.16. Average annual number of training hours over different employee groups

	Employee Groups				
Industrial Sector	Top Management	Managers/ Supervisors	Technical Personnel	Administrative Personnel	Operators / Workers
Electronics	24	3	24	dna*	35
Cement	36	49	56	3	38
Automotive	11	22	14	21	19
Appliances p&c suppliers	45	43	39	18	55

**dna : Data not available*

TABLE 3.17. The annual cost of training as a percentage of the employee payroll

	Percentage of the Employee Payroll (%)				
Industrial Sector	Less than 1.5	1.5 – 2.49	2.50- 3.49	3.50- 5.0	More than 5.0
Electronics	57	30	0	4	9
Cement	39	35	13	9	4
Automotive	50	20	10	20	0
Appliances p&c suppliers	53	32	15	0	0

➢ *We consider the above results as lower bounds due to the lack of proper documentation of the training activities and lack of proper accounts in the accounting system in certain cases.*

➢ *A benchmark from USA: According to American Society for Training and*

Development (ASTD) (http://www.astd.org) the average annual cost of training as a percentage of employee payroll is 2.3 % in 1997.

- *A benchmark from EU: The European average for technology companies is 6.7 days of training per employee annually (http://www.pwcglobal.com).*
- *A benchmark from EU: Fast growing companies allocate 67% more time for the training of their employees (EMI, 1999).*
- *Not only the amount of resources allocated but also how effectively these resources are employed is decisive on the outcome. It is interesting to observe that instructor led classroom training is declining. Learning technology (CD-ROM, Intranet, LAN, and Internet) is expected to support more than 20% of training time in USA in the year 2000 (http://www.astd.org)*
- *The resources should be sought for, allocated and implemented according to a plan supporting the training and development process.*
- *A major weakness in the area of training and development results from the lack of an organization-wide training and development process, including career path planning.*
- *The issue of training and development of employees is indeed an area open for improvement as the above results indicate.*
- *New and more effective training tools need to be introduced making use of the new learning technologies.*
- *Projects become the way of organizing for work. Thus team work and building teams become essential management tools for competitiveness and should be part of training programs.*
- *The training of the employees at all levels on the methodology and tools of problem solving should definitely become part of training programs.*
- *An observation is that topics such as quality function deployment, Taguchi methods, value analysis, design for manufacturing, simulation, failure*

mode and effects analysis are not well known among the companies (Ulusoy et al., 1999a and Ulusoy et al., 1999b; Payzın et al., 1998). But these are among the essential tools for improving quality and productivity. More training is needed in such topics.

3.7.3. Employee Relations

As reported earlier, an area of major weakness in employee relations is the lack of a formal and regular process for the measurement of employee satisfaction. Following the motto: "Anything one cannot measure, one cannot control", we suggest that:

➢ *Companies need to introduce some formal mechanism for measuring employee satisfaction.*

A statistics which might be employed in managing employee relations is *the duration of employment.* The values obtained for this measure in this study are presented in Table 3.18.

Table 3.18. The duration of employment in various sectors (years)

	Electronics	Cement	Automotive	App. p&c
White collar	6.7	13	9.3	5.6
Blue collar	5.7	18	7.7	5.7

3.8. Innovation Management

Innovation is defined as follows: (i). The renewal and enlargements of the range of products and services and the associated markets; (ii). The establishment of new methods of production, supply, and distribution; (iii). The introduction of changes in management, work organization, and the working conditions and skills of the workforce (European Commission, 1996). Like technology, innovation is a process and should be managed as such.

We have observed in this study some points regarding the status of innovation management in the manufacturing companies in Turkey. Manufacturers in general consider innovativeness to have the least impact on their success in recent past.

Employee participation in the quality improvement activities is rather low. Although companies have shown interest in it as a prospective action plan, employee empowerment appears to be still at its infancy.

An important point to stress is that building a system that facilitates innovation is much more important than individual innovations. Innovation management is closely linked to change management since implanting anything new results in a change in the environment, big or small, leading to a resistance, if not properly managed. Thus what is needed is to create an environment that is conducive to change. Such an environment can also be described as a learning environment. This obviously is a task for top management.

- *The observations made during this study lead us to the conclusion that innovation management is yet to be organized in the manufacturing industry in Turkey. It requires the full attention and the leadership of top management.*

3.9. Perceived Barriers To Success

An analysis is carried out to identify barriers to success for the manufacturing industry. The factors can be grouped largely under three headings.

Financial Factors

- *High financing cost of machinery and equipment investment.*
- *High financing cost for working capital.*
- *Fluctuations in currency rates.*
- *High national infrastructure costs (especially energy costs).*

These factors reflect the negative effects of the macro-economic situation on the manufacturing industry. The instruments for securing finance other than taking loans have to be employed more frequently. Capital needed for investment can be obtained through joint ventures and mergers with foreign and domestic companies. Companies can also look for capital through IPOs in the stock market.

Table 3.19 gives comparative industrial costs between EU and USA (UNICE Competitiveness Working Group, 1997). In Turkey, on the other hand, heavy oil costs 192.0 USD/toe; natural gas 208.7 USD/toe; electricity 992.0 USD/toe (TİSK,

1998). The relatively high level of all these industrial costs cause a disadvantage to the manufacturing industries in Turkey in their struggle for competitiveness in global markets.

TABLE 3.19. Comparative industrial costs – EU/USA, (USD, 1996)

Industrial Costs	USA	EU
Road freight transport - 1 km.	0.776	1.0716
Cost of internet connection (20 h on line/ month, outside peak hours)	13.9	31.7
Industrial energy costs (non-refundable taxes included) USD/toe*		
Solid fuels	57.5	166.2
Heavy oils	134.1	175.4
Natural gas	144.6	182.6
Electricity	543.2	966.6
Weighted average	235.2	344.9

** toe = ton per oil equivalent*

Structural Factors

➢ *Lack of organizational learning and transfer of knowledge.*

This item implies the lack of knowledge management practice in the companies. Further barriers to success stated by a relatively smaller number of companies are lack of common vision and resistance to change due to company culture and values.

Marketing

➢ *Difficulty of reaching global markets.*

Here, what is meant by difficulty of reaching global markets is multi-faceted. The companies in general have a difficulty of becoming part of a larger global network. They suffer under the lack of instruments (mostly institutional) introducing them into global markets. Here, the Government's role is primery and crucial, but the companies should also act more aggressively, particularly through their Associations.

SEARCH FOR BUSINESS EXCELLENCE: BEST PRACTICE MAP

IV. SEARCH FOR BUSINESS EXCELLENCE: BEST PRACTICE MAP

This section reports on the findings of the aggregation of a series of sectoral benchmarking studies conducted to quantify how well companies operating in various sectors of the Turkish manufacturing match up to best practice, both in the practices they adopt and in the operational outcomes that result, and further to quantify the impact of this matching up on the overall business performance.

Available data are analyzed to segregate the sample according to their success in implementing best manufacturing practices and in achieving high operational outcomes. As a result of the segregation process, out of 82 companies comprising the sample, ten companies are designated as *leaders* and nine companies as *laggards*. *Leaders* and *laggards* stand out from the rest of the sample with their extreme relative performance (excellent vs. bad) both both in the practices they adopt and in the operational outcomes that result. These groups are later analyzed closely to find out:

I. How well they implemented the best manufacturing practices in planning, focused strategies, factory operations, leadership, people management, customer focus, process and product quality, technology, and benchmarking;

II. Their success in achieving high operational outcomes in terms of cost, quality, flexibility and timeliness;

III. Whether adopting best practice correlated positively with business performance measured by average annual growth in total sales per employee, average annual growth in value-added per employee, and the level of pre-capital investment cash flow.

The central hypothesis of this section is the following: The closer a company is to best practice, both in the practices it adopts and in the operational outcomes that result, the more likely it is to achieve higher business performance. This hypothesis is strongly supported by the data on the business performance of the *leaders* and the *laggards*. It is shown that the *leaders* have achieved substantially higher business performance than the *laggards*.

4.1. Measuring Against Best Practice

Best practice adoption is a function of the success both in implementing best manufacturing practices and in achieving high operational outcomes. The section aims to quantify the extent to which best practice is adopted by the surveyed companies, and to assess the impact of industrial sector and company size on the adoption of best practice.

The objective is achieved in four steps. In the first step, a strategy & practices index, and an operational outcomes index are calculated for each company. In the second step, a best practice scorecard is created by plotting on a map the strategy & practices index vs. operational outcomes index position of each company. In the third step, the companies are categorized into five groups according to their relative positions on the best practice scorecard. They are identified as leader, laggard, medium-performer, promising, or won't go the distance companies. A series of statistical analysis are carried out to demonstrate that the categories are in fact different from each other both in implementing best manufacturing practices and in achieving high operational outcomes. Further analyses are carried out to see the relationship of business profiles in terms of industrial sector, company size, nature of business, and foreign investment with the five categories defined above. In the fourth step, two sets of statistical analysis are conducted to see whether the industrial sector and company size affect the adoption of best practice, and if they do, how.

4.1.1. Best Practice Scorecard of the Sample

The best practice scorecard is constructed to measure the proximity of the surveyed companies to best practice. The horizontal axis of the scorecard shows the score on the strategy & practices index, and the vertical axis shows the score on the operational outcomes index; out of 100. The strategy & practices index allows an overall assessment of a company's adoption of the best manufacturing practices related to the planning, focused strategies, factory operations, leadership, people management, customer focus, process and product quality, technology, and benchmarking. The operational outcomes index allows assessment of the extent to which these practices has been converted into operational outcomes in terms of cost, quality, flexibility, timeliness, and competitiveness (see Appendix II). Each of the 82 companies in the sample is plotted as a single point on the scorecard after calculating their individual scores on these indices (Figure 4.1).

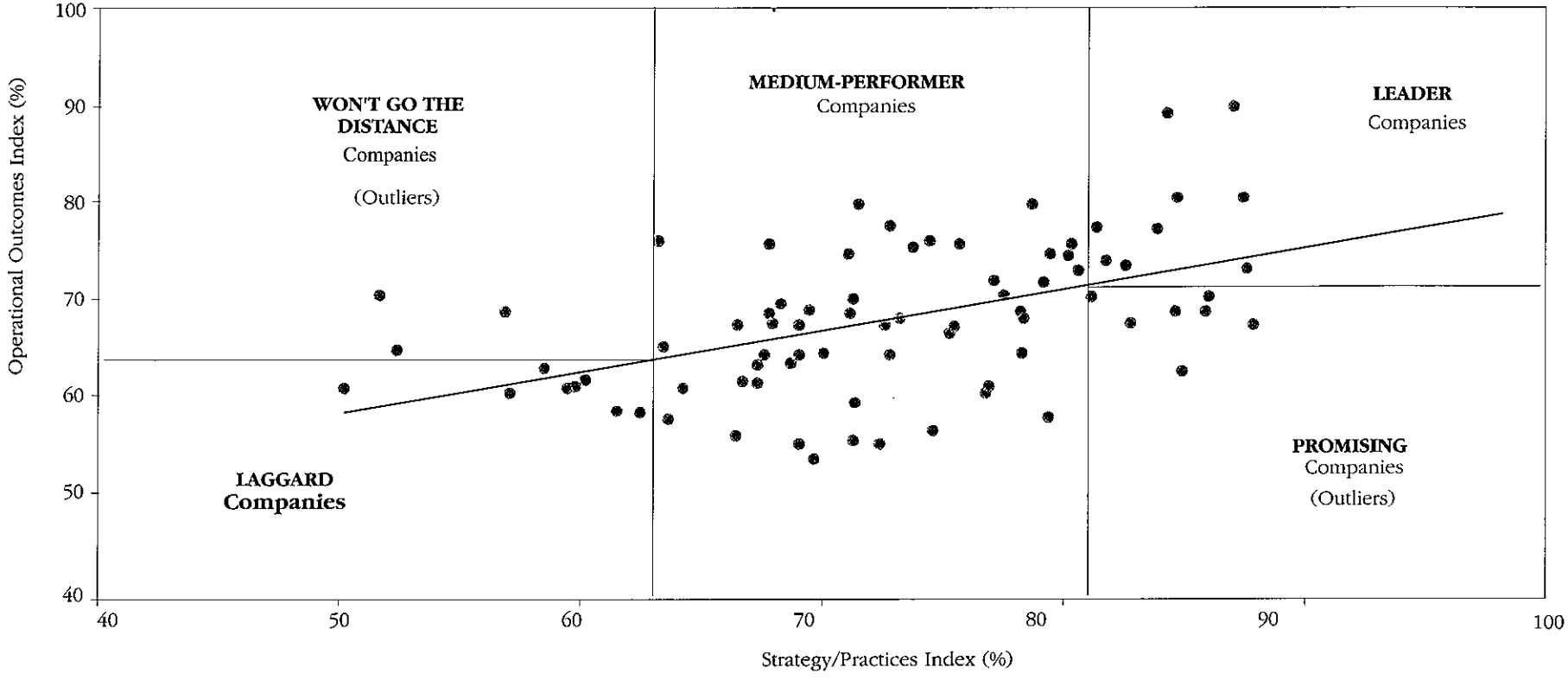

Figure 4.1. Categorization of the sample with respect to best practice adoption

4.2. Categorization Of The Sample

To categorize the surveyed companies according to their proximity to best practice, first, a linear regression analysis is performed on the distribution of companies depicted in the best practice scorecard of the sample. In the analysis, *operational outcomes index* is considered as the dependent, and the *strategy & practices index* as the independent variable. The next step is to divide the sample into subgroups with respect to their best practice adoption. Approximately the top-scoring 10% and the lowest-scoring 10% in the overall sample are described as the *leaders* and the *laggards,* respectively. The companies in the lower right rectangle of the scorecard are called the *promising* companies, and the companies in the upper left rectangle are called the *won't go the distance* companies (Figure 4.1). Companies in the middle rectangle are described as the *medium-performers.* The distiribution of the sample by category is depicted in Table 4.1.

