AN ASSESSMENT OF SUPPLY CHAIN AND INNOVATION MANAGEMENT PRACTICES IN THE MANUFACTURING INDUSTRIES IN TURKEY

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ABSTRACT

This paper aims at assessing the supply chain and innovation management in the manufacturing industries in Turkey on an empirical basis. The assessments presented are based on parts of the data and information collected through the execution of the Competitive Strategies and Best Practices Benchmarking Questionnaire in 82 companies from four sectors of the manufacturing industries in Turkey. Results of these sectoral benchmarking studies reported elsewhere indicate the need of adopting product differentiation particularly through more knowledge intensive products as the dominant competitive strategy and also the need for improvement in various areas of supply chain as well as innovation management. In this paper, these issues are analysed through the survey results and some conclusions are drawn. Several policy measures applicable in near future are suggested for improving the areas found in need of improvement.

INTRODUCTION

This paper aims at assessing the supply chain and innovation management in the manufacturing industries in Turkey on an empirical basis. The assessments presented here are based on parts of the data and information collected through the execution of the Competitive Strategies and Best Practices Benchmarking Questionnaire in 82 companies from four sectors of the manufacturing industries in Turkey. This present paper complements the two previous papers reporting on different aspects of the same study (Ulusoy and Ikiz, 2001; Ulusoy, 2000b).

The sectoral benchmarking studies reported have been realized with the cooperation of the Turkish Industrialists' and Businessmen's Association (TUSIAD), the Turkish Electronics Industrialists Association (TESİD), the Turkish Cement Producers' Association (TÇMB), the Automotive Manufacturers' Association (OSD), and the Appliances Part and Component Suppliers' Association (BEYSAD). The sectoral studies included 27 companies from the electronics sector, 25 companies from the cement sector, 10 companies from the automotive sector, and 20 companies from the appliances part and component (p&c) sector. In addition, two further sectoral studies are made use of extensively for shaping the contents of this paper. The first one of these realized in cooperation with the Turkish Electronics Industrialists' and Businessmen's Association (TESID) deals with the new product development (NPD) capability of the electronics sector in Turkey and covers 27 companies (Payzın *et al.*, 1998). The second one

realized in cooperation with the Turkish Automotive Parts and Components Manufacturers' Association (TAYSAD) is on technology management and NPD process in the automotive part and component suppliers in Turkey covering 21 companies (Ulusoy *et al.*, 1999b). In all of the above studies, companies were selected so as to comprise a sample representative of their respective sector.

Competitive Strategies and Best Practices Benchmarking Questionnaire and Its Implementation

The Competitive Strategies and Best Practices Benchmarking Questionnaire was developed following the preparation, testing, and finalization steps. The questionnaire consists of four modules. The competitive strategy module is designed along the lines of a process model of manufacturing strategy proposed by Kim and Arnold (1996). The model aims to explore possible near future developments in the competitive strategies of the companies by addressing their competitive priorities, manufacturing objectives and action plans. Manufacturing strategy module, practices module, and the performance and outcomes module all serve for the assessment of where the company stands in terms of its practices and outcomes in the context of business excellence and best practices. These modules of the questionnaire are based on the Excellence Model developed by the European Foundation for Quality Management (EFQM), which serves as the evaluation model for the European Quality Award (EFQM, 1999).

Both quantitative and qualitative information are collected through the questionnaire. Some of the performance and outcome measures such as "annual sales" or "annual exports" are asked to be reported as point values. Others, on the other hand, such as "research & development expenditures as a percentage of total sales" or "delivery in full on time to the customer" are asked to be reported by indicating into which of the five stated numerical ranges it falls. Whenever needed, formulae are provided for quantitative responses. Majority of the qualitative information is collected by asking the respondent to respond to statements. The responses are organized on a Likert scale with five options such as "1=strongly disagree, 5=strongly agree" or "1=much higher, 5=much lower". Few require "yes" or "no" for an answer.

After the design and testing of the draft questionnaire, the final version of the questionnaire is developed based on the feedback received during the testing phase. Two approaches have been employed for implementing the questionnaire. For the electronics, automotive, and cement sectors, the questionnaires have been distributed to a set of companies preselected jointly with the 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 return of the filled-in questionnaire forms. For this kind of implementation, response rates of 60% for the electronics, 56% for the automotive and 64% for the cement sectors have been achieved corresponding to 27, 10, and 25 companies, respectively. In the case of appliances p&c supplier sector, member companies preselected jointly with the respective Association have been approached for their approval to join the study. To those 20 companies which agreed, the questionnaire has been explained either by a site visit or in small group meetings of company representatives. This approach turned out to be more effective than the former one. Structured follow-up interviews and site visits have been made in several companies in each sector after the return of the filled-in questionnaire forms.

