T.C.
MARMARA UNIVERSITY
INSTITUTE FOR GRADUATE STUDIES IN
PURE AND APPLIED SCIENCES

TECHONOLOGY MANAGEMENT CAPABILITY PROFILES AS OBTAINED FROM THE ANALYSIS AND MODELING OF INTEGRATED TECHNOLOGY MANAGEMENT PROCESSES: "THE CASE OF AUTOMOTIVE SUPPLIERS INDUSTRY AND SUPERMARKETS IN TURKEY"

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SUBMITTED FOR PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN INDUSTRIAL ENGINEERING

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ABSTRACT

Technology is widely recognised to be essential to competitiveness in dynamic social and economic environments of 1990s and it has become a key resource for firms to create and sustain competitive strengths. Therefore, firms should develop their knowledge and skills in managing technology.

The management of technology is actually planning, development and implementation of technological capabilities to integrate technology strategy with business strategy. This integration requires all functions of firms such as marketing, sales, R&D, human resources, finance, investment, production to work together to accomplish strategic and operational objectives.

The firms that want to implement an integrated technology management approach as a part of their business strategy must have sufficient technological and managerial capabilities. These capabilities are embodied in three levels of management (operational, strategic and normative) in relation with their structures, behaviors and objectives.

At that point, the challenge is the development of a model that determines the sufficiency of technology management capabilities at each level of management. Such a model will allow us to diagnose the actual source of deficiency in management to implement integrated technology management strategy.

The next stage is the implementation of the model called as "Technology Processes Management Capabilities Assessment Model". The model was applied firstly in Turkish automotive suppliers industry. The results of the model gave a good opportunity for identification of strategic behaviors of sector's firms.

The flexibility of any model is an important indicator for its effectiveness. Therefore, the model was also implemented in supermarkets industry with slight modifications to see its flexibility and provide a conceptualization of technology management in service industries.

In summary, the study is an application of a wide range of theoretical concepts of integrated technology management in a real business environment and it is intended to constitute a good basis for future studies in the area of integrated technology management.

ÖZET

Teknoloji, 1990'lı yılların dinamik sosyal ve ekonomik ortamlarında rekabetin gereği olarak görülmektedir. Teknoloji, rekabet gücü yaratmanın ve bu gücü muhafaza etmenin en önemli kaynağı olmuştur. Bundan dolayı, şirketler teknolojiyi yönetmeye yönelik bilgi ve kabiliyetler geliştirmek durumundadırlar.

Teknoloji yönetimi aslında teknoloji stratejisi ile iş stratejisini entegre etmek için teknolojik kabiliyetlerin planlanması, geliştirilmesi ve uygulanmasıdır. Bu entegrasyon, firmanın pazarlama, satış, ar-ge, insan kaynakları, mali işler, yatırım ve üretim fonksiyonlarının hepsinin operasyonel ve stratejik hedefleri başarmak üzere birlikte çalışmalarını gerektirir.

Entegre teknoloji yönetimi yaklaşımını, iş stratejilerinin bir parçası olarak uygulamak isteyen firmalar, yeterli yönetsel ve teknolojik kabiliyetlere sahip olmak zorundadırlar. Bu kabiliyetler, operasyonel, stratejik ve üst düzey olarak adlandırılan ve kendilerine özgü, davranışları, yapıları ve amaçları olan yönetim kademelerinde bulunurlar.

Bu noktada, üstesinden gelinmesi gereken şey, her bir yönetim kademesinin teknoloji yönetimi kabiliyetlerinin yeterliliğinin tespit edilmesi sağlayacak bir modelin geliştirilmesidir. Bu şekilde tasarlanacak bir model, entegre teknoloji yönetimi stratejisini uygulamakta yetersizlik gösteren yönetim kademesinin teşhis edilmesine olanak tanıyacaktır.

Bundan sonraki aşama ise "Teknoloji Süreçlerini Yönetme Kabiliyetlerini İrdeleme Modeli" olarak adlandırılan modelin uygulamaya konmasıdır. Model öncelikle Türkiye otomotiv yan sanayi sektöründe uygulanmıştır. Modelin ürettiği sonuçlar, bu sektörde yer alan firmaların stratejik davranışlarının tanımlanması için iyi bir olanak sağlamıştır.

Esneklik, bir modelin etkinliğinin en önemli göstergesidir. Teknoloji Süreçlerini Yönetme Kabiliyetlerini İrdeleme Modeli, gerek esnekliği görmek ve gerekse teknoloji yönetiminin hizmet sektöründe kavranmasını sağlamak için süpermarket sektöründe de ufak değişikliklerle uygulanmıştır.