TABLE 4.1. Distribution of the sample by category

Category	Number of companies	Percentage of companies
Leader	10	12 %
Laggard	9	11 %
Medium-performer	53	65 %
Promising	7	9 %
Won't go the distance	3	4 %
Overall sample	82	100 %

The *leader* companies are those that score high on both the *strategy & practices index* and the *operational outcomes index.* These companies not only have the practices in place but also have linked them effectively to achieve high outcomes. On the other hand, the *laggard* companies are those with low scores on both indices, which means that they neither have practices in place nor do they achieve high outcomes. The *won't go the distance* companies achieve high scores on the *operational outcomes index,* but low scores on the *strategy & practices index.* According to the *Business Excellence Model,* such companies cannot achieve sustainable high outcomes in the long run without a focus on improvements in

practices. On the other hand, although the *promising* companies achieve high scores on the *strategy & practices index,* they have not yet converted their improved practices into outcomes. This situation may simply reflect the time lag between the time the practices have been in place and the time they result in acceptable level of outcomes. The *promising* and the *won't go the distance* companies are considered as the outliers according to the Business Excellence Model.

4.2.1. The Sample by Category

The business profiles of the categories in terms of the industrial sector, nature of business, foreign capital contribution, company size, export sales and total sales are shown in Table 4.2.

A few highlights from Table 4.2 are reported below:

- *The cement companies form 50% of the leader and 57% of the promising companies. Sixty-six per cent of the won't go the distance companies are the electronics companies. Majority (66%) of the appliances p&c supplier companies fall into either laggard or won't go the distance category.*
- *While 60% of the leaders are subsidiaries of parent or holding companies, 78% of the laggards are independent.*
- *Although in the overall sample, the ratio of companies with foreign capital is only 21%, this ratio is 50% for the leader and 11% for the laggard companies.*
- *While 50% of the leaders are large companies, all of the laggards are SMEs.*
- *The fraction of companies with export sales is 80% in the leaders, but 55% in the laggards.*
- *Half of the leader companies have annual total sales more than 100 million USD, compared with 67% of the laggard companies with annual total sales less than 10 million USD.*

TABLE 4.2. Business profile of the sample by category

	Industrial Sector			
Category	Electronics	Cement	Automotive	Appliances P&C Suppliers
Leader	10 %	50 %	30 %	10 %
Laggard	22 %	33 %	11 %	33 %
Medium-performer	40 %	25 %	8 %	28 %
Promising	14 %	57 %	29 %	0 %
Won't go the distance	66 %	0 %	0 %	33 %
Overall sample	34 %	30 %	12 %	24 %

Category	Independent	Operating Unit	Subsidiary
Leader	40 %	0 %	60%
Laggard	78 %	11%	11%
Medium-performer	66 %	9 %	27%
Promising	57 %	0 %	43%
Won't go the distance	66 %	0 %	34%
Overall sample	63 %	7 %	30%

	Existence of Foreign Capital in the Company	
Category	Yes	No
Leader	50 %	50 %
Laggard	11 %	89 %
Medium-performer	17 %	83 %
Promising	19 %	81 %
Won't go the distance	0 %	100 %
Overall sample	21 %	79 %

	Company Size		
Category	Large	Medium	Small
Leader	50 %	40 %	10 %
Laggard	0 %	78 %	22 %
Medium-performer	19 %	51 %	30 %
Promising	57 %	29 %	14 %
Won't go the distance	0 %	33 %	66 %
Overall sample	29 %	48 %	23 %

Category	Existence of Export Sales	
	Yes	No
Leader	80 %	20 %
Laggard	55 %	45 %
Medium-performer	60 %	40 %
Promising	67 %	33 %
Won't go the distance	71 %	29 %
Overall sample	37 %	63 %

Category	Distribution of Companies wrt Total Sales (million USD)			
	Less than 10	10 - 50	50 - 100	More than 100
Leader	10 %	20 %	20 %	50 %
Laggard	67 %	22 %	0 %	11 %
Medium-performer	46 %	29 %	6 %	19 %
Promising	100 %	0 %	0 %	0 %
Won't go the distance	13 %	29 %	29 %	29 %
Overall Sample	42 %	26 %	9 %	23 %

4.2.2. Best Practice Adoption of the Sample by Category

Best practice adoption is a function of both the *strategy & practices index* and the *operational outcomes index*. The statistics on the *strategy & practices index* and *operational outcomes index* of the overall sample and the companies in each category are tabulated in Table 4.3.

TABLE 4.3. The strategy & practices and operational outcomes indices of the categories

Category	Strategy & Practices Index (out of 100)			
	Minimum	Maximum	Mean	Standard Deviation
Leader	81	98	86	5
Laggard	50	62	59	4
Medium-performer	63	81	72	5
Promising	81	88	85	2
Won't go the distance	52	57	54	3
Overall sample	50	98	73	9

	Operational Outcomes Index (out of 100)			
Category	Minimum	Maximum	Mean	Standard Deviation
Leader	74	90	80	6
Laggard	59	64	61	2
Medium-performer	54	80	68	7
Promising	63	71	68	3
Won't go the distance	65	71	68	3
Overall sample	54	90	68	8

On the *strategy & practices index,* the leaders have an average total score of 86, whereas the *laggards* have 59; and on the *operational outcomes index,* they have an average total score of 80 and 61, respectively. The *won't go the distance* companies achieve an average score on the *operational outcomes index* equal to those of the *medium-performers* and *promising* companies, but with a lower average score on the *strategy & practices index.* Moreover, while the average score on the *operational outcomes index* of *promising* companies is equal to those of the *medium-performers* and the *won't go the distance* companies, their average score on the *strategy & practices index* is significantly higher (Table 4.2 and Table 4.3). These findings demonstrate a simple but important fact:

➢ *To be a leader, all-round excellence is needed, and there are no short cuts.*

4.2.3. Differences in Best Practice Adoption of the Categories

A company's adoption of best practice is measured in terms of their total scores on the strategy & practices index and on the operational outcomes index. A higher total score on the strategy & practices index implies more successful implementation of best manufacturing practices, and a higher total score on the operational outcomes index implies more successful achievement of operational outcomes. Based on these definitions, it is statistically proved that leaders perform better than medium-performers, which in turn perform better than laggards, both in implementing best manufacturing practices and in achieving high operational outcomes.

4.2.4. Best Practice Adoption and Industrial Sector

Considering that the sample of the study is composed of companies from four different industrial sectors, it would be interesting to see whether industrial sector affects best practice adoption. Table 4.4 shows the percentages of companies in each industrial sector that are called the *leader, laggard, medium-performer, promising,* and *won't to go the distance.*

TABLE 4.4. Category distribution of the sample by industrial sector

	Category				
Industrial Sector	Leader	Laggard	Medium-performer	Promising	Won't go the distance
Electronics	4 %	7 %	78 %	4 %	7 %
Cement	20 %	12 %	52 %	16 %	0 %
Automotive	30 %	10 %	40 %	20 %	0 %
White Goods Suppliers	5 %	15 %	75 %	0 %	5 %
Overall sample	12 %	11 %	65 %	9 %	4 %

Figure 3 displays the average scores of the companies by industrial sector on both the *strategy & practices index* and on the *operational outcomes index* as a bar chart.

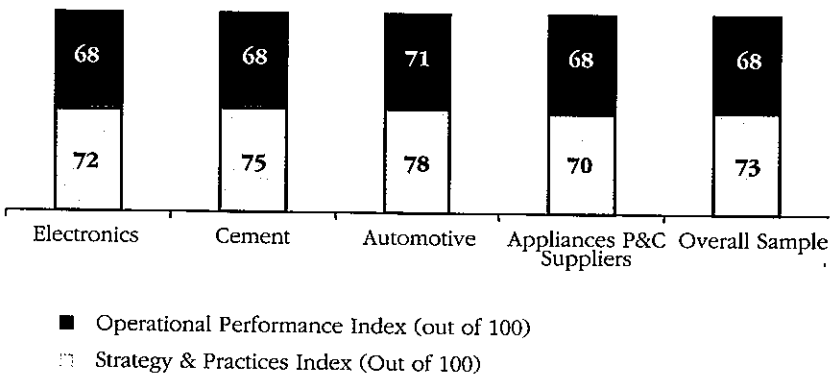

Figure 4.2. Best practice adoption of the sample by industrial sector

The results of the statistical tests conducted to investigate statistically the effect of industrial sector on best practice adoption demonstrated that:

➢ *Neither the implementation of best manufacturing practices nor the achievement of high operational outcomes are affected by the industrial sector the company is in.*

4.2.5. Best Practice Adoption and Company Size

Considering that the sample used in the study is composed of companies of varying company sizes, it would also be interesting to see whether there is a significant relationship between company size and the adoption of best practice. Table 4.5 shows the percentages of companies in each company size category that is called the *leader, laggard, medium-performer, promising,* and *won't to go the distance* companies.

TABLE 4.5. Category distribution of the sample by company size

	Category				
Company Size	Leader	Laggard	Medium-performer	Promising	Won't go the distance
Large (more than 500)	26 %	0 %	53 %	21 %	0 %
Small (less than 100)	5 %	9 %	73 %	5 %	9 %
Medium (100 – 499)	10 %	17 %	66 %	5 %	2 %
Overall sample	12 %	11 %	65 %	9 %	4 %

Figure 4.3 displays the average scores of the companies by company size category on both the *strategy & practices index* and on the *operational outcomes index* as a bar chart.

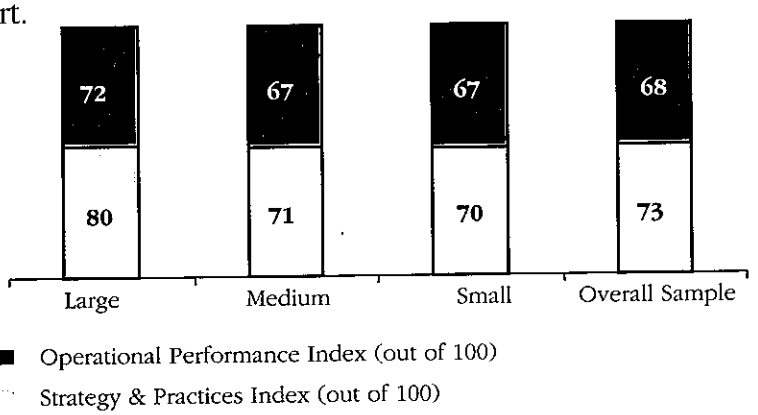

Figure 4.3. Best practice adoption of the sample by company size

The results of the statistical tests conducted to investigate statistically the effect of company size on best practice adoption demonstrated that:

➢ *Company size affects the adoption of best practice. Large companies are better than medium ones both in implementing best manufacturing practices and achieving high operational outcomes. Medium and small companies do not differentiate themselves from each other.*

4.3. Best Practice Adoption

The central hypothesis tested in this section is the following:

The closer a company is to best practice, both in the practices it adopts and in the operational outcomes that result, the more likely it is to achieve higher business performance.

This section aims to quantify the impact of best practice adoption on business performance, the extent to which best manufacturing practices are implemented and the extent to which these practices are converted into high operational outcomes.

This objective is achieved by analyzing in detail the leader and the laggard companies together with the companies in the overall sample in terms of their responses to surveyed questions that are used to measure the *business performance,* and to construct the *strategy & practices index* and the *operational outcomes index.* No analysis is carried out for the *won't go the distance* and the *promising* companies which are considered as outliers in the *Business Excellence Model,* and for the *medium-performers* which represent 65% of the overall sample. Although the surveyed companies are categorized into five groups to gain a broader view on the proximity to best practice, understanding the gap between the *leader* and the *laggard* companies both in implementing best manufacturing practices and in achieving high operational outcomes is the central theme for answering the question: *Does best practice adoption lead to higher business performance?*

4.3.1. Impact of Best Practice Adoption on Business Performance

Average annual growth in total sales per employee, average annual growth in value-added per employee, and the level of pre-capital investment cash flow are considered as the three measures of business performance. Total sales per

employee is an indicator of growth. Value-added per employee is a widely-used indicator of employee productivity. A high level of pre-capital investment cash flow indicates a healthy growth of the business.