For each sector, an Industrial Advisory Board consisting of 6-9 members has been assigned by the respective Association. The Industrial Advisory Board has contributed mainly through lengthy discussions of the draft report in a joint meeting with the project team. The final reports were written in the light of the remarks and recommendations made during these discussions.

Companies in the Sample

The companies in the sample will be presented here with respect to their size distribution and their annual sales ranges within each industrial sector and in the overall sample. More detailed information concerning these companies is provided in Ulusoy and Ikiz (2001).

TABLE 1. Company size of the sample by industrial sector

	Percentage of companies that are		
Industrial sector	Small-Sized	Medium-Sized	Large-Sized
Electronics	52 %	26 %	22 %
Cement	8 %	84 %	8 %
Automotive	0 %	30 %	70 %
Appliances p&c suppliers	30 %	55 %	15 %
Overall sample	23 %	48 %	29 %

Size distributions of the companies in the sample is given in Table 1. Here, companies with the total number of employees less than 100, between 100 and 499, and more than or equal to 500 are considered to be small-sized, medium-sized, and large-sized companies, respectively.

The classification of the companies in the sample with respect to their annual sales is provided in Table 2.

TABLE 2. Annual sales of the sample by industrial sector

	Percentage of companies with annual sales (million US$)			
Industrial sector	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 %

In the following, the results will be reported for the electronics sector in terms of its sub-sectors since these sub-sectors are observed to display rather different characteristics in the areas studied here at a level that cannot be ignored. These sub-sectors are: (i) Component, (ii) professional and industrial (P&I) equipment, (iii) telecommunication, and (iv) consumer electronics. In Table 1, the cement sector is classified based on the number of employees. But it is a process industry open to full automation and hence, the number of employees is not a representative characteristic for size in this sector. Instead, the level of production is employed here as the classification parameter leading to two groups with their own distinct characteristics, which should not be overlooked: (i) Large cement companies and (ii*)* small cement companies. Cement companies with more than 1,000,000 tons of annual sales are classified as large companies and the others as small companies. In both the electronics and the cement sectors, it is shown that the companies in the sample are representative of the whole sector based on their sales, exports, and size distribution. In the automotive sector, the sample covers 10 out of a total of 15 automotive manufacturing companies in operation at the time of the study. These companies are relatively large companies manufacturing mainly commercial vehicles. As the name implies, appliances p&c suppliers are mostly small and medium size enterprises (SMEs). Due to the large number of companies, the sample has been preselected and their contribution to the study has been secured beforehand so as to obtain a representative sample. Further details concerning the sample companies can be found in Ulusoy (2000a) and Ulusoy and Ikiz (2001).

Some Key Findings from the Study on Competitive Strategies

There are certain results in the competitive strategies' analysis of the four sector studies (Ulusoy, 2000b), which will be reiterated here to give a better appreciation for the scope of this paper. It is concluded that at this stage of its development, in general, the manufacturing industry in Turkey bases its competition strategy mainly on low price rather than product differentiation in the sense of Porter (1980), but companies express an inclination to increase the weight of the product differentiation strategy within their mixed strategy in near future particularly through more knowledge intensive products. The ranking of the manufacturing objectives implies that the agenda of the manufacturing industries in Turkey is to be capable to manufacture quality products at low cost and to increase their market share. The companies also want to increase their profitability through introducing relatively higher value-added products into the market. This is also in line with the increasing emphasis on product differentiation and on improving their NPD capability. The companies have specified quality as the outcome having the biggest impact on their success. Quality is stated to be the most important supplier selection criterion for the manufacturers. The manufacturing companies in Turkey are aware of the fact that quality is a fundamental requirement for sustaining their existence in the market as well as a qualifier to enter the market place. Total quality management (TQM) is by far the most preferred action plan with several other quality tools included in the list of action plans to be adopted. In contrast to the conclusion reached by De Meyer (1998) that European quality movement has reached a point of decreasing marginal returns for the European companies in the 1990s, the quality movement in Turkey is still on the rise providing substantial benefits to its practitioners. Based on the data from the last three modules of the questionnaire, we tested how the companies match up with the best practice, both in the practices they adopt and in the operational outcomes that result. It is shown that the closer a company is to best practice, the more likely it is for that company to achieve higher business performance (Ulusoy and Ikiz, 2001). A further observation is that the sample companies consider both supplier relations and innovativeness to have the least impact on their recent success (Ulusoy, 2000b). These two areas are open to major improvement. Thus, proper management of supply chain and innovation promises a great deal to improve the competitiveness of the manufacturing companies in Turkey.

