AN EMPIRICAL STUDY ON THE COMPETITIVENESS AND INNOVATION IN FOUR SECTORS OF THE TURKISH MANUFACTURING INDUSTRY

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ABSTRACT
In this paper, we report on some of the results of the *Innovations in Manufacturing Industries in Turkey Study* (IMITS). This study is an empirical investigation into the innovation performance and competitive strategies of manufacturing firms in Turkey. The data was gathered in nine different cities in Turkey during the period August 2004 – January 2005. The survey was conducted through face-to-face interviews due to the complex nature of the survey and was implemented in 135 manufacturing firms operating in four sectors: Textiles, chemicals, food processing, and metal. The study has been an extension of the *European Manufacturing Survey 2004* (EMS 2004) coordinated by the Fraunhofer Institute for Systems and Innovation Research and covering nine countries: Germany, Turkey, Austria, Switzerland, France, Slovenia, Croatia, Italy, and United Kingdom. Some of the basic results concerning competitive priorities, modernization of manufacturing, new product development, and quality management are presented.

Keywords: Competitiveness, innovation, empirical analysis

INTRODUCTION

Innovation is an essential component of the competitiveness and manufacturing strategies. The strategic nature of innovation for the competitiveness of enterprises as well as regions and countries has been the subject of increasing attention particularly in the last decades. As put forward by the resource-based theory of competitive advantage, the competitive advantage of a firm is increasingly dependent on valuable, rare, non-substitutable and unique resources, where innovation is one of these special resources (Wernerfelt, 1984; Grant, 1991; Barney, 1992; Christensen, 1995). Innovation is an intangible resource but it is not only important for becoming competitive but also for the sustainability of a firm's competitive advantage. Porter (1980) has attached critical importance on the ability to continually innovate for being able to sustain competitive advantage. These are some of the reasons of the increasing interest in innovation studies across the globe.

A massive data gathering on innovation in enterprises on an international scale has been accomplished through the *Community Innovation Survey* (CIS) involving Eurostat and OECD. CIS is implemented in European Union (EU) Member States, EU Candidate Countries, Iceland and Norway. The data is collected on a four-yearly basis. Australia and Japan are also reported to implement *National Innovation Surveys* (OECD, 2002). Another data gathering study on innovation in enterprises in Europe has been the *European Manufacturing Survey* 2004 (EMS 2004) performed in 2004 by a consortium led by the Fraunhofer Institute for Systems and Innovation Research. The consortium included Germany, Austria, France, United Kingdom, Slovenia, Switzerland, Croatia, Italy, and Turkey. Turkey was represented by the TUSIAD – Sabanci University Competitiveness Forum (REF). Some of the results obtained are reported by Armbruster *et al*. (2005).

The *Innovations in Manufacturing Industries in Turkey Study* (IMITS) has been an extension of EMS 2004. The extension was realized in the structure of the questionnaire as well as in the industry sectors included in the field study. The questionnaire implemented in EMS 2004 contained 249 information requests organized under 23 main headings. It was extended by REF to 529 information requests under 62 main headings and was employed in IMITS. Some of the results of IMITS have been presented earlier (Ulusoy and Yegenoglu, 2007).

In this paper, some of the basic results concerning competitive priorities, modernization of manufacturing, new product development and quality management obtained

from the IMITS will be presented. But first a brief description of the design and implementation of the survey will be provided.

DESIGN AND IMPLEMENTATION OF THE SURVEY

IMITS covered nine cities in Turkey representing approximately 72% of the added value created in the manufacturing sector. Due to the complex nature of the survey, face-to-face interview method for implementation of the survey was preferred in order to increase the number of responses and to reduce possible errors. Face-to-face interviews were conducted with 135 firms in food processing, textiles, metal and chemical industries in these nine cities. These firms were randomly selected from the database of the Union of Chambers and Commodity Exchanges of Turkey. The chance of a firm of being selected for interview was taken to be directly related to the relative density of the manufacturing base in the city it was located. Those declining to be interviewed were replaced randomly using the same database. Six graduate assistants were employed to conduct the interviews. In the majority of the interviews two of them were present. Each interview took roughly from 90 to 180 minutes. Data collection took place from August 2004 to January 2005. In retrospect, the choice for the method of implementation turned to be correct although indeed it was a relatively expensive one.