To quantify the impact of best practice adoption on business performance, these three measures are calculated for the *leader* and the *laggard* companies, and for the overall sample (Figure 4.4 through Figure 4.7). The results show that:

- *The leaders in adopting best practice are rewarded by higher business performance. They have accomplished substantially higher values than the laggards in the measures of business performance; demonstrating that best practice adoption has a positive impact on business performance.*
- *The leaders have achieved 20% average annual growth in sales per employee in the last three years compared with 11% achieved by the laggards.*
- *The leaders have achieved 21% average annual growth in value-added per employee in the last three years compared with -1% obtained by the laggards.*
- *Majority of the leaders (75%) have icreased their level of cash flow in the last two years compared with 33% of the laggards.*
- *More than half of the leaders (63%) have experienced positive pre-capital investment cash flows compared to only 11% of the laggards.*

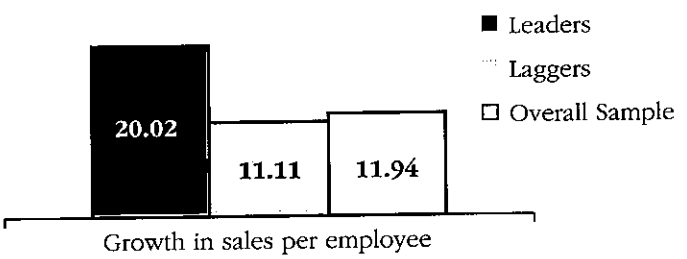

Figure 4.4. Average annual growth in total sales per employee over the last three years

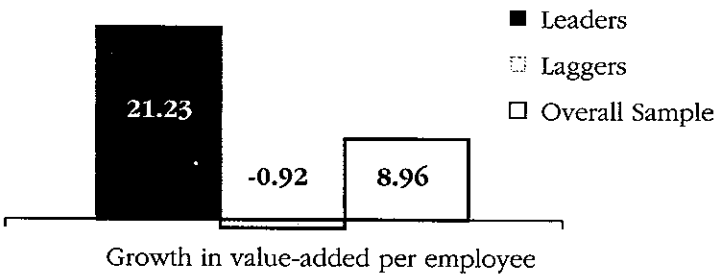

Figure 4.5. Average annual growth in value-added per employee over the last three years

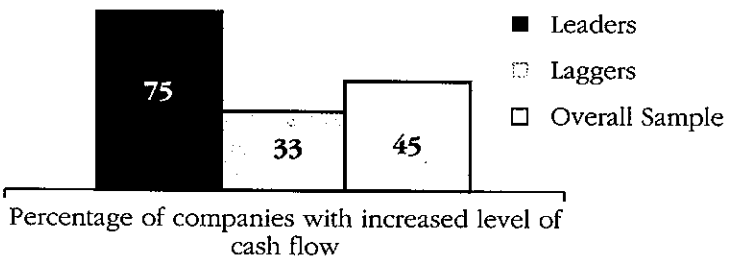

Figure 4.6. Average annual increase in the level of cash flow over the last two years

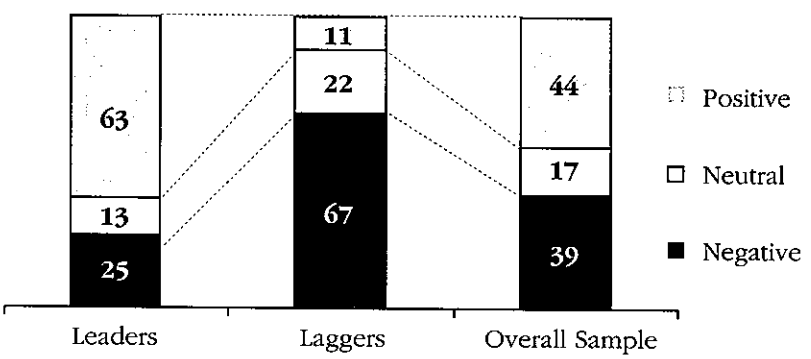

Figure 4.7. Pre-capital investment cash flow levels

Considering the facts that while 50% of the *leaders* are large and all of the *laggards* are SMEs (Table 4.5), it is interesting to analyze the average annual growth in employment over the last three years of the *leader* and the *laggard* companies. The analysis reveals that while the *laggard* companies experienced 17% employment growth, the *leader* companies had 11% (Figure 4.8). This finding might indicate that:

- *The laggard companies are increasing their total number of employees. A reason for this could be to compansate for the growing business, which is a good indication, since, as discussed before, company size affects best practice adoption, which in turn, would affect the overall business performance. Another reason could be to compansate for the quickly changing demand under the pressure of not loosing business but at the expense of productivity.*

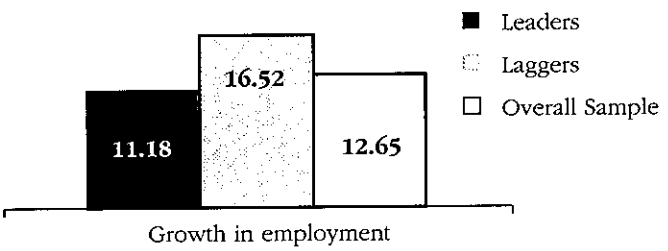

Figure 4.8. Average annual growth in employment over the last three years

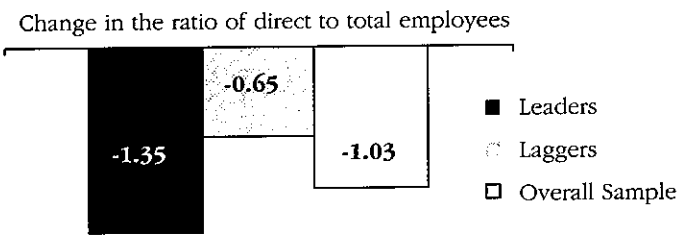

Figure 4.9. Average annual change in the employement ratio over the last three years

It might also be interesting to examine the average annual change in the ratio of the number of direct workers to the number of total employees of the *leader* and the *laggard* companies. As shown in Figure 4.9, while the ratio is decreased at an average annual rate of 1.35% in the *leaders*, it is decreased by 0.65% in the *laggards* during the last three years. This implies that:

➢ *The number of direct employees in the total number of employees is decreasing more steeply in the leaders than in the laggards. While the leaders are trying to increase the ratio of their white-collared employees, the laggards are trying to increase the ratio of their blue-collared employees.*

4.3.2. Practices and Outcomes in Relation to Company Success

In the survey, companies are asked to rank five practices and five outcomes in relation to their impact on their success in the last 2 years. Figure 4.10 and Figure 4.11 displays the percentages of the *leader* and the *laggard* companies that rank the listed practices and outcomes as the *most important* to their current success.

Five practices include leadership, planning, employee relations, customer relations, and supplier relations. Leadership is considered to be the most important one in relation to their current success by the companies in the sample (Figure 4.10). On the other hand, none of the companies considers supplier relations as the most important practice. Recently, developing new supplier management practices and forging stronger relationships with the suppliers take on paramount importance for continuous improvement throughout the supply chain.

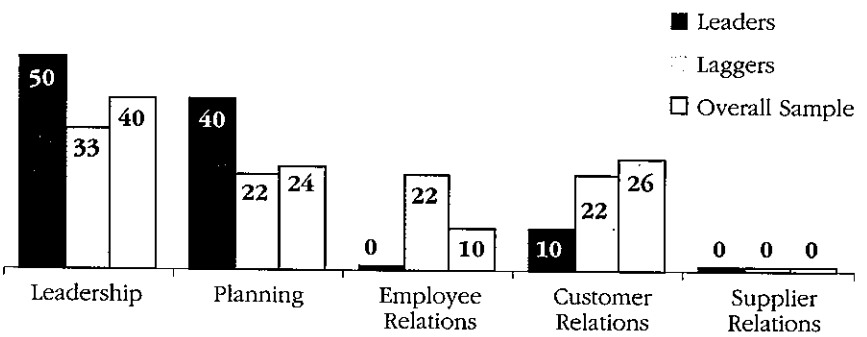

Figure 4.10. Practices ranked as the most important in relation to company success

Among the five outcomes (cost, quality, flexibility, timeliness, and innovativeness), quality is ranked first as the key factor contributing to their success by 54% of the companies in the overall sample, and cost is the second most frequently first ranked outcome. Timeliness and innovativeness are not considered the most important factor by any of the *leader* companies. The *leader* companies attribute their current success mostly on the quality and cost issues. Timeliness is the first success factor together with quality for the *laggard* companies (Figure 4.11).

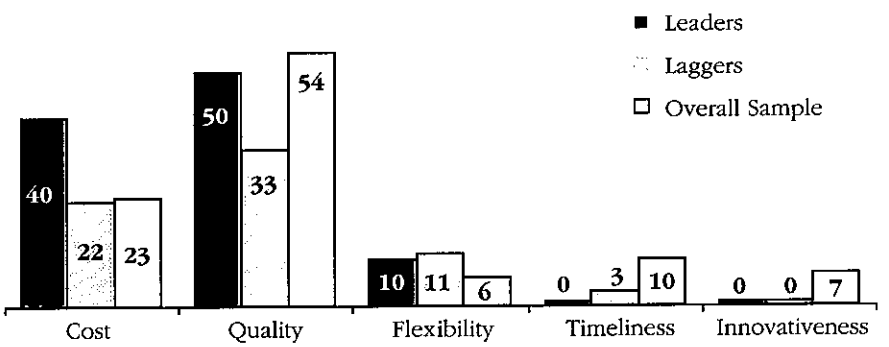

Figure 4.11. Outcomes ranked as the most important in relation to company success

4.3.3. Implementation of Best Manufacturing Practices

Implementation of best manufacturing practices is measured by means of calculating a *strategy & practices index.* Figure 4.12 shows the average total scores on the index attained by the *leaders, laggards,* and by the overall sample.

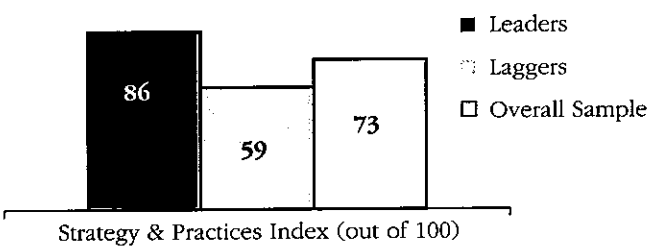

Figure 4.12. Average total scores on the strategy & practices index

By definition, *strategy & practices index* measures the companies in terms of their manufacturing strategies and practices. Transforming an organization to achieve and sustain best practices requires an appropriate manufacturing strategy. While the scores on planning, focused strategies and factory operations contribute to the strategy part, the scores on leadership, people practices, customer focus, product and process quality, benchmarking and technology contribute to the practices part of the index. Figure 4.13 exhibits the positions of the *leaders, laggards,* and the overall sample in a spider diagram.

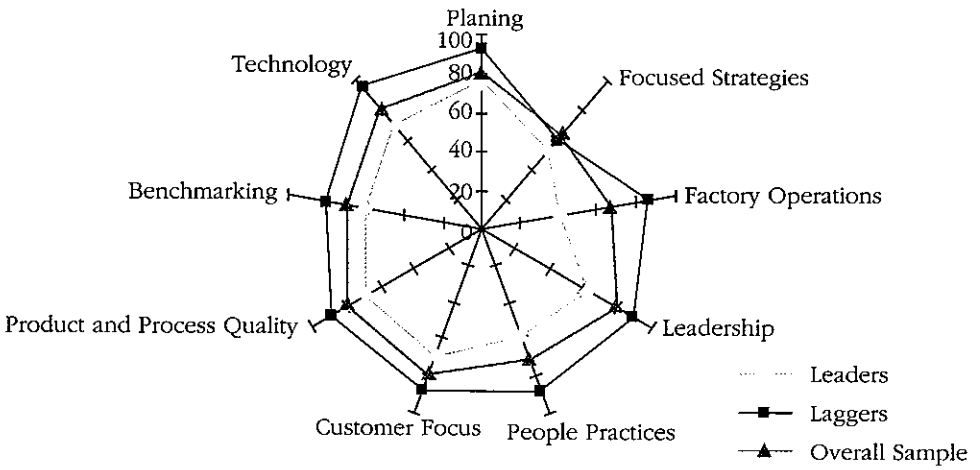

Figure 4.13. Positions of the categories on the components of strategy & practices index

The scores of the *leaders* are significantly higher than those of the *laggards* on each component of the *strategy & practices index.* The distance between the *leaders* and the *laggards* is largest in the area of factory operations but smallest in the area of focused strategies.