The above arguments can be put into context through Porter's (1996) efficient frontier concept for competitiveness. According to Porter, the efficient frontier for competitiveness consists of two components: Strategic positioning and operational effectiveness. Strategic

posititoning in the context of Turkish manufacturing industries is associated with product differentiation strategy with particular emphasis on knowledge intensive products. Operational effectiveness, on the other hand, is associated with business excellence. Major components of business excellence are supply chain and innovativeness – both in operations and in technology and product development. Having dealt with the strategic positioning issue elsewhere (Ulusoy, 2000b), this paper is devoted to the analysis of the operational effectiveness aspect of competitiveness in the context of the Turkish manufacturing industries. Thus, the scope of this paper is limited to the analysis of supply chain and innovation management issues in the manufacturing industries in Turkey. The analysis of supply chain will be structured around the assessment of operational performance in terms of logistics, supplier relations, customer relations, and production. The analysis of innovation management will mainly deal with human resources management, technological competitiveness, and various aspects of NPD.

LOGISTICS

As mentioned earlier, "decreasing unit cost" is the number one manufacturing objective adopted by the companies (Ulusoy, 2000b). The breakdown of manufacturing costs within different sectors of manufacturing industry is given in Table 3. The relatively high share of material cost attests to the importance of the purchasing and logistics functions for the companies trying to reduce their unit cost of manufacturing.

TABLE 3. The breakdown of manufacturing costs

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

During this study, logistics is found to be an area for further improvement especially against foreign competitors. The companies, in general, are not comfortable with the effectiveness of their global sourcing activities, materials management, and warehousing. These are thought to be the three disadvantageous factors in the area of logistics.

Effective Global Sourcing

This factor takes on paramount importance in gaining competitive advantage through timely and low cost deliveries. Suppliers both in electronics and appliances p&c sectors consider the effectiveness of their global sourcing activities as a disadvantage, which might stem from having a high ratio of suppliers based abroad (Table 4). 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 imported incoming materials is higher than one third of the total value. For instance, on the average, the value of imported incoming materials account for 34% of the total value of incoming materials for the appliances p&c suppliers.

TABLE 4. Distribution of suppliers with respect to their geographic locations

	Geographic Location		
Industrial Sector	Within 200km	Elsewhere in Turkey	Abroad
Electronics	30 %	25 %	45 %
Cement	59 %	31 %	10 %
Automotive	50 %	32 %	18 %
Appliances p&c suppliers	54 %	22 %	24 %

Materials Management

Although all the companies have some form of materials management software running, this does not solve the problem. The deficiency in materials management arises mainly from the abrupt fluctuations in aggregate production plans of the companies. Geographic location of suppliers also appears to have an 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 5).

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 (JIT) delivery. Table 5 also indicates the relatively high incoming goods inventory levels, which reflects itself into the cost of manufactured goods.

TABLE 5. 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.

The figures reflected in Table 4 and Table 5 might explain the disadvantageous situation faced by electronics companies and appliances p&c suppliers when comparing their performance in access to incoming materials and materials management especially against their foreign competitors. In as much they substantially differ from other companies surveyed in their relationship with suppliers, the automotive companies consider these aspects neither as an advantage nor as a disadvantage.

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.

SUPPLIER RELATIONS

Suppliers can be classified 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.

Supplier Selection Criteria

The rankings of the supplier selection criteria employed by the manufacturing companies in different sectors are displayed in Table 6. Quality appears to be 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.

TABLE 6. The ranking of the 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.	Technical competence and experience	ISO 9000	Technical competence and experience	Technical competence and experience
ISO 9000	ISO 9000	Production capacity	Production capacity	Production capacity

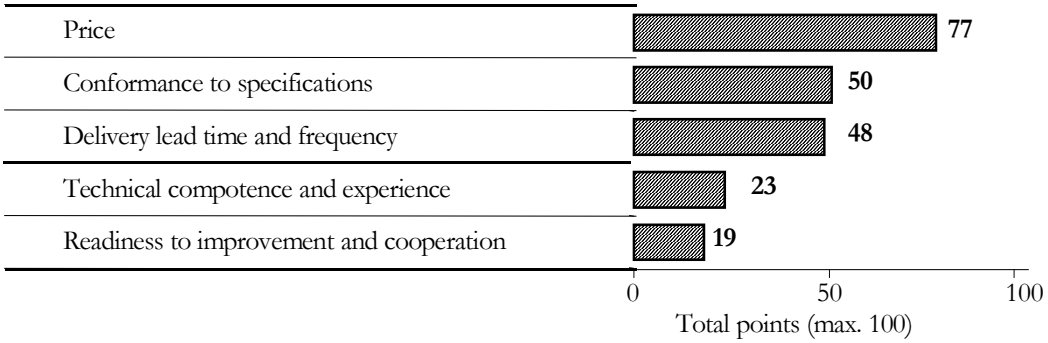

Figure 1. The ordering of vendor selection criteria as perceived by the appliances p&c suppliers

The above ranking is based on the statements of the manufacturers. But how do the suppliers perceive this ranking? The answer is provided in Figure 1. The supplier companies seem to believe that the manufacturers have "price" on top of their list. This difference in opinion indicates to a lack of communication and mutual understanding.