The distribution of the firms into the four sectors is as follows: food processing 16%, textiles 34%, metal 35% and chemical industries 16%. Following the official classification, firms are classified as small, medium, and large depending on whether their workforce falls into the range of 1-49, 50-99, 100 or more, respectively. The classification of the firms in the sample as small, medium, and large turned out to be 22%, 27%, and 51%, respectively. Around 75% of the firms designate themselves mainly as end product manufacturers with the remainder designating themselves mainly as suppliers. The percentage of family ownership is 60% with family establishments being particularly dominant among small firms. Foreign direct investment is present in 14% of the firms. The presence of foreign direct investment is observed to increase with increasing firm size.

It is also revealing for the nature of the sample to assess the geographical extent of trade of the firms in different sectors investigated. The purchase of input materials and sales of products of the majority of the firms in the metal sector are mainly confined to their own region. Majority of the firms in textiles provide for their input material mostly from their own region but more than 40% of their sales are to the EU countries. In the chemical industries, the input material provided from sources in the EU slightly exceeds those from Turkey and the products are marketed within all regions of Turkey. The general pattern for the firms in the food sector is purchasing input material mostly from sources all over Turkey and realizing their sales mostly in their own region.

STRATEGIES

Determinants of competitiveness

The most important determinants of competitiveness in these four sectors are specified by the firms participating in the study as *product quality/performance*, *delivery lead time*, and *production cost* (Figure 1). Firms display a tendency to assess their competitive position as being better or equal to their competitors in many of the determinants listed in the questionnaire. An exception is the production cost. The percentage of firms stating that their performance is inferior compared to the leading competitor in the sector is relatively high for production cost. This result can be interpreted as an indication of the difficulties faced by these companies in keeping their production costs under control.

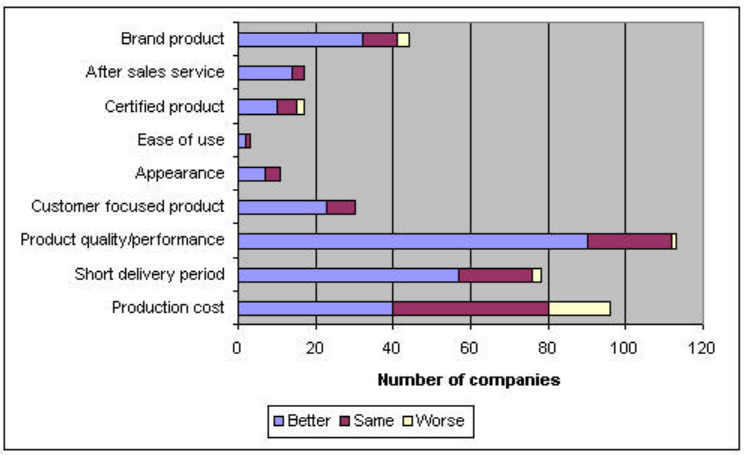

Figure 1 - The determinants of competitiveness and the relative positioning of the firms against the leading competitor

Competitive priorities

In IMITS, the firms are asked to rank their competitive priorities from the following list: *Customized products, short delivery lead time, innovation/technology, product quality, price* and *after sales service*. The competitive priorities are to be ranked from "1 to 6" with "1" indicating highest importance. For ease of reporting a "1 to 4" scale is adopted, where "2" represents "2 and 3" and "3" represents "4 and 5" combined. As a result of the ranking of these competitive priorities product quality turns out to be top competitive priority for the firms in all sectors (Figure 2). Particularly in food processing industry, product quality comes out very strong. The second most sought for competitive priority in all sectors is specified as price. These two top competitive priorities indeed overlap with the results obtained in previous field studies performed in different sectors of the Turkish manufacturing industry (Ulusoy, 2000). Although product quality turns out to be the top competitive priority, it serves as a qualifier for participation in the competition game. Price, on the other hand, becomes the top selection criterion for the customer.