Planning

➢ *The leaders are performing better than the laggards in almost all aspects of planning, except in the practice of incorporating the concerns and requirements of customers, suppliers, and other stakeholders, including the community into their plans.*

➢ *There is a lack of alignment of manufacturing operations with the business mission, in general. Nevertheless, the leaders are more likely to achieve alignment.*

Focused strategies

➢ *Focused strategy development and implementation appears to be an area open for improvement for both the leaders and the laggards.*

Factory operations

➢ *The leader companies, by far, performed better than the laggard companies in adopting best manufacturing practices related to factory operations.*

➢ *The most important result is that, while majority of the leaders have reported a significant or major contribution resulting from preventive maintenance and quality improvement teams, none of the laggards claimed they even applied these approaches.*

Leadership

➢ *The leader companies, to a great extent, performed better than the laggards did, on the average. Particularly, there are significant differences observed between the leaders and the laggards in the effective use of team spirit and motivation, and in the assurance of unity of purpose throughout the organization.*

People practices

➢ *The leaders are significantly better than the laggards in almost all aspects of people management. They reported relatively successful implementation of effective top-down and bottom-up communication, formal and regular measurement of employee satisfaction, better occupational health and safety practices, and training. Another significant difference between the leaders and the laggards is observed in relation to the extent organization-wide training and development, and career path planning are employed by these companies. However, the leaders fail to differentiate themselves from the laggards in the practice of developing human resources plans that focus on the core skills and competencies required to manufacture competitive products.*

Customer focus. The survey address customer focus in terms of various aspects related to the usage of customer requirements and measurement of customer satisfaction. The analyses demonstrated that:

- *In general, there is a widespread and keen awareness of the importance of customer focus both in the leader and the laggard companies. Majority of the companies stated that they know current and future requirements of customers to a great extent, and that they use these requirements in designing new products and services. However, information on these requirements is mostly gathered from the domestic customers. In the laggard companies, there seem to be some obstacles in the dissemination of this information to the employees.*

Product and process quality. The percentage of companies with one or more quality certificate such as ISO 9000 is 60% among the leaders and 22% among the laggards. The analyses demonstrated that:

- *Majority of the companies, be a leader or a laggard, claimed that all of their employees believed that quality is their responsibility.*
- *All of the leader companies stated that their employees had a clear understanding of internal customer concept compared to a very small percentage of the laggards who can make such a claim.*
- *The leaders performed far better than the laggards in working closely with their suppliers in product or process development but their performance cannot be judged as satisfactory either. Thus this point is open to improvement for all companies.*

Technology

- *The leaders are much better than the laggards in that their core manufacturing technology is appropriate to their business needs and that they utilize their manufacturing technology to its maximum potential.*

4.3.4. Achievement of High Operational Outcomes

The extent of achieving high operational outcomes is measured by means of calculating an *operational outcomes index.* Figure 4.14 shows the average total scores on the *operational outcomes index* attained by the *leaders, laggards,* and by the overall sample.

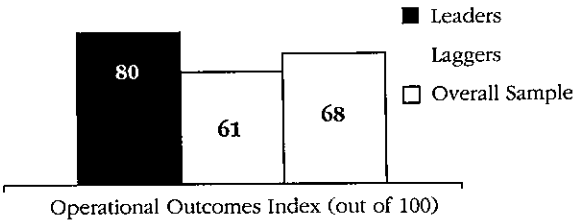

Figure 4.14. Average total scores on the operational outcomes index

Operational outcomes index is constructed by the responses given to the selected questions incorporated in the questionnaire that aim to assess companies' operational performance in terms of cost, quality, flexibility, timeliness, and competitiveness. The survey questions made up the *operational outcomes index* can be classified into two groups:

I. Comparison of companies with the best results achieved by the domestic and foreign competitors in terms of *total cost per unit of product, finished product defect rate, order to delivery time, and lost capacity due to production breakdowns.*

II. Assessment of operational performance in terms of *customer satisfaction, employee morale, process changeover time, productivity, technological competitiveness, delivery full on time, proportion of production operators involved in process improvement or problem solving teams, and proportion of quality control inspectors to direct operators.*

Comparison with competitors. In today's global competitive market, accessing and reviewing competitors' information is essential for a company for finding out its relative strengths and weaknesses. In the survey, companies are asked to compare their values with the best results achieved by their competitors.

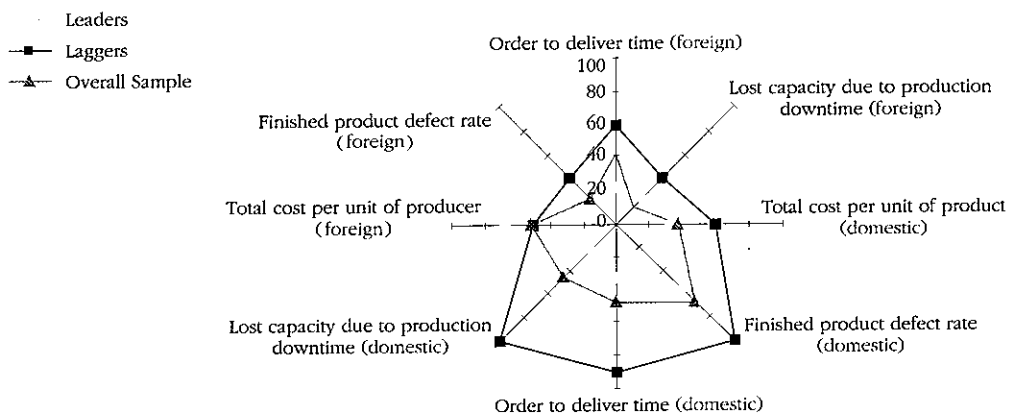

Figure 4.15. Comparison with the best results achieved by the competitors

Figure 4.15 exhibits the positions of the *leaders, laggards,* and the overall sample in a spider diagram, in relation to their comparisons with the best results achieved by their competitors.

The values in the spider diagram indicate the percentages of companies in the specified categories that reported lower or much lower levels achievements in these factors relative to their domestic and foreign competitors. Hence, these values indicate the fraction of advantageous companies in each factor with respect to their competitors. The results reveal that:

- *While more than half of the leaders thought that they had cost advantage relative to their domestic and foreign competitors, the laggards thought that they had cost advantage especially relative to foreign competitors.*
- *Regarding quality, the results imply the existence of a gap with the foreign competitors, as stated earlier. It seems to be a valid gap also for the leaders. Yet, larger percentage of the leader companies think that they are more advantageous relative to their competitors*
- *In general, order to delivery cycle time is not considered to be a point of superiority. Relative to foreign competitors, 60% of the leaders reported lower cycle times, compared with 33% of the laggards. Moreover, the leaders are performing far better than the laggards in comparison to their competitors.*
- *One of the primary reasons of capacity loss in a manufacturing company is the production downtimes caused by machine breakdowns or unplanned stops. In general, companies had problems in this area, particularly relative to foreign competitors. However, this is the single performance outcome that most clearly separated the leaders from the laggards.*

Assessment of operational performance. In the survey, companies are required to assess their operational performance in terms of eight performance attributes and indicators.

Figure 4.16 exhibits the positions of the *leaders, laggards,* and the overall sample in a spider diagram, in relation to their assessment of operational performance.

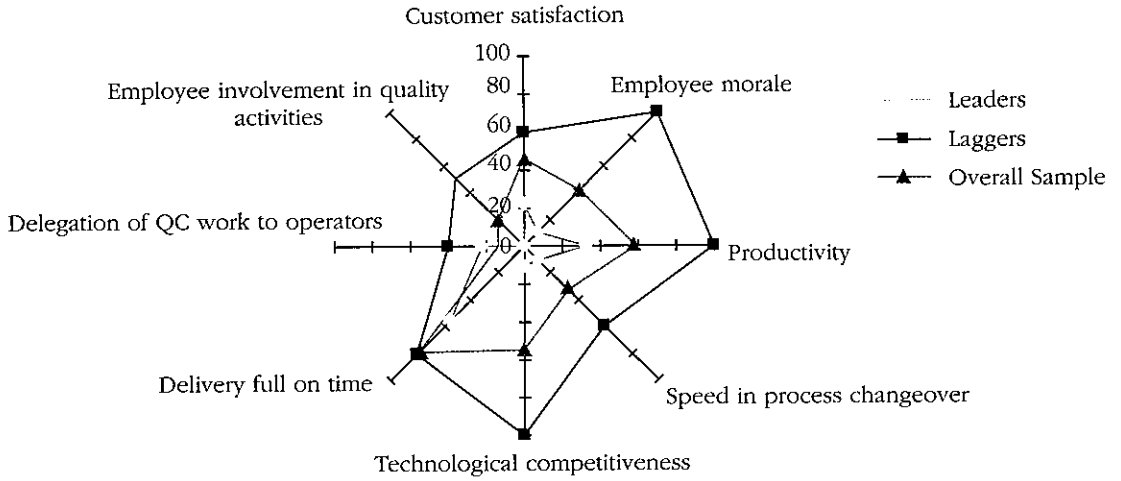

Figure 4.16. Assessment of operational performance

The values in the spider diagram indicate the percentages of companies in the specified categories that achieve high outcomes in each operational performance attribute or indicator. The results on the operational attributes reveal that:

- *Although the leaders differentiate themselves from the laggards in customer satisfaction it is deemed to be unsatisfactory.*
- *Employee morale is an indicator of employee satisfaction. All of the leader companies reported high level of employee morale compared with the one-tenth of the laggards.*
- *Value-added per employee is a widely-used indicator of productivity. All of the leader companies reported that their level of productivity is consistently improving and they gained significant benefits, compared with one-third of the laggards.*
- *Although the leaders are much better than the laggards in the average processe change over time indicator, still 40% reported a need for improvement.*
- *Committing to remain technologically competitive is a necessity for manufacturing companies to ensure continuous improvement in their production systems. All of the leader companies reported that they have*

advantages over competitors or that they are technologically leaders, compared with only one-tenth of the laggards.

The values in the spider diagram corresponding to delivery full on time to customers, transfer of quality control work to operators, and employee involvement in quality activities are obtained from the responses to the questions requiring objective assessments of operational outcomes in ratio of deliveries to customers that are full and on time, ratio of quality control inspectors to direct production operators, and the ratio of production operators involved in process improvement or problem solving teams, respectively. The corresponding results are displayed in the Table 4.6, Table 4.7, and Table 4.8.

TABLE 4.6. Ratio of deliveries to customers that are full and on time

Category	Percentage of companies that have				
	Less than 50	50 – 80	81 – 90	91 – 96	More than 96
Leader	20	0	0	40	40
Laggard	11	0	33	11	44
Overall Sample	4	5	12	35	44

TABLE 4.7. Ratio of quality control inspectors to direct production operators

Category	Percentage of companies that have				
	Less than 1.0	1.0 – 2.0	2.1 – 10.0	10.1 – 20.0	More than 20.0
Leader	30	10	50	0	10
Laggard	0	22	56	0	22
Overall Sample	7	7	57	24	4

TABLE 4.8. Ratio of production operators involved in process improvement teams

Category	Percentage of companies that have				
	Less than 5.0	5.0 – 9.9	10.0 – 19.9	20.0 – 50.0	More than 50.0
Leader	40	0	10	10	40
Laggard	100	0	0	0	0
Overall Sample	52	9	20	9	11

Delivery full on time is the most widely used performance indicator in measuring delivery performance. It is defined as the percentage of time a company delivers the orders at the right quantities and at the right time to its customers. The values in Table 4.6 demonstrate that:

➢ *The leaders far outperform the laggards in the ratio of deliveries to customers that are full and a time.*

Lean production approach and TQM advocate lowering of the number of quality inspectors and delegation of quality related responsibilities to production operators. Moreover, quality advocates have long stresses employee involvement as an important key to turning quality strategies into demonstrable quality performance. The values in Table 4.7 and 4.8 demonstrate that:

➢ *Despite the fact that, the leaders are far better than the laggards in employing less quality control inspectors, this ratio needs to be decreased further.*

➢ *The leaders are clearly separated from the laggards in the ratio of production operators involved in process improvement or problem solving teams.*

CHAPTER 5

TECHNOLOGY AND PRODUCT INNOVATION: AREAS OF POTENTIAL COMPETITIVE ADVANTAGE

V. TECHNOLOGY AND PRODUCT INNOVATION: AREAS OF POTENTIAL COMPETITIVE ADVANTAGE

Both accelerating pace of change in technology and the rapidly improving technology access globally make technology to a major agent of threat and opportunity for sustainable competitiveness. Technology is defined as the study of human techniques for making and doing things (Buchanan, 1992). It follows from this basic definition that the level of technology we successfully employ is one of the determining factors for our relative position on the ladder of competitiveness. Note that this definition does not limit technology to the physical realm of production but includes also the managerial and organizational aspects of making and doing things. The increasingly complex and crucial nature of technology has created the need to manage technology as a process and has led to the development of technology management.

In a study conducted among the largest companies in Europe (MERIT, 1995), it is found that the innovative activities are directed towards improving products (quality and/or performance of products), creating new products, and the reduction of production costs. It is interesting to note that the first two items are heavily design and product technology oriented. The third item is more process technology oriented. In the manufacturing industries in Turkey, on the other hand, currently the emphasis is on developing process technologies. Developing design capability appears to be of lesser priority. Research into product technology is rather rare.

In the remainder of this chapter, we will deal with technology management process, R&D as the major source for product and process technology, and new product development process and capability. We will report mainly from two studies made in automotive p&c sector (Ulusoy *et al.,* 1999b) and electronics sector (E. Payzın *et al.,* 1998) in Turkey.