Özet olarak, bu çalışma geniş bir kapsamı olan entegre teknoloji yönetiminin teorik kavramlarının bir uygulamasıdır ve gelecekte entegre teknoloji yönetimi alanında yapılacak çalışmalar için iyi bir temel oluşturma niyeti gütmektedir.

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I hope this study becomes a reference for future studies in the area of "Technology Management" for many researchers. This will be the best pleasure for me.

Birol Yüksel

1. INTRODUCTION

Company models set on the basis of managing human, capital and land efficiently and effectively to create competitive advantage have faced a reality of integrating a new key resource to their management organisations in 1990s. This key resource which will inevitably challenge industrial and social development in the next century is technology event.

Today, we encounter two models of company comprehension for manufacturing and service firms; technology managing, and technology managed. This comprehension is actually directly related with the answers that will be given to the questions of how the firm perceives technology and the firm has sufficient capabilities for integrating technology management with its business strategy. At that point, a methodology has to be developed to assess whether the firm views technology management as an integrated component of its general management organisation or not.

This study purposes the development of a standard methodology for the assessment of technology management capabilities of both manufacturing and service firms. If the firms have sufficient technology management capabilities, this will mean that they are adequately equipped to integrate their technology strategy with their business strategy.

1.1. A Competitive Edge

Companies nowadays are facing a new economic and social environment characterised by several significant implications: the existence of global competition, the emergence of new competitors changing the behaviour of the agents and the structures of industries, customers' changing needs and the continuous shortening of product life cycles.

As a result of globalisation, the firms must constantly compete for customer attention not only locally, but also globally. In such a business environment, technology has inevitably become the primary factor that will direct the industrial and societal development for coming century. Firms can achieve this constant competition through cutting down on all extra costs and continuously bring out new or modified products/services in exceedingly short time spans. Moreover, companies must deal with increasing demands for efficiency, quality, flexibility, and innovation.

Until the 1970s, efficiency was the dominant weapon in industrial competition. Formal hierarchical communication was the main structure for decision making; management tasks consisted mainly of planning and control. Then, in the late 1970s and early 1980s, the quality-oriented firms emerged. After mastering efficiency and quality, the leading quality companies started to become more flexible: externally oriented, and interpreting quality as the balance between expected value and perceived value by the customer.

In the 1990s, the flexible firms are mastering a new competitive weapon: innovation. These firms use innovation to distinguish themselves from competitors, and define new norms and standards in their products and services. Speeding up processes and reducing time-to-market are essential for these firms, because successful new innovations and technologies are likely to be copied by competitors. The challenge for the 21st Century will be experimenting with new forms of organisation, for entire firms involved in such technological advancements.

1.2. The Objectives of Study

This study firstly purposes the development of a methodology for the assessment of technology management capabilities of both manufacturing and service firms. The second purpose of the study is to diagnose the actual source of deficiency in management for inadequate management of technology processes.

The study addresses three important issues of technology management: (1) developing a framework for assessing technology management capabilities, (2) providing a conceptualisation of technology management in service industries, and (3) integrating technology specific concepts with general management concepts. Therefore, the study integrates a process model, which includes the processes of technology identification, technology selection, technology acquisition, technology exploitation, technology protection, and technology abandonment with the levels of management defined as normative, strategic, and operational. (Figure 1.2.1.and Figure 1.2.2.)

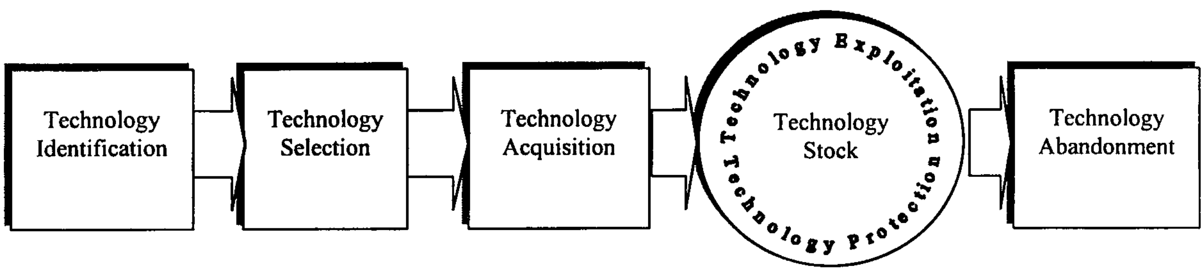

FIGURE 1.2.1. Technology management process model (Özgür, 1999)

Technology identification includes the technology intelligence activities through which particular technological alternatives are identified. In the selection phase a specific technology is chosen on the basis of evaluation of multiple factors. The next step is the transfer of technology to company's technology stock. On one hand, the technologies available in the stock are exploited to generate added value; on the other hand, they are protected from unplanned diffusion out of the company. Technologies in the stock are phased out through the process of technology abandonment when they are no more economical to run.