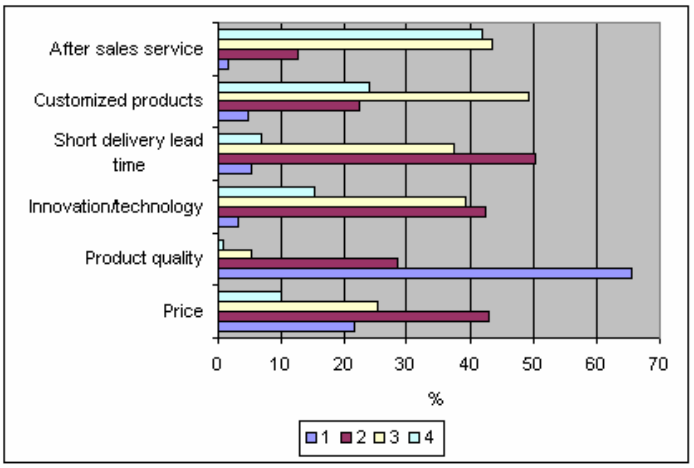

Figure 2 - The ranking of competitive priorities across the sectors

In all sectors, the competitive priority after sales service is ranked as the last among the five competitive priorities. This is mainly because some of the firms do not provide any after sales service. Food processing and chemical industries seem to rank

innovation/technology slightly higher than short delivery periods. The reverse is true for textiles and metal industries.

Does size have an impact on the choice of competitive priorities? Investigation of the ranking of competitive priorities within the small, medium, and large company groups does not reveal any significant difference among the rankings of the companies in these groups. In general, the ranking of competitive priorities is as: product quality, price, short delivery lead time, innovation/technology, customer specific products, and after sales service.

Product strategy

It is observed that the most widely used product strategy is *differentiation through product variety* (56%). Other product strategies employed are found to be *focus on specific products* (29%) followed by *focus on cost* (15%). Differentiation through product variety strategy requires an indigenous product development capability in the firm. Product variety leads to additional costs compared to product focused strategy. Being able to keep the product costs at least at the level of the competitors' is a prerequisite for the attempts to differentiate. Recall the observation reported earlier about the perceived assessment of the firms regarding their product costs being relatively inferior compared to the leading competitors in that aspect. It should not surprise one that product costs arise as a problem for the firms, which base their product strategy mainly on differentiation through product variety.

When developing new products, the strategy more widely adopted is determined as *being the first in the market strategy* followed by *being the follower in the market strategy*. It appears that around 60% of the firms reported to implement the first in the market strategy. This result supports the result concerning the product strategy reported above. First in the market strategy is a relatively aggressive strategy like the differentiation through product variety strategy and might require more resources and might involve more risk.

MODERNIZATION IN MANUFACTURING

The most surprising result coming out of the investigation into modernization of manufacturing is the high percentage of firms with no modernization activity (55%) in the last 3 years. Among those firms having some form of modernization activity, 61% annually invest 250.000 Euro or less.

It is observed that in general R&D and product design functions are not organized as separate units within the organization but rather reported to be performed by engineers or experts mostly employed in production. It appears that the development part of R&D is by far the dominant component of this function with a particular emphasis on the development of production technology. Concerning the organization of modernization activities, it is widely observed that there is no organizational unit specifically earmarked for this purpose. The planning phase is usually performed by the unit responsible for planning and the execution of the plans by the unit responsible for production. The planning horizon for modernization activities is usually 2-5 years. The sector with the shortest planning horizon is textiles (at most two years). In the food processing industry, on the other hand, modernization usually becomes an issue only when a problem occurs.