Reduction of the Number of Suppliers

Traditionally manufacturers have tried 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 has progressed, a trend observed worldwide has been the reduction of the number of suppliers. Rommel et al. (1995) provide an example of this trend. 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 number of suppliers. For suppliers to become a system supplier, they need to generate the resources required and to develop their own product design capability as well as organizational/managerial capabilities. Not every supplier, of course, is capable of becoming a system supplier. For such companies, a survival strategy is to join forces with other companies to form a network of companies acting as a system supplier each contributing with its own capabilities. This points to the importance of defining and developing their core competencies for the manufacturing companies.

An Evolution towards Strategic Partnerships

The evolution of strategies adopted for manufacturer-supplier relationships over time is given in Table 7. The most popular strategy 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 the dominant strategy shifts from bid evaluation towards joint value generation strategy. Joint value generation aims at providing benefits to both the manufacturer and the supplier in short and medium terms. It is based on the premise that collaborating with the suppliers to improve their operations can reduce purchasing costs. Purchasing cost includes not only the purchasing price but all the other costs incurred due to uncertain deliveries and further due to handling defective parts and components being supplied and even worse, used in the manufacturing process. As a result of joint value generation, the purchasing cost is reduced for the manufacturer and the manufacturing cost is reduced for the supplier putting it into a more advantageous position than before even if its selling price is reduced.

Manufacturers in Turkey aware of such advantages have started certification and training programs for their suppliers (Ulusoy *et al.*, 1999a). A very large percentage of suppliers agree 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.

TABLE 7. Evolution of strategies adopted for manufacturer-supplier relationships over time

Strategy Adopted	Time Frame		
	Last Two Years (%)	Current (%)	Next Two Years (%)
Bid evaluation	**60**	15	15
Technological competence	**25**	**30**	5
Joint value generation	5	**40**	**15**
Strategic partnership	10	15	**65**

TABLE 8. Information sharing between manufacturers and suppliers

	Suppliers having access to the information base of all/some of the manufacturers (%)
Manufacturer's demand forecasts	35
Manufacturer's production plans/schedules	25
Manufacturer's sales data	5
Manufacturer's inventory data	10
	Suppliers allowing access to their own information base to all/some of the manufacturers (%)
Supplier's inventory data	20
Supplier's production plans/schedules	20
Supplier's manufacturing cost structure	15

Companies expect strategic partnership to become the dominating modality in manufacturer-supplier relations in the near future. A form of strategic partnership to be emphasized here is one where the partnership is based on complementary knowledge and capabilities leading to supply of systems. It 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 lead to increases in the added value and in the sales for such products.

Strategic partnerships involve long term relations based on mutual trust. Information sharing is an important instrument in building trust among the manufacturer and the supplier.

Information sharing is essential for the proper coordination of the supply chain, particularly in reducing the uncertainties involved around order levels and schedules. Reduction in uncertainties leads to improvements in the inventory positions of both parties and thus to cost savings for both parties. The results reported in Table 8 concerning information sharing are obtained when looking into appliances p&c suppliers in Turkey. The figures indicate to a relatively low level of information sharing among suppliers and manufacturers. When this result is evaluated in conjunction with the incongruity of the supplier selection criteria as seen from the angle of both parties, it appears that both parties have to collaborate more intensively for building mutual trust, if the expectation for the diffusion of strategic partnership is to be fulfilled.

CUSTOMER RELATIONS

The results on customer relations are reported here under the headings of customer satisfaction, customer service, and delivery performance, which are followed by a section on the impact of JIT delivery on the appliances p&c suppliers.

Customer Satisfaction

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. It is only recently that companies in general have started to assess customer satisfaction in a formal way. A classical proxy indicator has been the customer complaints which the companies are very keen to document and to follow up. 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.

Customer Service

Customer service is considered by the sample companies to be one of the two major competitive advantages against their foreign competitors in the Turkish market. Important components of customer service are the existence of a dense distribution network and a responsive, high quality after sale service. Companies, which manufacture end products, need to reach larger segments of the market and thus a dense distribution network is an effective means to fulfil this need. Those companies, which decide on extending their activities to cover the

entire product life cycle, organize their own after sale service. This not only increases their revenue stream but also makes their product more attractive for the customers by increasing product availability. Furthermore, the feedback from the field helps to improve the product design to meet the customer expectations better.