5.1. Technology Management Process

In the literature, numerous approaches for the management of technology are discussed. These models aim to position technology strategy into the overall framework of competitive strategy. With the technology intensity increasing in all sectors of the economy, the successful integration of technology planning with business planning gains in importance for business success. One of the five

technology planning best practices reported by Metz (1996) is to establish a structured process for technology planning. As has been stated earlier, the model representing technology management process consists of the sub-processes of identifying, selecting, acquiring, protecting, exploiting, and abandoning technologies (Figure 1.3).

Strategy and planning

➢ *Among the automotive p&c suppliers surveyed, only 48% strongly emphasized that they have consistent and stable strategic management. The proportion of companies reporting that they have a systematic process for technology planning and strategy development is even lower, only 33%. This fact illustrates a major weakness.*

Technology monitoring and intelligence. Technology monitoring and intelligence are important activities to secure the survival of the company. As Drucker (1995) states, *"At least half of the important new technologies that have transformed an industry in the past fifty years came from outside the industry itself."* Attacks from outside the sector become a real possibility, increasing the need for firms to maintain at least a watching brief on technological developments, and indeed the upstream R&D, across a wider spectrum of activity (Competitiveness Advisory Group, 1999) A few findings from the study conducted among the automotive p&c suppliers in Turkey are summarized below.

➢ *Among the companies surveyed, 57% strongly emphasize that they monitor the developments in the field of their existing technologies and 52% strongly emphasize that they monitor technologies planned for future. The ratio of companies that monitor the technologies of competitors is substantially lower, at 29%.*

➢ *With respect to relative frequency of usage and benefit, customers and poduct benchmarking appear to be the top two information sources.*

➢ *It is notable that, reverse engineering, a practice that does not seem to be widely popular within the sector is found to provide beneficial information by those companies who practice it.*

➢ *Universities, pofessional associations, consulting companies, and disclosed patents turn out to be the least frequently used sources of information.*

Technology acquisition. Technology acquisition can be made from external and internal sources. The internal sourcing is mainly from the R&D function in the company wich is covered in some detail in section 5.2.

The principal reason for internal development is found to be the determination of the company to gain expertise in a particular technology. Another reason is the availability in the company of the capabilities required by the technology to be developed. A third reason found is that the company might prefer to develop a particular technology for protecting it more effectively. Another reason of equal weight is observed as the cost advantage of internal development.

The main reason for acquiring technology from external sources, on the other hand, is the lack of the competence in that particular area. Other reasons following are to avoid the uncertainties involved in terms of time and cost of developing a technology and the excessive leadtime. The companies would like to have the technology available as soon as possible. Another interesting observation is that the R&D Department is usually structured and managed in such a way so as to maintain the existing technologies in the company and to introduce minor improvements.

The use and efficiency of external technology sources are presented in Table 5.1 for the automotive p&c sector.

TABLE 5.1. Use and efficiency of external technology sources – Automotive p&c sector

Source	Per cent of usage	Efficiency (per cent)		
		Not efficient	Moderately efficient	Very efficient
Trade fairs, conferences	95	16	47	37
Publications	86	6	76	18
Customer companies	80	0	63	38
Affiliated companies	76	0	44	56
Supplier companies	70	14	57	29
Consulting companies	45	11	89	0
Other companies	38	13	75	13
University laboratories	14	0	100	0
R&D institutions	10	0	50	50

➢ *While trade fairs and conferences stand out as the major technology source, university laboratories and R&D institutions are distinctively not utilized (Table 5.1).*

➢ *Lack of skills, over occupation of R&D function with incremental improvements, and the need to reduce the uncertainties in the performance of new technology, are the factors leading to acquisition of externally developed technologies.*

Technology renewal cost expenditures as a per cent of total sales is a measure of the technology acquisition level of a company. The levels obtained for the automotive p&c sector in Turkey together with its breakdown into its components are given in Table 5.2. The components are: (i) Licence, patent, know-how, technical consulting expenditures (L/P), (ii) R&D expenditures (R&D), (iii) equipment purchase expenditures (EQU). As has been explained in the Introduction section, companies with less than 250 employees belong to Group I; companies with the number of employees between 20 and 500 are in Group II; and companies with more than 500 employees belong to Group III.

TABLE 5.2. Technology renewal expenditures as a per cent of total sales – Automotive p&c sector

	1995				1996				1997			
Group	L/P	R&D	EQU	Total	L/P	R&D	EQU	Total	L/P	R&D	EQU	Total
Group I	0.1	0.5	1.3	1.9	0.2	0.5	2.1	2.8	0.1	0.3	3.9	4.3
Group II	0.0	0.1	6.8	6.9	0.4	0.1	9.1	9.6	0.4	0.3	9.3	10.0
Group III	1.1	1.3	9.3	11.7	1.0	1.2	1.0	3.2	0.7	1.0	10.9	12.6
Overall	0.4	0.7	6.1	7.2	0.5	0.6	7.7	8.8	0.4	0.5	8.3	9.2

➢ *For all the years covered there is an increasing trend of equipment purchase ratios from Group I through Group III. The comparison of R&D expenditures with external equipment and technology purchasing expenditures reveals a great dependence on external technology.*

In the study, external technology acquisition strategies employed in the electronics industry in Turkey are grouped under eight headings. The responses

obtained to the inquiry on how frequently they employ particular strategies are given in Table 5.3.

- ➢ *Large companies and SMEs alike, the most favored strategy for technology acquisition appears to be through employing skilled technical personnel.*
- ➢ *Equipment purchasing and communication with other companies' specialists are the next two more popular strategies.*
- ➢ *The choice of strategies is consistent with the expenditure levels displayed in Table 5.2.*
- ➢ *The intensity of activities for technology acquisition is relatively low.*

TABLE 5.3. Implementation rates of external technology acquisition strategies – Electronics sector

	Averages (1)	
Technology Acquisition Strategy	*SME*	*Large*
Through licence, patent, know-how agreements	1.4	2.4
Contracted-out R&D projects	1.6	1.9
Making use of consultancy services	1,7	2.1
Through purchasing another company or parts of it	0.9	1.0
Equipment purchasing	2.1	3.1
Reverse engineering	1.9	1.9
Communication with other companies' specialists	2.3	2.9
Employing skilled technical personnel	3.6	3.5
Other	0.3	1.4
Overall	1.7	2.2

(1) (1: Never, 5: Always)

Technology exploitation. One might consider four major ways of exploiting the current technology stock in the company: employing it in its own processes or products; contracted-out manufacture or marketing; joint-venture; and license-out. A company's relative self-confidence and competence in the technology development process influence the exploitation decisions. With lower competence and confidence, the external exploitation of technology decreases.

➢ *The study shows that, to a great extent, companies exploit the technologies available in their stock internally and although many companies have developed their own technological competencies, they lack experience in the external exploitation of these.*

The implementation rates of technology transfer strategies in the electronics sector are given in Table 5.4. The term technology transfer implies here the technology diffusion from the company to outside the company.

TABLE 5.4. Implementation rates of technology transfer strategies – Electronics sector

	Averages (1)	
Technology Transfer Strategies	*SME*	*Large*
Through sale of license, patent, know-how rights	1.0	1.6
Through contract R&D projects	1.3	1.5
Through providing consultancy services	1.9	2.1
Through sale of part of the company	0.9	1.3
Through equipment sale	2.3	1.9
Through loss of skilled technical personnel to other companies	1.4	2.6
Other	0.3	0.6
Overall	1.7	2.2

(1) (1: Never, 5: Always)

➢ *The intensity level of technology transfer is very low.*

➢ *Just like in the case of technology acquisition, the highest rate of technology transfer is achieved through the mobility of qualified personnel. Equipment sale and providing consultancy services follow as the next more popular means of technology transfer.*

Data related to internal technology exploitation is provided in Table 5.5.

TABLE 5.5. Quantitative results of new technology use (%) – Automotive p&c sector

Operational result	No change	Moderate improvement	Major improvement
Increase in conformance quality	0	35	65
Reduction in production lead time	10	30	60
Increase in manufacturing capacity	0	48	52
Increase in production precision	15	40	45
Increase in the time for new product development	20	40	40
Cost reduction	10	52	38
Increase in flexibility	20	45	35
Decrease in setup times	10	57	33
Increase in safety	15	60	25
Decrease in lot sizes	45	35	20

➢ *It appears that the greatest impact of new technology on operational results comes mostly as reduction in the conformance quality, production cycle time and as increase in the manufacturing capacity.*

➢ *It is interesting to note that the impact of new technologies are mainly in the areas along the lines of supplier selection criteria provided in Table 3.8.*

5.2. Research And Development Intensity

In this section, R&D intensity in the manufacturing industry in Turkey will be investigated through a globally accepted performance measure, namely the ratio of R&D expenses to total sales. A word of caution is needed here though, since the output resulting from this investment in R&D does not only depend on the level of the input (R&D expenses) but also on the effectiveness of the mechanism within the company that converts the input into output. R&D expenses to total sales ratio values for the automotive p&c sector in Turkey are reported in Tables 5.6 and 5.7.

TABLE 5.6. R&D expenses as a per cent of total sales – Automotive p&c sector

Range (%)	Percentage of Companies		
	1995	1996	1997
0.00	41	29	29
0.01 – 0.50	29	35	35
0.51 – 1.00	12	24	24
1.01 – 2.00	12	6	6
Larger than 2.00	6	6	6

TABLE 5.7. R&D expenses as a per cent of total sales – Automotive p&c sector

Group	1995	1996	1997
Group I	0,5	0,5	0,3
Group II	0,1	0,1	0,3
Group III	1,3	1,2	1,0
Overall	0,7	0,6	0,5

- *Almost 1/3 of the companies have no R&D reported. Slightly more than half of the companies have an R&D ratio to total sales less than 1%.*
- *Group I has a larger ratio compared to Group II. A possible reason for this could be that Group I needs to develop more endogenously since they do not have enough resources to purchase equipment comparable to Group II (Table 5.7).*
- *Large companies in the automotive p&c sector have this ratio above 1%.*
- *In the corresponding sector in USA, this performance measure varies between 4-6%. In Japan, the range is reported as 12-14%. The difference is explained to result from the more frequently practiced delivery of the design function to the supplier (Hatfield, et al., 1995). Valeo, a major first tier supplier from Europe, has reported her R&D expenses to total sales ratio as 6% for 1997 (http://www.valeo.com).*

R&D expenses to total sales ratio values for the electronics sector in Turkey are reported in Tables 5.8 and 5.9.

TABLE 5.8. R&D expenses as a per cent of total sales – Electronics sector

Company Size	R&D Expenses to Total Sales Ratio (1996) (%)
SME	3.6
Large	4.0

TABLE 5.9. R&D expenses as a per cent of total sales – Electronics sector

Subsector	R&D Expenses to Total Sales Ratio (1996) (%)
Consumer electronics	1.4
Telecommunication	5.6
P&I equipment	4.3
Military electronics	8.9
Overall	3.9

➢ *It is interesting to note that military electronics and telecommunication subsectors display a relatively higher R&D intensity. This can be due to these subsectors operating mostly in made-to-engineering mode.*

➢ *In the electronics sector in USA, the sector average for R&D expenses to total sales ratio is reported to be around 5.7% (Hatfield, et al., 1995). Further international benchmarks are provided on a company basis in Table 5.10.*

TABLE 5.10. R&D expenses as a per cent of total sales –Electronics sector
(Booz-Allen and Hamilton, 1997)

Company	Subsector	R&D Expenses to Total Sales Ratio (1995) (%)
Hitachi	Consumer electronics	7
Philips	Consumer electronics	6
Sony	Consumer electronics	6
Nortel	Telecommunication	15
Ericsson	Telecommunication	15
Cisco	Telecommunication	8
Siemens	Telecommunication	8
Motorola	Telecommunication	8
Nokia	Telecommunication	5

➢ *All the above results indicate that in both sectors more R&D intensity is required.*

5.3. Design Capability And New Product Development

Design capability is the underlying capability for product design change and for new product design. As has been reported earlier, rapid design change / new product introduction is in the short list of competitive priorities and decreasing new product development time is in the short list of manufacturing objectives.

5.3.1. Product Design Improvement

Product design improvement can be attempted due to purely aesthetical reasons, due to standards and other regulatory requirements, and for cost reduction. Depending on the nature and scope of the design change, a new product with minor improvement might result. We will deal here only with product design improvements made for cost reduction.

Cost reduction can be achieved through reducing the complexity of the product. This is achieved by reducing the number of parts and components and moving towards a modular design. This approach not only reduces the assembly and disassembly efforts but also contributes to the reduction of the number of suppliers. Cost reduction can also be achieved through the standardization of parts and components. Another means of reducing cost is by redesigning parts and components so as to simplify the production processes and to decrease material consumption, and to achieve savings due to material type change.

All these product improvement changes have to be evaluated from the point of view of product life cycle cost. An example is the increasing use of aluminum in cars leading to lighter vehicles and thus to reduced gasoline consumption.