Modernization activities are financed to a large extent through self financing by the firms (74%) followed by the bank loans (22%). The fact that further financial instruments are rather restricted is indeed a cause for concern.

The most important barriers in front of modernization activities are the high cost of finance for investment in machinery and equipment and for operating capital. These two barriers are followed by the lack of qualified labor (Figure 3).

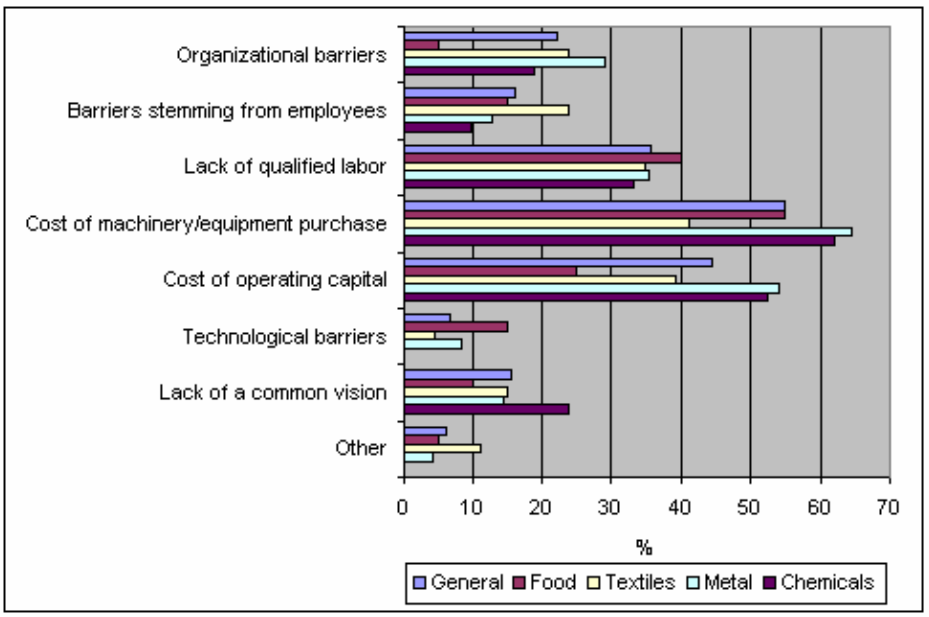

Figure 3 - Barriers in front of modernization activities

The price hikes in energy and raw materials are observed to be the most influential factor in leading to modernization activities in manufacturing. Energy and raw materials constitute a large portion of the production cost. The importance of production cost as a major determinant of competitiveness has been stressed above. The aims of modernization activities differ among the sectors considered. In the chemical industries, the most preferred aim of modernization is the development of new products; in metal industries and food processing, the modernization of production; in food processing and textiles, the upgrading of product range by offering services. It should be noted that the most preferred aims of modernization are in alignment with the preferred competitive priorities and product strategies.

The most preferred modernization strategy is investing into machinery, equipment, and information technology. This is followed by the human resources development strategy and further by organization strategy. It is expected that the adoption of human resources development strategy by the firms will support their innovation activities. It appears that investing into machinery, equipment, and information technology is a major component of innovation investments. It is reported by the Turkish Institute of Statistics that 62% of all innovation investments is made into machinery and equipment. In accordance with the human resources development strategy adopted firms seem to be in the process of reducing the share of unskilled employees in their employee portfolio. In a large number of firms, the share of skilled personnel is reported to increase particularly in engineering, administration, and production functions.

A relatively high percentage (47%) of firms report to have gone through major production technology changes in the last 3 years and around 30% of the firms foresee going through a major production technology change. For firms, which have gone through major production technology changes in the last 3 years, there is indeed a close relationship between the budget allocation and the level of change accomplished in production technology. For example, the budget allocation and the level of major production technology changes are at their lowest in the food processing industries. On the other hand, the level of major production technology changes is the highest in the chemical and textile industries, where the budgets allocated are also relatively large exceeding 1 million Euro for 24% of the firms. When assessing the impact of major production technology changes, it is observed that these changes have not only resulted in the improvement of existing products but also made the

production of new products possible. The results indicate that the introduction of production technology changes is mainly directed to products.