The model developed within the context of this research assumes that three levels of management plays a role in the management of technology processes. Normative level contains the far-reaching issues, such as company policy, company culture, and the structures of top management. The strategic level consists of the business strategy, the strategic structures and the strategic behaviour. The operational level contains the operational goals such as project goals, or any short-term goals, operational structures, and operational behaviour.

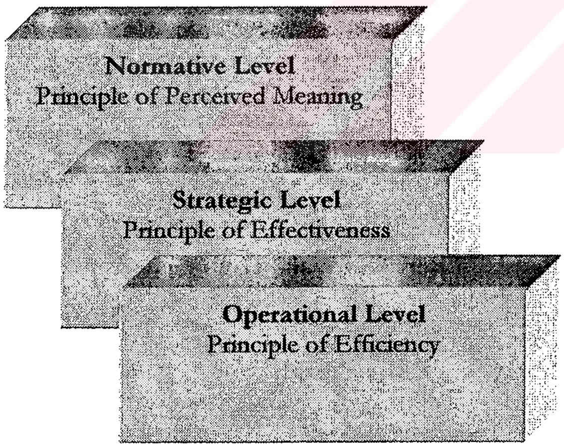

FIGURE 1.2.2. Three levels of management (Tschirky, 1996)

The study starts out perceiving technology management as an integrating function of general management and develops a model on this start up to assess technology potential of an organisation at the normative, strategic and operational management levels. The model will be applied firstly in Turkish automotive suppliers' industry. After drawing results with the suppliers' firms, the model will be modified for the supermarket firms as an application in service industry.

2. LITERATURE REVIEW

This literature review includes various studies evaluating technology management related topics that was used to build the theoretical basis of this study. The topics are collected under the headings of *world of strategic management, integrated technology management, and technology management processes.*

2.1. World of Strategic Management

The changes taking place all around led to different approaches to management. Instead of focusing on today all time, trying to anticipate the future and to prepare for it has become the major issue in management. This new approach is called strategic management, which is a stream of decisions and actions that leads to he development of an effective strategy or strategies to help achieve corporate objectives (Jauch and Glueck, 1998). Strategy, strategic advantage, competitive advantage, and competence development are the dominant themes in the study of strategic management.

A strategy can be simply defined as the means used to achieve the objectives. Jauch and Glueck (1998) make a more concrete definition; *"A strategy is a unified, comprehensive, and integrated plan that relates the strategic advantages of the firm to the challenges of the environment"*. According to this definition, a strategy begins with a concept of how to use the resources of the firm most effectively in a changing environment. At that point, Chaharbaghi and Lynch (1999) state that the purpose of an organisation can potentially be twofold. First, the organisation has to focus on its existing resources in exploiting existing business opportunities. Second, the organisation has to develop, at the same time, a new generation of resources in order to sustain its competitiveness. There is therefore a need to balance living and unborn resources. This balance, which determines the effectiveness of strategy, is achieved when organisations succeed in marrying sustainability and competitive advantage.

The term "competitive advantage" has been traditionally described in terms of attributes and resources of an organisation that allow it to outperform others in the same industry or product market (Christensen and Fahey, 1984; Kay, 1994; Porter, 1980). However, concern of companies is also to develop the ability to remain competitive in the future while exploiting existing opportunities. This ability is referred to as strategic advantage, which describes an organisation's dynamic and unique resources that determines its competitive renewal. To make clear the difference, Chaharbaghi and Lynch (1999) argue that strategic advantage explains how it can be sustained in dynamic business environments while competitive advantage is a static concept.

A new economic and social environment characterised by the existence of global competition, the emergence of new competitors, and customers' changing needs have made competence development as one of the critical strategic factors ensuring companies' competitiveness. Nyhan (1998) portray overall competence as an integration of four different kinds of competences depending on the nature the company. These are:

(1) cognitive

(2) technological

(3) business (entrepreneurial); and

(4) social (organisational)

On the other hand, Richardson and Thompson (1996) categorised the generic competences in eight sections under the headings of content, learning and process that compromise a generic requirement for all organisations (Figure 2.1.1.).