➢ *For the facilitation of product design improvement, one can easily see the crucial nature of the ownership (co-ownership) of design. That a company doesn't own the design can be a major hindering block in front of product design improvement, which then also weakens the competitive capability of the company.*

5.3.2. New Products

New products are among the end results of technology and innovation efforts within a company. One of the most effective enablers on the way into global

markets is to create an inherent new product development capability within the companies.

New products are classified in this study into two classes: (i). Products in which the company has no design contribution but the product is new for the company. (ii). Products in which company has design contribution and the product is being produced by the company for not more than the last three years. New products are further classified among themselves as new products with major innovation and with minor improvement.

Distinguishing between these two classes is meaningful and important. Introduction of products new for the company to which the company has no design contribution, is a process to be planned and executed skilfully. It might seem similar to the new product development process depicted in Figure 1.4, but is a process with its own characteristics requiring some different capabilities and competences.

Unless otherwise stated, for the rest of this chapter, new product will imply products in which company has design contribution and the product is being produced by the company for not more than the last three years.

5.3.3. Competitive Priorities and Marketing Strategies for New Product Development

The competitive priorities in new product development play an important role in the formulation of the new product development strategies. The first three competitive priorities in the electronics sector in Turkey are depicted in Figure 5.1.

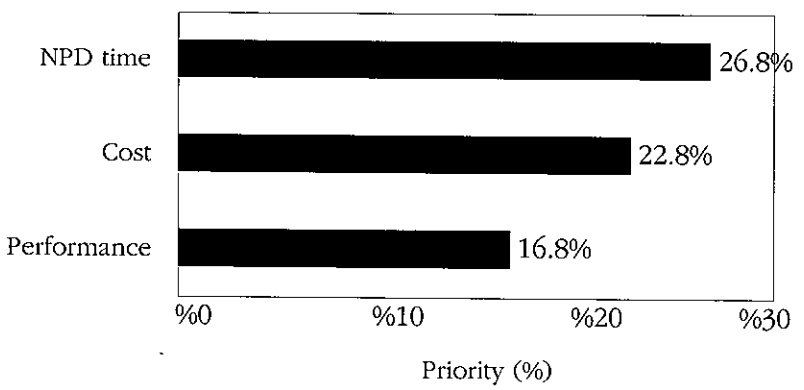

Figure 5.1. The top three competitive priorities of electronics companies

➢ *New product development time constitutes an important component of time-to-market and is thus very important to electronics sector where companies are competing in a market with relatively short product life cycles.*

➢ *New product development time as the top competitive priority for new product development is consistent with the competitive priorities and manufacturing objectives at company level where rapid design capability and decrease new product development time appeared high in the short list of the electronics sector.*

➢ *Cost and performance are also consistent with the competitive priorities and manufacturing objectives at company level.*

TABLE 5.11. New product technology strategy - Electronics sector

	Implementation Percentage	
New Product Technology Strategy	*SME*	*Large*
Developing new product technology	12	16
Improving product technology developed by others	24	16
Using product technology developed by others	25	12
Improving one's own product technology	39	56

➢ *The results summarized in Table 5.11 indicate that for both SME's and large companies developing new product technologies is relatively rare.*

➢ *The preference indicated for "improving one's own product technology" for both large companies and SMEs is consistent with the low levels of technology acquisition exhibited in Table 5.3.*

TABLE 5.12. Market entry strategy for new products with major innovation - Electronics sector

	Implementation Percentage	
Market Entry Strategies	SME	Large
First in the target market	29	30
Close follower	32	49
Late/Delayed entry	39	22

TABLE 5.13. New product marketing strategy - Electronics sector

New Product Marketing Strategy	Implementation Percentage SME	Large
Products with minor improvements into existing markets	32	52
Products with major innovations into existing markets	19	13
Products with minor improvements into new markets	26	26
Products with major innovations into new markets	22	9

➢ *Interpreting both Table 5.12 and 5.13, it appears that large companies are more cautious in entering new markets. On the other hand, the SMEs are more cautious in their market entry with products with major innovations into either new or existing markets. In other words, SMEs are more risk averse.*

5.3.4. New Product Idea Sources

An assessment of the impact (effectiveness) of new product idea sources for both the electronics sector and the automotive p&c sector are given in Figure 5.2 and Table 5.14 respectively.

➢ *For the large companies in the electronics sector, customers are on the top of the list followed by R&D Depaertment, trade fairs/exhibitions and top management. For SMEs, on the other hand, top management is on the top of the list followed by customers, R&D Department and trade fairs/exhibitions.*

➢ *Companies in the automotive p&c sector cite customers, top management and R&D Department as the major sources of new product ideas.*

➢ *It is interesting to note that for SMEs top management is an important source. This is an indication that product innovation is conceived by top management as a strategic issue to be closely monitored. Although the intensity of R&D activities in these firms is rather low in general, the fact that R&D Department is perceived as a major source of new product ideas indicates to an important function of R&D Departments; namely, to serve as a product innovation gate for their companies.*

➢ *In a study conducted among the largest companies in Europe (MERIT, 1995), the most important external source of technical knowledge for innovative activities in the company turned out to be the technical analysis of the products of the competitors, ie., product benchmarking. It is followed by customers and suppliers.*

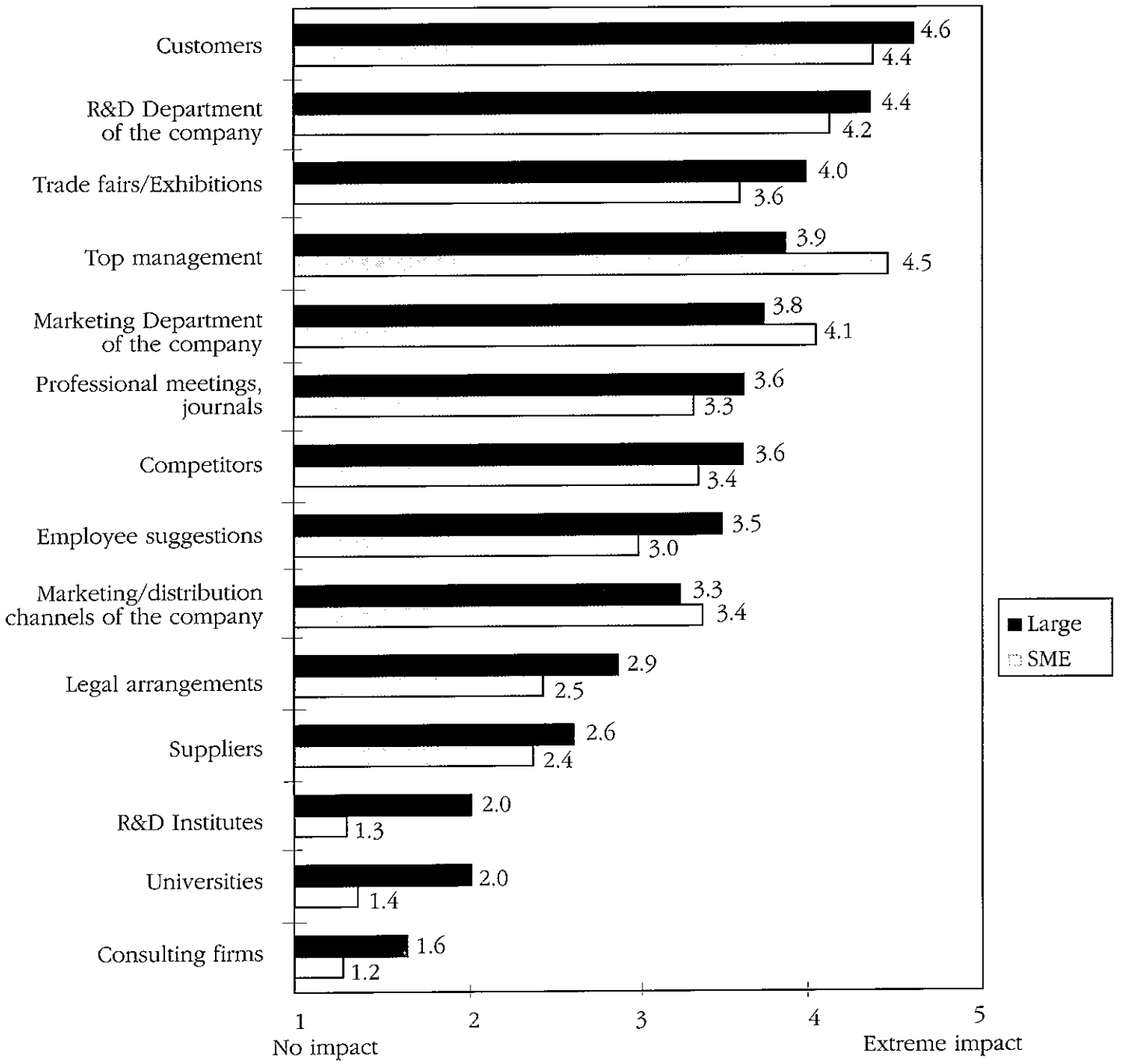

Figure 5.2. Sources of new product ideas - Electronics sector

TABLE 5.14. New product idea sources – Automotive p&c sector (%)

New Product Idea Source	*Not Effective*	*Effective*	*Very Effective*
Customers	0	35	65
Top management	6	35	59
R&D Department of the company	13	44	44
Competitors	24	47	29
Marketing Department of the company	24	47	29
Trade fairs/Exhibitions	41	35	24
Legal arrangements	29	53	18
Professional meeting, journals	44	44	13
Employee suggestions	29	59	12
Marketing/distribution channels	41	47	12
Suppliers	53	35	12
Consulting firms	88	12	0
Universities	88	12	0
R&D Institutes	88	12	0

5.3.5. Share of New Products in Product Portfolio

The share of new products in the product portfolio of the company is an indicator of turnover rate of products. For the automotive p&c sector, it is seen from Table 5.15 that in 1997 slightly more half of the products are taken over from year 1996 without any change. On the average, 17.5% of the products in the product portfolio of the companies have undergone major innovation and 29.4% minor modification.

TABLE 5.15. Distribution of product portfolio – Automotive p&c sector

New products with no design contribution from the company	*Per cent*
With major innovation	11.6
With minor modification	19.4
New products with design contribution from the company	
With major innovation	5.9
With minor modification	10.0
Products continuing with no change from 1996	53.2

➢ *The value of the percentage of new products with design contribution from the company as well as its comparison with the percentage of new products without design contribution from the company indicate to the low level of design and co-design activities in the automotive p&c manufacturers.*

5.3.6. Share of New Product Sales in Total Sales

The share of new product sales in total sales is another common performance measure monitored for product management. It is one of the basic measures according to which companies might formulate their new product strategies including policies related to the infrastructure for new product development process. The corresponding values for the automotive p&c manufacturers in Turkey in 1997 are given in Table 5.16.

TABLE 5.16. Share of new product sales in total sales – Automotive p&c sector

For new products	Per cent
with no design contribution from the company	18.9
with design contribution from the company	9.1

➢ *New products with or without design contribution from the company have roughly the same diffusion in terms of sales in comparison to their share in the product portfolio. That their shares in the total sales are less than their respective shares in the product portfolio can be explained by the expected relatively small diffusion rate initially for the new products.*

The shares of new products in the electronics sector in Turkey in 1996 of designed or co-designed products by the companies in the period (1993-1996) are displayed in Figures 5.3 and 5.4 broken down by company size and subsectors respectively.

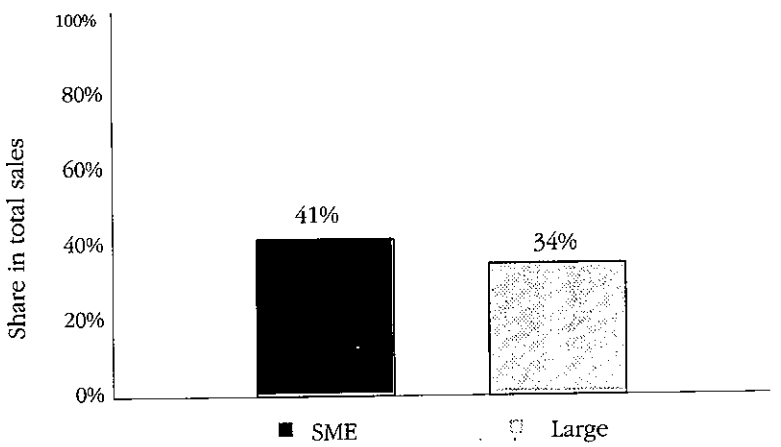

Figure 5.3. Share of new product sales in total sales broken down by company size – Electonics sector

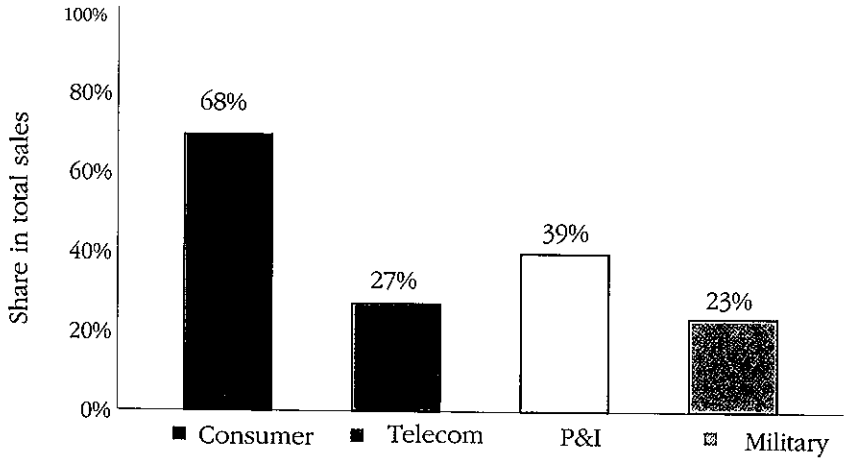

Figure 5. 4. Share of new product sales in total sales broken down by subsectors – Electronics sector

➢ *There seems to be no significant difference between the shares of new product sales in total sales of SMEs and large companies (Figure 5.3). But there are distinct differences among the subsectors (Figure 5.4). Consumer electronics has the highest share and military electronics the lowest, which are expected results considering the life cycle of products in these subsectors.*

The results obtained by Kluge *et al.* (1996) in a study they have conducted among 102 large electronic companies from USA, Europe and Japan are reported here in Table 5.17. The classification as to unsuccessful and successful companies is made based on profitability and growth in total sales in the last three years period (1989-1991).