OUTCOME PERFORMANCE

New product development performance

The percentage of companies, which have introduced at least one new product in the last three years, is 90% in chemical industries, 85% in metal industries, 75% in textiles, and 80% in food processing. This percentage is 80% for large firms and 85% for SMEs. Putting it differently, 20% of large companies and 15% of SMEs have not introduced any new product in the last 3 years. The most frequently met number of new products introduced in the last 3 years was in the range 1-5 (Figure 4). More than half of the firms (52%) in the sample from the food processing and metal industries, 39% from textiles and 38% from the chemical industries have introduced new products in this range. The most productive of all sectors turned out to be the firms from chemical industries, where in 20% of them 51 or more new products were introduced in the last 3 years. It should be noted that the share of products new to the market is relatively low. But still the attempts to introduce products new to the market need to be appreciated.

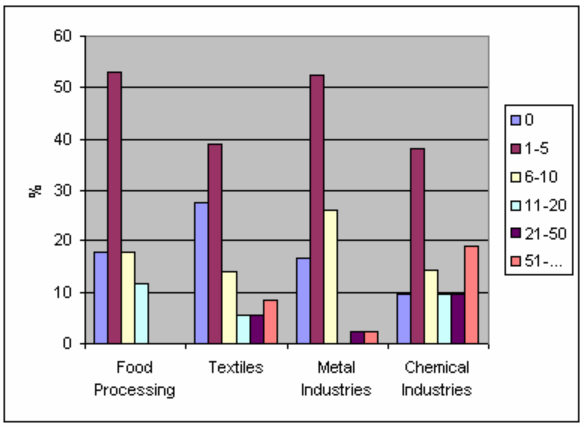

Figure 4 - Number of new products introduced to the market in the last three years

The relatively low number of new products introduced reflects itself to the share of new products in total sales. In more than 50% of firms in all sectors the share of new products in total sales was in the range 1-20%. The manpower employed in the new product development projects is observed to be at most 5 man-months in 42% of large firms, 38% of small firms, and 22% of medium-size firms. This level of man-power requirement implies that to a large extent the new products developed should be products with minor improvements over existing products. This observation might also be one of the reasons of the relatively low share of new products in total sales revenue. Such a low level of man-power requirement might also have a negative impact on the success of new products developed. The ratio of firms with at least one unsuccessful new product introduction in the last 3 years varies between 24%-35% across sectors. Large firms on the average appear to have a smaller number of unsuccessful new products in the last 3 years. The number of unsuccessful new products in the last 3 years is observed to be in the range 1-5 (Figure 5).

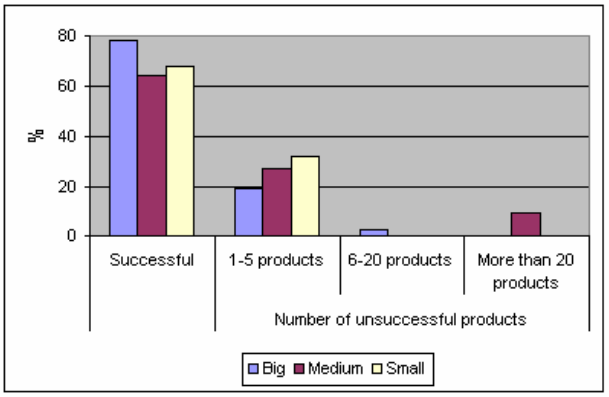

Figure 5 - The success rate and number of unsuccessful new product introductions in the last 3 years

What are the reasons for these failures? In food processing, failures usually result from low demand. In metal and chemical industries the main factor for failure is found to be technical problems, which can be attributed to the relatively more complex nature of technologies employed in these sectors. In textiles, where a relatively more competitive environment exists, top factor for failure turns out to be marketing issues. These reasons for failure draw attention to weak points in firms, which need to be treated in a systematic way not only within firms but also at the sector level.