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

	Percentage of companies that have				
Industrial Sector	<50%	50 – 80%	81 – 90%	91 – 96%	>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

Delivery performance is of particular importance for the suppliers. For decreasing their manufacturing costs, manufacturers impose JIT delivery on their suppliers. As can be inferred from both Tables 3 and 5, this is a realistic policy. But how are the burdens and benefits resulting from this policy shared between the suppliers and the manufacturers ? This is a relevant question whose answer can provide some clues for the healthy development of the relations between the both parties. The case of appliances p&c suppliers is presented here as a typical one to provide an answer to the above question.

The Impact of JIT Delivery on Suppliers: The Case of Appliances P&C Suppliers

The study conducted in the appliances p&c suppliers has resulted in the following observations summarized in Table 10 (Ulusoy *et al.*, 1999a). Recalling that a value of 3 on the Likert scale here corresponds to "no change", the last column of Table 10 attests to an increase

in all items listed. Manufacturing companies appear to shift the burden of keeping inventories onto their suppliers during the process of JIT delivery. The finished goods inventories of the supplier companies seem to have swollen after the introduction of JIT delivery by the manufacturers. Although a numerical result cannot be reported here, the structured interviews conducted following the questionnaire phase have indicated to an increase in the incoming material inventories as well. If one of the major reasons for this result is the inability of the suppliers to adopt themselves to the new environment through operational improvements, the other is obviously the lack of any stability in the order mix and schedules of the manufacturers and the very frequent changes with very short lead times.

TABLE 10. The impact of JIT delivery on the 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.*

One major reason for the increase in product quality appears to be the training and certification activities of the manufacturers for their suppliers. This also explains partly the relatively low increase in costs in spite of the increases in inventory levels. The practice of JIT delivery becoming more common puts continuous pressure on the delivery performance of the supplier companies. The relatively high improvement in delivery performance is partly accomplished by the increases in both incoming materials and finished goods inventories. The need for mutual trust and information sharing between manufacturers and suppliers becomes more apparent after this analysis into the impact of JIT delivery on the suppliers.

PRODUCTION

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 JIT production, JIT delivery, machine set-up time reduction, warehouse management, materials management, production planning and control, statistical process control, TQM, 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.

Productivity

As stated by Eilon (1984), added value per employee, added value to total wage cost, and added value to total investment are the most commonly used productivity ratios. In this study, added value per employee is employed. Added value is defined as the difference between the values of outputs and inputs. Outputs consist of finished and semifinished products manufactured and services rendered to outside. The inputs consist of materials, energy, and services bought from outside, which are employed in generating the outputs.

TABLE 11. Added value per employee in various sectors and sub-sectors (US$)

Sector / Sub-sector	1994	1995	1996	Ave. Increase in the Period
Component	12,133	12,864	13,443	5
P&I equipment	10,094	10,360	10,847	4
Telecommunication	54,055	29,690	32,872	-20

Consumer electronics	34,306	39,056	47,575	19
Electronics - overall	25,176	20,507	23,160	-4
Cement – small	37,262	34,166	41,262	5.4
Cement – large	44,334	43,058	54,682	11.7
Cement- overall	39,384	36,833	45,288	7.5
Automotive	29,410	49,962	63,348	58

The added value per employee in various sectors and sub-sectors is given in Table 11. It is interesting to note the difference between the sectors. The component and P&I equipment sub-sectors indeed produce rather low added value per employee. The decrease in the added value per employee in the telecommunication sector is due to the extraordinary cut-off of orders from the Turkish Telecom, which is by far the largest customer in the sector. The difference between the small and large cement companies is mainly due to the relatively advanced level of automation in the large companies. The increase in the automotive sector is mainly due to the rising internal demand in those years resulting in better exploitation of the existing manufacturing capacity. In the overall sample, close to 60% of the companies stated that their level of productivity needs improvement to some extent.

Flexibility

Flexibility to adopt product mix and/or volume changes rapidly is considered by the sample companies as one of the two major competitive advantages against their foreign competitors in the Turkish market. This kind of flexibility is essential particularly for the suppliers in order to cope with the rather unstable order schedules of the purchasing companies and also for the end product manufacturers serving largely the unstable domestic market. Schedule stability as a benchmark is provided in the study by Anderson Consulting (1993). In that study, a measure of variability of customer orders is used measuring the difference between what the customer ordered one month before delivery and what was actually required. In non-world class companies this measure is found to be 12%, more than twice that experienced by the world class companies. Schedule stability is not measured in this study, but it is observed that customer companies change their order schedules rather freely.

Average process changeover time is one of the indicators of flexibility. It is the time required to change a specific machine, work center, or production line from finishing the very last piece of a product to starting with the very first piece of a 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. This particular indicator and other observations such as the relatively small size of these establishments and the close cooperation of particularly the shop floor personnel with the management lead to the conclusion that flexibility stated as a competitive advantage is to a large extent not the result of a system built in and nortured for this purpose. It is, of course, very important to achieve such flexibilities as a result of such a system especially once the company size grows and investments into expensive advanced manufacturing systems are made.