TABLE 5.17. Share of the sales of new products introduced within the last 12 months in total sales of large electronic companies (%) (Kluge et al., 1996)

Subsector	Unsuccessful Companies	Successful Companies	Best in Class (World Class)
Industrial electronics	11	9	28
Large electronic systems	28	26	50
Computers & communication	27	49	82
Consumer electronics	28	45	80

5.3.7. Good Design Practice

Good design practice is the key to manufacturing. Flexibility and cost of a product are determined largely by design. What is meant by flexibility here is the ability to reconfigure the product easily; to change the design easily. For a flexible design, number of parts needs to be kept at minimum; the design of the parts and components should minimize the need for jigs and fixtures so that no special tooling is needed when a part or component is redesigned.

The impact of good design practice on unit cost is demostrated by Kluge et al. (1996) in their comparison of unit costs of average European companies and world class companies in the electronics sector. They state that differences of 40-60% are not uncommon. The components of this difference that can be eliminated by good design practice are indicated in Figure 5. 5.

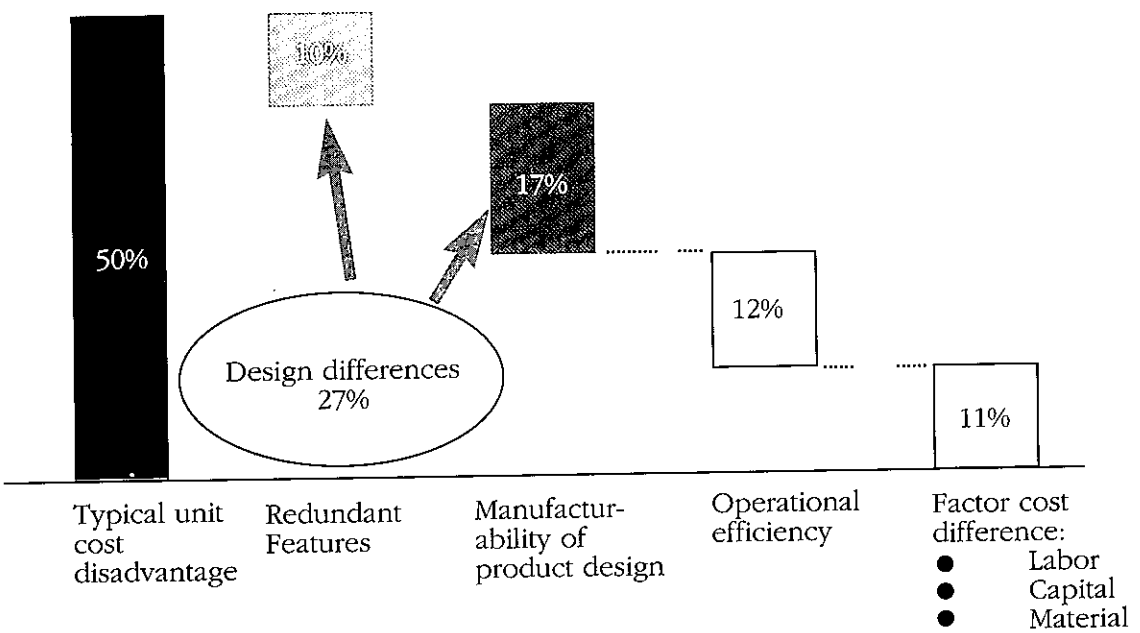

Figure 5.5. Impact of good design practice on unit cost (Kluge et al., 1996)

In order to strike a balance between product cost, reliability, durability and customer expectations, methods and techniques have been developed. A list of such methods and techniques employed by American and Japanese companies is compiled by Gevirtz (1994).

- Quality function deployment (QFD).
- Value analysis – Value engineering (VA –VE).
- Design for manufacturing (DFM).
- Simulation.
- Failure mode and effect analysis (FMEA).
- Design of experiments (DOE).

In the studies in the automotive p&c sector (Ulusoy *et al.,* 1999), electronics sector (Payzın *et al.,* 1998) and in the appliances p&c sector (Ulusoy *et al.,* 1999), the diffusion of these methods and techniques among the firms is investigated.

➢ *None of the above methods and techniques are being widely implemented within the sectors cited above. Although not at a satisfactory level, the most widely employed method is design for manufacturing. It is followed by value analysis, simulation, and failure mode and effect analysis. The implementation is more diffused among the large companies as would be expected.*

➢ *Recalling that decreasing unit cost is the top manufacturing objective of the companies in general, it would be a good policy to intensify the training programs on these methods and techniques for companies involved in or planning to get involved in some form of design.*

5.3.8. Barriers to Success in New Product Design

The barriers to success in new product design as perceived by the companies in the electronics sector in Turkey are summarized in Table 5.18.

TABLE 5.18. Barriers to success in new product development – Electronics sector

Internal Obstacles	External Obstacles
Skilled employees	Skilled employees
NPD* strategy	Uncertain demand
Knowledge management	Financial problems
NPD goals	Innovation costs
NPD control-monitoring	Taxation, subsidies, etc.

**NPD = New product development*

We have to explain some of the terms appearing in Table 5.18. Knowledge management refers to a lack of documentation resulting in relatively high lead times for getting organized. NPD control-monitoring indicates to a deficiency in the proper management of the projects. What taxation, subsidies, etc. refers to is the lack of financial instruments and regulations to ease the burden on the company. Beyond favorable taxation regulations and subsidies such as R&D subsidies, risk capital and credit lending are the financial instruments the companies have in mind.

- *The basic difficulty appears to be the lack of skilled technical personnel within the company as well as in the market. Remedies for that would be putting more emphasis on in-house training of technical personnel and increasing the interaction with the universities, namely the source of technical personnel.*
- *Beyond the lack of skilled technical personnel, internal obstacles center around generating NPD strategies, specifying NPD goals and improving project management and documentation in general.*
- *Beyond the lack of skilled technical personnel, external obstacles, on the other hand, center around uncertain demand and financial issues.*
- *In a study performed in Europe (ZEW, 1997), similar results are obtained. Market related risks, high innovation costs, pay-off period of innovation being too long and lack of appropriate sources of finance are cited as the major obstacles to innovation activities.*

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APPENDICES

APPENDICES

Appendix I. Assessing Competitive Strategies For Manufacturing

In this competitive strategies module of the questionnaire, respondents are required to select the most important five competitive priorities, five manufacturing objectives, and five action plans envisaged for the next two years out of a list of 15 competitive priorities, 15 manufacturing objectives, and 35 action plans, respectively. Using the responses given, the five most important competitive priorities, manufacturing objectives and action plans of the companies envisaged for the next two years are analyzed to highlight the strategic aspects of manufacturing management in the electronics, cement, automotive, and appliances p&c suppliers sectors of the Turkish industry.

The lists of competitive priorities, manufacturing objectives, and the action plans provided in the questionnaire is tabulated in the following tables.

Competitive Priorities	
Reliable products	A broad product line
Dependable deliveries	After sale services
Rapid design change / new product introduction	Rapid adoption to volume changes
Consistent quality level	Wide distribution
Durable products	Niche market
Rapid delivery	Customized products
Low price	Brand image
High performance products	

Manufacturing Objectives	
Decrease unit cost	Increase delivery rate
Increase conformance quality	Decrease set-up times
Increase direct labour productivity	Increase profitability
Decrease product break-even point	Increase inventory turnover rate
Reduce production lead time	Increase market share
Increase production rate	Increase return on investment
Reduce new product development lead time	Decrease breakdowns and unplanned stops
Increase delivery reliability	

Action Plans	
Integration of information systems to manufacturing	Automation production and inventory control systems
Developing new processes for new products	Integration of information systems of functions
Just-in-time production	Production automation
Improvement of facility layout	Material requirements planning
Activity-based costing	Conformance to environmental standards
Just-in-time procurement	Improvement of supplier relationships
Employee empowerment	Zero defect
Restructuring	Warehouse management
Developing new processes for existing products	Improvement of quality control laboratory facilities
Value engineering	Quality certificate for environmental issues
Quality function deployment	Quality certificate for processes
Green production technologies	Quality certificate for products
Set-up time reduction	Energy saving
Cross-functional teams	Training of managers
Computer-aided design	Training of employees
Preventive maintenance	Total quality management
Statistical process control	Aligning manufacturing strategy with business strategy
Quality improvement teams	

Appendix II. Measuring Against Best Practice

The methodology for measuring against best practice is based on the principle that measures the competitiveness of companies in terms of their operational practices and outcomes. The Business Excellence Model employed in the methodology embodies best manufacturing practices and high operational outcomes. The model is used to calculate a *strategy & practices index* and an operational outcomes index for each of the surveyed companies. These two indices are then used simultaneously to measure the proximity of an individual company to best practice. Companies are then classified into five categories with respect to their indices: *leader, lagger, promising, medium-performer, won't go the distance.* The business performances of the identified subgroups are analyzed to reflect the effect of best practice adoption to business performance.

II.1. Determining Best Practice Indices and Business Performance Measures

To map the proximity of surveyed companies to best practice, two indices are constructed: *strategy & practices index and operational outcomes index.*

To quantify the impact of best practice adoption on business performance, three measures of business performance are calculated: *average annual growth in total sales per employee in the last three years, average annual growth in value-added per employee in the last three years, and the level of pre-investment cash flow* at the time when the questionnaire is applied.

The responses given to the selected questions included in the questionnaire are used to construct the indices and to calculate the measures of business performance. These questions are designed in a manner so as to be universally applicable in all companies regardless of industrial sector or company size. In the following tables, questions used to construct the two indices are tabulated. In the tables, each question appearing in the question(s) columns of the corresponding tables is considered to be equally weighted. Moreover, each construct appearing in the construct columns of the tables is considered to have an equal amount of contribution to its respective index, such that the maximum total score that can be attained on an index becomes 100.

In the calculation of the *strategy & practices index,* for each respondent, missing values occurring in questions are retained. For each construct, total score attained by the respondent is calculated ignoring questions with no answers, and then rescaled so as to contribute a potentially maximum value of per cent contribution of its respective construct to the *strategy & practices index.* By doing so, the questions with no answers are thought to be filled with values that actually reflect the respondent's current position with respect to implementing best manufacturing practices included in the construct.

In the calculation of the *operational outcomes index,* for each respondent, missing values occurring in each question are retained. On the operational outcomes index, total scores of the respondents are calculated ignoring questions with no answers, and then rescaled so as to allow respondents to attain a maximum total score of 100 on the index. Again, by doing so, the questions with no answer are thought to be filled with values that actually reflect the respondent's current position with respect to achieving high operational outcomes.

In the calculation of the business performance measures, whenever a missing value occurs in the question inquiring the pre-capital investment cash flow level, the record is excluded from the calculation to prevent over or understating its respective measure. Missing values occurring in the questions used to calculate the average annual growth in sales per employee and value-added per employee are treated differently. The total sales, value-added numbers, and total number of employees required for the last three years are analyzed one by one to identify suspected errors and missing values. Some of the suspected errors are resolved and missing values are completed through contacts with the respondents. When either of the numerator or the denominator for the ratios: total sales per employee, and value-added per employee, the resulting value is set as a blank, and eliminated from further consideration. For the remainder, the ratios are calculated for the first, second and the third year. Average annual growth between each consecutive pairs of years are calculated. The overall average annual growth for the three years is calculated by averaging the growth figures for the two consecutive periods. In cases where one or two of the three ratios are missing for reasons described above, the overall average annual growth is based on the available ratios.