It is observed that beyond new products there are also products with a long life cycle, which are still produced and sold. To investigate such products we have asked the firms, which have been around for 10 years or more, about their products they have been producing for 10 years or more. The percentage of firms within this class of firms with at least one product produced for 10 years or more is found to be as follows: In food processing 75%, in textiles 78%, in metal industries 85%, in chemical industries 100%. In 65% of these firms in food processing the share of such products in total sales revenue was in the range 61-80%. In textiles, on the other hand, in roughly 45% of these firms the share of such products in total sales revenue is well above 81%. These observations indeed reflect in a rather negative way on the new product introduction capability of the firms investigated.

Quality

As reported under the *Strategies* section, product quality is found to be number one competitive priority across all sectors. Similarly, the firms in the sample rate product quality as the most influential factor determining the competitive environment in the market. Hence, it would be worthwhile to look into quality and quality related issues in the firms more closely.

Rework and scrap rates are relatively high across all sectors (Figure 6). The rework and scrap rate over all sectors is larger than 5% for 18%of the firms in study. For 52% of the firms, the rework and scrap rate is larger than 2%. The firms indeed need to attack this problem swiftly.

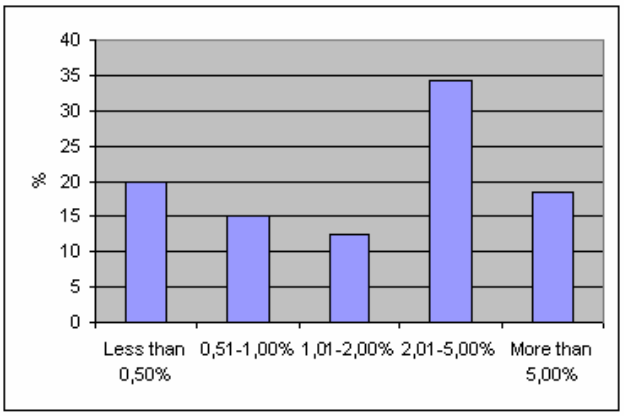

Figure 6 – Rework and scrap rates

The diffusion of ISO 9000:2000 and sector specific certificate ownership is found to be still limited but it is even more limited in the case of ISO 14001, the environmental audit. ISO 9000:2000 diffusion has a diffusion range between 20% in textiles to 75% in chemical industries; for ISO 14001, the range is between 8% in food processing and textiles to 18% in chemical industries. It is observed that wherever appropriate customer audits are applied to a large extent, which can be interpreted as a remedy to make up for the limited diffusion of certification but in some cases can also be attributed to a lack of confidence in those certificates. Customer audits are reported to be applied in 50% of the firms in the chemical industries and 80% of the firms in the remaining three sectors.

It is found that a large number of firms claim to practice continuous improvement in their establishment: 89% food in processing, 83% in textiles, 87% in metal, and 95% in chemicals). The results of EMS 2004 study show that the Turkish firms in metal industries investigated rank second among the consortium countries (Figure 7).

Just-in-time (JIT) delivery and JIT purchasing are practices to be implemented in firms where TQM has already taken root. JIT delivery is observed to have diffused among firms in all sectors rather widely. The reason behind such high levels of implementation can be attributed to the high inventory holding cost due mostly to high interest rates. JIT purchasing is found to be relatively less widely implemented - the highest rate of implementation being in textiles with 72%. The reason might be that a high percentage of the firms investigated are not powerful enough to impose JIT delivery rules on their suppliers. The Turkish firms in metal industries investigated took the first place among the consortium countries in the EMS 2004 study for the high rate of implementation of JIT delivery. The same result was obtained for the practice of JIT purchasing although with a more restricted implementation. It is interesting to note that the observation of implementation of JIT purchasing being more restricted compared to JIT delivery holds true in the case of all consortium countries (Figure 7). Zero inventory policy is not attempted to be practiced as widely as JIT delivery or JIT purchasing. Actually it is questionable how wise it would be to do so considering the relatively high defect and scrap rates.