INNOVATION

Innovation is a fundamental pillar upon which competition is built and an essential component of policies seeking best practices. The outputs of innovation directly affect productivity. On the global scene, rate of innovation is considered a major driver of competitiveness (Porter and Stern, 1999). Innovation can be 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 organisation, and the working conditions and skills of the workforce (European Commission, 1996). Continuous improvement, learning, problem solving, product development are all among the capabilities needed to be developed to execute successfully the policies suggested by the companies. These capabilities can only be nurtured in an environment open to innovation.

Intangible aspects of product lines – quality, reliability, design, delivery times – assume greater importance, as even manufactured products themselves contain an even higher knowledge and service component (Competitiveness Advisory Group, 1999). 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. In the manufacturing industries in Turkey, on the other hand, the first and the third items are among the more popular manufacturing objectives (Ulusoy, 2000b). It is true that innovation needs an environment conducive to innovation, but still the main drivers of innovation are the employees themselves. Thus, the main resource driving the companies' innovation strategies is their human capital.

Human Resources Management

An uncountable number of sources discuss the importance of human resources for

competitiveness and conclude that human resources are at the center of global competition. The Competitiveness Advisory Group (1999) state, 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. Keywords like problem solving organisation and learning organisation are cited frequently, and all have human factor at the center. The sustainability of different competitive advantage factors reported in Table 12 also indicates the central role played by human resources (IPTS and ECJRC, 1999).

TABLE 12. Sustainability of different competitive advantage factors

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

The study reveals the lack of an organisation-wide training and development process, including career path planning; and employee relations. In this section, we will concentrate on issues of training and development of employees, and employee satisfaction.

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 NPD 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 organizations 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 13 and 14 respectively.

TABLE 13. Average annual number of training hours over different employee groups

	Employee Groups				
Industrial Sector	Top Management	Managers/ Supervisor	Technical Personnel	Admin. 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

We consider the results reported in Table 14 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.

TABLE 14. The annual cost of training as a percentage of the employee payroll

	Percentage of the Employee Payroll (%)				
Industrial Sector	<1.5	1.5 – 2.49	2.50-3.49	3.50-5.0	>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

It would be informative to introduce a few benchmarks from USA and EU at this point. 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. The EU

average for training in technology companies is 6.7 days (*http://www.pwcglobal.com*). Fast growing companies in EU allocate 67% more time for training of their employees (EIM, 1999).

Employee Relations

An area of major weakness in employee relations is the lack of a formal and regular process for the measurement of employee satisfaction. Employee morale is an indicator of employee satisfaction. Less than half of the companies in the overall sample reported high levels of employee morale. 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 15.

TABLE 15. The duration of employment in various sectors (years)

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

An important result in this context has been reported earlier (Ulusoy and Ikiz, 2001). Two areas open for improvement are employee involvement in quality activities and delegation of QC work to operators, which can be considered a form of employee empowerment.

Technology Strategy

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. Among the automotive p&c suppliers surveyed, the proportion of companies reporting that they have a systematic process for technology planning and strategy development is only 33%. This fact indicates to a major weakness in that respect.

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 knowledge 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 knowledge.

Technology Acquisition and Exploitation

Technology acquisition can be made from external and internal sources. The internal sourcing is mainly from the R&D function in the company, which is covered in some detail under the heading "R&D Intensity". While trade fairs and conferences stand out as the major technology sources university laboratories and R&D institutions are not utilized by the industry. Lack of skills, over occupation of R&D function with incremental improvements, and the need to reduce the uncertainties involved in the performance of new technology acquired are the major factors leading to the acquisition of externally developed technologies. The most favoured strategy for technology acquisition appears to be through employing skilled technical personnel followed by equipment purchasing. The intensity of activities for technology acquisition is found to be relatively low.

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 intensity level of technology transfer activities 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.

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

R&D Intensity

In this section, R&D intensity, namely the ratio of R&D expenses to total sales, will be reported for three sectors of the manufacturing industry in Turkey. Obviously, higher R&D intensity levels are desired and recommended. But it is not necessarily true that higher levels of resource input, here through higher R&D intensity, lead to higher output, here in terms of new products, patents and know-how with a market value. The R&D intensity in the sectors investigated is reported in Table 16.