	Strategy & Practices Index Construction
Construct	Question(s)
Planning	A mission statement communicated to and supported by employees
	A comprehensive and structured planning process regularly sets and reviews short- and long-term goals
	Plans focus on the achievement of best practices
	Incorporation of customer requirements, supplier capabilities, and the needs of other stakeholders, including the community into the plans
	A written statement of strategy approved by top management covering all manufacturing operations
	Alignment of manufacturing operations with the central business mission
	Capability of manufacturing operations
Focused Strategies	Trying to make too many products
	Trying to address several different markets with different competitive priorities
	Having too many technologies to develop and to maintain
	Attempting too many simultaneous improvement initiatives
Factory Operations	Just in time production
	Just in time procurement
	Machine set-up time reduction
	Warehouse management
	Materials management
	Production planning and control
	Statistical process control
	Total quality management
	Preventive maintenance
	Housekeeping
	Working with suppliers
	Quality circles
	Employee empowerment
Leadership	Active encouragement of change by senior management and implementation of a culture of trust, involvement and commitment in moving towards best practices
	Unity of purpose throughout the site, and elimination of barriers between individuals and / or departments
	Effective use of team spirit and motivation to drive best practices
	Proactive pursuit of continuous improvement rather than reacting to crises

	Active utilization of ideas from production operators in assisting management
	Proactive management of environmental protection issues
People Management	An organization-wide training and development process, including career path planing, for all employees
	Effective "top-down" and "bottom-up" communication processes
	Formal and regular measurement of employee satisfaction
	Excellent occupational health and safety practices
	Active utilization of employee flexibility, multi-skilling and training to support improved performance
	Human resources plan clearly focusing on the core skills and competencies required to manufacture competitive products
Customer Focus	Knowing customers' current and future requirements both in terms of volume and product characteristics
	Effective dissemination of customer requirements throughout the workforce
	Utilizing the requirements of domestic customers in designing new products and services
	Utilizing the requirements of foreign customers in designing new products and services
	An effective process for resolving customers' complaints
	Utilizing customer complaints as a method to initiate improvements in current processes
	Systematic and regular measurement of customer satisfaction
Quality of Products and Processes	Suppliers have an effective system for measuring the quality of the materials they deliver to the site
	Working closely with suppliers to improve each others processes
	Well-established methods to measure the quality of products and services
	Site-wide standardized and documented operating procedures
	Employees believe that quality is their responsibility
	Dissemination of the concept of internal customer
Technology	Appropriateness of core manufacturing technology for our competitive needs
	Utilization of manufacturing technology to its maximum potential
Benchmarking	Performing benchmarking with various organizations
	Performing benchmarking on various areas
	Reviewing various information about competitors

	Operational Outcomes Index Construction
Construct	Question(s)
Self-comparison with the Best Results Achieved by Domestic and Foreign Competitors	Total cost per unit of product
	Finished product defect rate
	Order to delivery time
	Lost time due to accidents per year per employee
	Lost time due to industrial dispute
	Lost capacity due to breakdowns
Operational Performance in terms of Performance Indicators	Customer satisfaction
	Average process changeover time
	Employee morale
	Productivity
	Relative technological competitiveness
Operational Performance in terms of Performance Attributes	Delivery in full on time to our customers
	Proportion of production operators involved in process improvement /problem solving teams
	Ratio of quality control inspectors to direct production operators

II.2. Construction of Best Practice Scorecard and Categorization of the Sample

Plotting the accomplishment of companies in the pursuit of best practice on a two-dimensional graph provides the best practice scorecard. The horizontal axis shows the score on the *strategy & practice index* and the vertical axis shows the score on the *operational outcomes index*. Each point in the plot represents a single company.

In order to categorize the surveyed companies according to their proximity to best practice, first, a linear regression analysis is performed on the distribution of companies depicted in the best practice scorecard of the sample. In the linear regression analysis, *operational outcomes index* is considered as the dependent variable, and the *strategy & practices index* as the independent variable. The regression line fitted to the distribution is:

*Operational outcomes index = 37.955 + 0.418 * Strategy & practices index*

The coefficient of determination (r^2) for the distribution is approximately 27%,

which demonstrates that the practices described in the model are a significant determinant of the operational outcomes sought.

To divide the overall sample into subgroups with respect to their best practice adoption, two 90 degrees angles are drawn intersecting the upper most and the lowest tips of the regression line. The 90 degrees angle at the upper most tip is moved down along the regression line until approximately 10 per cent of the companies are covered. These companies are called the leader companies. To identify the *laggard* companies, the 90 degrees angle at the lowest tip is moved up along the regression line until approximately 10 per cent of the companies are covered. The vertical lines of the 90 degrees angles are extended to the horizontal borders of the plot to identify the *won't go the distance* and the *promising* companies. The companies left in the middle are called the *medium-performers.*

II.3. Validating the Differences in Best Practice Adoption of the Categories

As discussed earlier, a company's adoption of best practice is measured in terms of their total scores on the *strategy & practices index* and on the *operational outcomes index.* A higher total score on the strategy & practices index implies more successful implementation of best manufacturing practices, and a higher total score on the *operational outcomes index* implies more successful achievement of operational outcomes. Based on this method, it is assumed that the leader companies are performing better than the *medium-performers,* and that the *medium- performers,* in turn, are performing better than the *laggard* companies in adopting best practice. This assumption is trivial when the implementation of best manufacturing practices is considered. This is because, the ranges of possible total scores on the *strategy & practices index* a *leader,* a *laggard,* and a *medium-performer* could get, are non-overlapping and are wide enough. Therefore, to validate the assumption, a series of hypothesis tests are conducted only on the operational outcomes indices of these categories. These tests are meaningful from the statistical viewpoint, since although the ranges of possible total scores on the *operational outcomes index a leader* and a *laggard* could get are non-overlapping and wide enough, a *medium-performer* can get every possible value on this index. The won't go the distance and the *promising* companies are excluded from the hypothesis tests, since they are considered as outliers from the viewpoint of the *Business Excellence Model.*

Two hypothesis tests are set on the operational outcomes indices of the leader, medium-performer, and the laggard companies to see whether these categories differ statistically from each other in achieving operational outcomes:

Hypothesis Test # 1:	Hypothesis Test # 2:
Ho: $\mu_{Leaders} = \mu_{Medium\text{-}performers}$	Ho: $\mu_{Medium\text{-}performers} = \mu_{Laggards}$
H1: $\mu_{Leaders} > \mu_{Medium\text{-}performers}$	H1: $\mu_{Medium\text{-}performers} > \mu_{Laggards}$

A t-test with the assumption that the variances are equal is performed for each hypothesis test. The statistics of the two t-tests are tabulated in the following table.

	Category		
Statistics	Leader	Medium-performer	Laggard
Mean	79.5991	67.5734	60.8697
Variance	34.5209	47.3522	2.7616
Number of observations	10	53	9
	Hypothesis Tests		
	# 1	# 2	
Degrees of freedom	61	60	
t-value	5.1733	2.8896	
t-critical one-tail ($\propto$= 0.05)	1.6702	1.6706	

The outcomes of the statistical analyses reveal that Ho should be rejected, and that *leaders* are performing better than *medium-performers,* which in turn, are performing better than *laggards* in achieving high operational outcomes. In fact, in both tests, the t statistics value is greater the one-tail t-distribution value at 0.05 level of significance.

Together with the fact that these results also apply for the implementing best manufacturing practices by definition, the assumption saying that these categories differ from each other in terms of best practice adoption is statistically validated.

II. 4. Investigating the Effect of Industrial Sector on Best Practice Adoption

The sample used in the study is composed of 82 companies from four different industrial sectors. To investigate statistically the effect of industrial sector

on best practice adoption, two hypothesis tests are conducted using the analysis of variance technique for the four sectors: one on the *strategy & practices index* and one on the *operational outcomes index* in the form:

H_o: $\mu_{Electronics} = \mu_{Cement} = \mu_{Automotive} = \mu_{App.\ P\&C\ Suppliers}$

H_1: $\mu_i \neq \mu_j$ for at least one pair (i,j)

For both tests, a single factor analysis of variance is conducted to test the hypotheses. The statistics of the two t-tests are tabulated in the following table.

Statistics on the Hypothesis Test Set for the Strategy & Practices Index

Groups	Count	Sum	Average	Variance
Electronics	27	1932.69	71.11	84.36
Cement	25	1877.79	75.11	104.66
Automotive	10	776.06	77.61	82.82
Appliances P&C Suppliers	20	1393.71	69.68	61.30

ANOVA

Source of Variation	SS	df	MS	F	P-value	Fcrit
Between Groups	597.30	3	199.10	2.3476	0.0791	2.7218
Within Groups	6615.03	78	84.81			
Total	7212.32	81				

Statistics on the Hypothesis Test Set for the Operational Outcomes Index

Groups	Count	Sum	Average	Variance
Electronics	27	1827.37	67.68	63.72
Cement	25	1711.37	68.45	68.89
Automotive	10	708.40	70.84	56.95
Appliances P&C Suppliers	20	1362.26	68.11	39.68

ANOVA

Source of Variation	SS	df	MS	F	P-value	Fcrit
Between Groups	75.22	3	25.08	0.4274	0.7340	2.7218
Within Groups	4576.61	78	58.67			
Total	4651.83	81				

The outcomes of the statistical analyses reveal that Ho cannot be rejected, inasmuch as F-values computed are less than the Fcritical-value at 0.05 level of significance. Hence, it is concluded that industrial sector does not have a significant effect the implementation of best manufacturing practices and achievement of high operational outcomes. In fact, the variation across industrial sectors is greater than the variations in practices and outcomes within each sector.

II.5. Investigating the Effect of Company Size on Best Practice Adoption

The sample used in the study is composed of 82 companies of varying company sizes. To investigate statistically the effect of company size on best practice adoption, two hypothesis tests are conducted using the analysis of variance technique for the three company size categories: one for the strategy & practices index and one on the operational outcomes index in the form:

H_o: $\mu_{Small} = \mu_{Medium} = \mu_{Large}$

H_1: $\mu_i \neq \mu_j$ for at least one pair (i,j)

For both tests, a single factor analysis of variance is conducted to test the hypotheses. The statistics of the two t-tests are tabulated in the following table.

Statistics on the Hypothesis Test Set for the Strategy & Practices Index

Groups	Count	Sum	Average	Variance
Large	19	1517.45	79.87	29.38
Medium	41	2923.08	71.30	90.11
Small	22	1539.71	69.99	88.82

ANOVA

Source of Variation	SS	df	MS	F	P-value	Fcrit
Between Groups	1214.26	2	607.13	7.9964	0.0007	3.1123
Within Groups	5998.07	79	75.93			
Total	7212.32	81				

Statistics on the Hypothesis Test Set for the Operational Outcomes Index						
Groups	Count		Sum	Average		Variance
Large	19		1375.96	72.42		59.99
Medium	41		2757.60	67.26		57.63
Small	22		1475.65	67.08		41.33
ANOVA						
Source of Variation	SS	df	MS	F	P-value	Fcrit
Between Groups	398.93	2	199.46	3.7051	0.0290	3.1123
Within Groups	4252.90	79	53.83			
Total	4651.83	81				

The outcomes of the statistical analyses reveal that Ho should be rejected, inasmuch as F-values computed are greater than the Fcritical-value at 0.05 level of significance. Hence, it is concluded that there is a significant relationship between company size and both the implementation of best manufacturing practices and achievement of high operational outcomes. In fact, the variation in practices and outcomes within each industrial sector is greater than the variation across sectors.

In order to find out the sources of differences on both indices, three hypothesis tests are conducted: two on the *strategy & practices index* and one on the *operational outcomes index* of the company size categories, in the respective forms:

Hypothesis Test # 1:	Hypothesis Test # 2:	Hypothesis Test # 3:
Ho: $\mu_{Large} = \mu_{Medium}$	Ho: $\mu_{Medium} = \mu_{Small}$	Ho: $\mu_{Large} = \mu_{Medium}$
H1: $\mu_{Large} > \mu_{Medium}$	H1: $\mu_{Medium} > \mu_{Small}$	H1: $\mu_{Large} > \mu_{Medium}$

A t-test with the assumption that the variances are equal is performed for each hypothesis test. The statistics of the two t-tests are tabulated in the following table.

Statistics	Category		
	Large	Medium	Small
Mean	79.8659	71.2946	69.9867
Variance	29.3748	90.1049	88.8153
Number of observations	19	41	22
	Hypothesis Tests		
	# 1	# 2	# 3
Degrees of freedom	58	61	58
t-value	3.6586	0.5227	2.4339
t-critical one-tail (α= 0.05)	1.6716	1.9996	1.6716

The outcomes of the first and the third hypothesis test reveal that Ho should be rejected (t statistics values are greater than the one-tail t-distribution value at 0.05 level of significance). However, the outcome of the second hypothesis test reveals that Ho cannot be rejected (t statistics value is less than the one-tail t-distribution value at 0.05 level of significance).

The results of the hypothesis test reveal that large-size companies are performing better than the medium- and the small-size companies both in implementing best manufacturing practices and achieving high operational outcomes. Yet, there is no significant difference between the medium- and the small-size companies from those aspects.


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