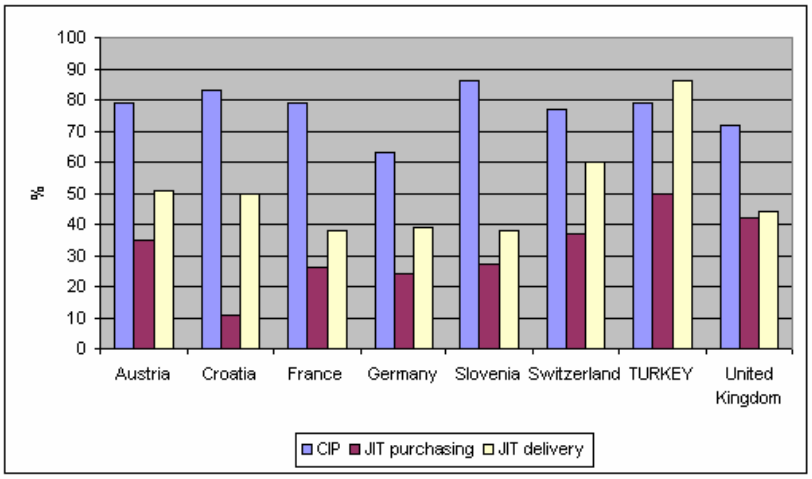

Figure 7 – Diffusion rates of CIP, JIT purchasing and JIT delivery

MANAGERIAL IMPLICATIONS

The ranking of the determinants of competitiveness and the competitive priorities do overlap in general, which is an indication that the firms have aligned themselves with the requirements of the market at least in this respect.

When considering the relative positioning of the firms against the leading competitor, the determinant for which the firms appear to be least secure is production cost. The implications of this finding will be evaluated from two aspects:

(i). The rework and scrap rates are relatively high across sectors. Firms need to put more emphasis on improving their operations to reduce waste of all kinds.

(ii). The most widely used product strategy is differentiation through product variety (56%). Product differentiation can become a relatively costly strategy to implement, if the infrastructure necessary for this is not in place, such as, e.g., a well functioning new product introduction process, a flexible production system to handle the high product variety.

The relatively high rework and scrap rates indicate to the need of further diffusion and improvement of practices such as continuous improvement, JIT delivery, and JIT purchasing. Although the practices just cited have already relatively high diffusion rates among the firms, more effort should put into making these practices to take firm root in these firms. The diffusion of six sigma implementation; the shift of responsibility and administration of quality assurance and control activities from a central unit to workers on the shop floor are some further suggestions for improvement.

Modernization of manufacturing is one of the fundamental means of making innovation in a manufacturing firm. We would recommend the firms to view their modernization activities from an innovation perspective and consider them as part of their innovation management. As stated earlier, the share of the firms with no modernization activity in the last 3 years is 55%. More investment is needed.

It should be noted that 74% of the firms use self financing for modernization activities. Further financial instruments need to be introduced by the financial institutions.

When compared with research on this aspect performed earlier (Ulusoy, 2000), it appears that the manufacturing sector in Turkey is increasing the weight of the product differentiation strategy against low cost strategy within their mixed strategy. Besides brand reputation, or an extensive sales and service network product differentiation can be achieved through proprietary technology or through new products. The firms adopting the product differentiation strategy in this study seem to put the emphasis more on production technology

and development of new products. The results indicate that the introduction of production technology changes is mainly directed to products.

More investment and organizational innovation are needed for R&D projects and new product development. Organizational innovations such as collaboration with other firms as well as effective and flexible organization of R&D and product development functions are at least as important as more investment for the trend towards product differentiation strategy to be successful.

Further improvement of the new product introduction process is a basic requirement. Particularly, the reasons for failure of new product introductions have to be approached in a more systematic way in order to be able reduce the rate of failures.

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