TABLE 16. R&D expenses as a per cent of total sales

Range (%)	Percentage of Companies		
	Cement	Automotive	Electronics
Less than 0.50%	58	41	9
0.50 – 0.99%	16	29	13
1.00 – 1.99 %	21	12	13
2.00 – 5.00%	0	12	17
Larger than 5.00%	5	6	48

There is a distinct difference between the electronics sector and the other two sectors in terms of their R&D intensities. In the cement sector, the companies limit themselves to only a few products and a well-known process technology. The companies simply aim at producing those products in a competitive way, i.e., with high quality and at low cost. In the automotive sector, the R&D intensity is also found to be rather low mainly due to the fact that the companies manufacture under the license of foreign motor vehicle manufacturers and have not seen the need for developing an indigenous R&D capacity until recently. The electronics sector is the closest to adopt the product differentiation as a competitive strategy among the sectors studied. This reflects itself in the R&D intensity figures of this sector. It is found in the electronics sector that SME and large companies have relatively close R&D intensities of 3.6% and 4.0% respectively (Payzın *et al.*, 1998). Among its sub-sectors, telecommunication sub-sector displays a relatively higher R&D intensity, mainly due to the fact that this sub-sector operates mostly in made-to-engineering mode.

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.

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) as: 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).

The diffusion of these methods and techniques among the firms is investigated in the studies in the automotive p&c sector (Ulusoy *et al.*, 1999b), in the electronics sector (Payzın *et al.*, 1998) and in the appliances p&c sector (Ulusoy *et al.*, 1999a). 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. Value analysis, simulation, and FMEA follow it. The implementation is more diffused among the large companies as would be expected.

Competitive Priorities and Marketing Strategy for New Product Development

The observations to be cited in this section are based on the study in the electronics sector by Payzın *et al.* (1998). NPD time constitutes an important component of time-to-market and is thus very important for the electronics sector where companies are competing in a market with relatively short product life cycles. NPD time has been found to be the top competitive priority for NPD. NPD time is followed by product cost and performance. These results are consistent with the competitive priorities and manufacturing objectives in the electronics sector at company level, where rapid design capability and decreasing NPD time appeared high in the short list.

New Product Ideas

For the large companies in the electronics sector, customers are on the top of the list

followed by R&D Department, 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 top management conceives product innovation 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. Customers and suppliers follow as the next most utilised sources.

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 an indicator reflecting how fast a company is changing its product portfolio. It is one of the basic measures according to which companies might formulate their new product strategies including policies related to the infrastructure for NPD process.

New product implies here products in which the company has design contribution and the company is producing the product for not more than the last two years.

TABLE 17. Share of new product sales in total sales

Sector	Per cent
Components	5
P&I equipment	30
Telecommunication	15
Consumer electronics	41
Appliances p&c suppliers	15*
Automotive p&c suppliers**	9

*Average value for only those companies having a new product

development activity – 7 companies out of a total of 20.
**Ulusoy, 1999b.

The corresponding values in Turkey in 1997 are given in Table 17. In the electronics sector, there seems to be no significant difference between the shares of new product sales in the sales of SMEs and large companies. But there are distinct differences among the sub-sectors. Consumer electronics has the highest share, which is an expected result considering the relatively short life cycle of products in this sub-sector.

For both the automotive and appliances p&c sectors, the figures are rather low as would be expected since the suppliers mostly produce based on the design provided by the manufacturers. Since most of the products are manufactured under license from some foreign company, it is rare to observe a co-design relationship between the supplier and the manufacturer. Once one extends the definition of a new product to include the situation where the company might not have a design contribution but the product is new for the company, then one obtains a more meaningful picture of the situation for the supplier companies. In that case, the shares of new products in total sales for automotive and appliances p&c sectors become 28% and 42%, respectively. These figures attest to the importance of the introduction of products new for the company, to which the company has no design contribution. This process incorporates a large number of steps of NPD process and hence, should be planned and executed skilfully.

An international benchmark is provided for the US companies and European companies (UNICE, 2000). New products are defined as products introduced to the market no more than three years earlier, designed to meet the new needs or to make a significant difference to the way in which existing needs are met. Per cent of companies with more than 10% of total sales coming from new products is found to be 26% for US companies and 21% for European companies.

Barriers to Success in New Product Design

The internal and external barriers to success in new product design as perceived by the companies in the electronics sector in Turkey are listed in Table 18 in decreasing order of importance.

The basic difficulty appears to be the lack of skilled personnel within the company as well as in the market, in particular of technical personnel. Poor knowledge management refers to a lack of documentation resulting in relatively high lead times for getting organised when confronted with the task of developing a new product. Lack of NPD control/monitoring

indicates to a deficiency in the proper management of the projects.

TABLE 18. Barriers to success in NPD – Electronics sector

Internal Barriers	External Barriers
Lack of skilled employees	Shortage of skilled employees
Lack of NPD strategy formulation	Uncertain demand
Poor knowledge management	Financial problems
Lack of clearly defined NPD goals	High innovation costs
Lack of proper NPD control and monitoring	Lack of support from government through taxation, subsidies, etc.

Uncertain demand is partly due to the volatile nature of the markets but it mainly results from the lack of proper support by services like market research, proper positioning of new products and focused advertisement. What taxation, subsidies, etc. refers to is the lack of financial instruments and regulations to ease the burden on the company. Beyond favourable taxation regulations and subsidies such as R&D subsidies, venture capital and credit lending under favourable conditions are the financial instruments the companies have in mind.

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 by the companies as the major obstacles to innovation activities.

MANAGERIAL IMPLICATIONS AND SOME POLICY MEASURES

Neither operational effectiveness nor strategic positioning is sufficient by itself for the survival of the companies. Strategic positioning of a company supported by operational effectiveness is what is needed. In order to survive, a company needs to make intelligent choices concerning its strategic positioning and operational effectiveness (Porter, 1996). In the following, some policy measures will be proposed for the strengthening of the strategic positioning and operational effectiveness of the companies. These proposals are formulated around three themes, which have emerged from the study on competitive strategies: Increasing emphasis on product differentiation and improvement of NPD capability, the need to grow for stability and survival, and the capability to manufacture quality products at low cost.

- The management needs to understand the overall encompassing role of innovation. It is the management's role to create an environment encouraging innovation. Fostering innovation appears to be a focal point for the foreseeable future providing the largest marginal contribution to the manufacturing industries in Turkey.

- Human capital is of crucial importance for fostering innovation. The resources should be sought for, allocated and implemented according to a plan supporting the training and development process of the employees.

- New and more effective training tools need to be introduced making use of the new training technologies.

- Technology strategy development and planning is not so common and this is indeed a major deficiency. Companies need to get involved in these activities and make them an integral part of their business strategy.

- All the observations made during the sector studies indicate that more investment into R&D and product development is required for reaching respectable levels of competition.

- Turkish manufacturing companies should systematically strive to become part of global research networks. International R&D and product development activities imply partnership possibilities in these areas (EUNIP, 1995). Similar strategies to becoming part of global extended enterprises can be implemented for becoming part of the global research networks. Developments in information technology increasingly support international R&D and product development activities (Hameri and Nihtila, 1997).

- There is a lack of NPD strategy. The increase in NPD activities needs to be led by an NPD strategy.

- If a company adopts the option of increasing the indigenous knowledge component in its products, this, in general, will lead to high development costs. These costs are recovered only by relatively large sales volumes, usually not possible, if limited to the domestic market. Thus, companies adopting such product development strategies should also strive for access to global distribution channels seeking relatively large sales volumes.

- Domestic market size is rather restricted for many companies. Thus, a growth strategy by creating access to global distribution channels and by exporting has become imperative for the survival of leading manufacturing companies.

- For companies limited by the size of their domestic market, the basic business strategy appears to be growth leading to an efficient utilization of productive capacity. These companies usually adopt a policy of diversifying in products, markets, and technologies in order to secure orders. Being able to enter the global markets often allows growth by expanding one's markets for the same family of products and thus avoiding the heavy burden of not adopting focused

strategies.

- Those companies aiming to become part of the global supply chains have to overcome the additional cost of being far away from the production bases and the uncertainties associated with the delivery over long distances. Lean production can stabilize the supply chain particularly through the reduction of defects and engineering change orders (Levy, 1997). Adoption of lean production by these companies will help them to overcome the location's cost disadvantage by reducing disruptions to the supply chain.

- Focused strategy development and implementation appears to be an area open for improvement of operations. This should be achieved in coordination with activities concerning flexibility, since focused strategies might act against flexibility, if not properly planned and implemented.

- Flexibility appears to be imposed on the manufacturing companies rather than a conscious choice. But it has become a primary competitive advantage. To keep it that way, companies need to make flexibility an important component of their manufacturing and business strategy. A major challenge is to preserve flexibility as a competitive advantage while the company continues to grow.

- Delivery performance is an area where high performance of the companies is observed. But because of its crucial nature for the success particularly of supplier companies, delivery performance needs to be continuously monitored and further improved through innovative measures. In order to further improve on this success under the JIT delivery policy, manufacturers and suppliers have to collaborate and share the burdens and benefits resulting from this policy through measures such as joint value generation, information sharing, and building mutual trust.

- A further focal point for improvement for the companies is the supplier relations. The results reported here have demonstrated the weakness of the interaction among the manufacturers and their suppliers. There is evidence that strategic partnership is diffusing among manufacturing companies and their suppliers but there is still a long way to go to be able to organize extended enterprises 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 strategic partnerships, companies contribute and benefit through their set of core competencies. Thus it becomes imperative for Turkish manufacturing companies to define and

foster their core competencies, which, according to our experience, is not a common practice.

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