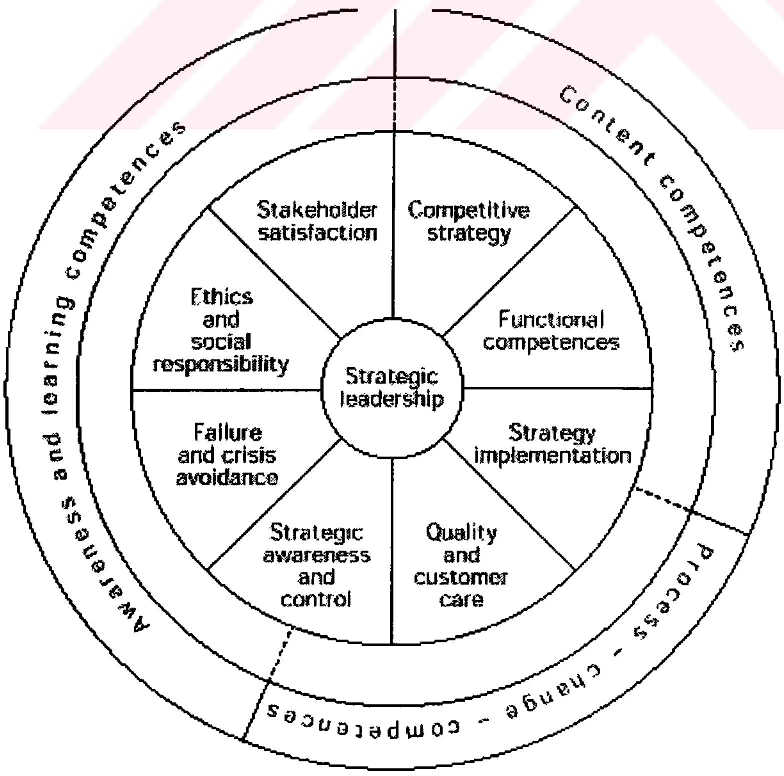

FIGURE 2.1.1. Generic Competences

Richardson and Thompson argue that strategically viable organisation will need to use most of these competences in the organisation's products and services, its processes for adding and delivering value, and in its people, but their relative significance will vary between organisations and change over time.

In global competition, companies are attempting to implement a competence-based strategy and within this strategy, a new idea, core competence, has started to shape the businesses. According to this approach, business strategies will be based less and less on products or markets and, on the other hand, will depend more and more on those competences that bring lasting competitive advantages which will be so essential for the promotion of new productive or commercial initiatives. Therefore, the key to success will not lie in the creation of a portfolio of products but indeed in the creation of a portfolio of core competences capable of continuously generating new products. Even, Betz (1993) appreciates the development of core competencies as the determinant of why some diversified firms have thrived, as others have died in1990s.

Prahalad and Hamel (1990) defined a core competency as the collective knowledge in an organisation about how to coordinate and integrate the multiple resources efficiently for product design and production. They stated that the most important resources and capabilities are those which are most difficult for competitors to imitate and difficult to understand, provide potential access to a wide variety of markets, make a significant contribution to the perceived customer benefits of the end product, and very durable. In this context, some examples of core competencies would include innovation, short product development cycles, well-motivated employees, and a strong service reputation.

According to Bueno and Morcillo(1997), core competence represents a set of three elements which are: *intent, knowledge* and the *capacities* or *capabilities* controlled in the company.

Intent, (what the company wants to do): this translates the insight and forward thinking of the company management with regard to its business. The company must be very clear on the role it plays or wants to play within its environment.

Knowledge (what the company knows how to do): this is gained through practice accumulated by the company and comes both from its own experience and that of others. It is the organisation's task to optimise, enrich and safeguard its stock of knowledge to maintain or improve its competitive position.

Capabilities (what the company can do): these indicate what professional skills, talents and aptitudes the organisation has. Capabilities envisage and exploit different ways of doing things and enable old rules persisting within companies to be broken. These companies will try to set a value on capabilities that will be very difficult for competitors to imitate.

Among core competencies, technological ones are the crucial. Because, intent, knowledge and the capabilities making up the core competences are all dynamic elements influenced by the determining weight of technology. Furthermore, if we turn to the different works published since the early 1980s on the analysis of business excellence, when listing the main factors of competitiveness all of them stress the prominent position of technology (Bueno and Morcillo, 1997). Therefore, control over core technological competencies is a secret of power and success in industry. Hamel and Prahalad (1990) consider that the core technological competences need to be embedded across a corporation, underpinning all its ongoing strategic developments and philosophies.

2.2. Integrated Technology Management

In recent years, the studies related with technology and its management have grown considerably. Many approaches have been developed to provide structures for positioning technology strategy into the overall framework of business strategy. In spite of this growing literature, integrating technological considerations into business decision making process continue to become a complex issue in practice.

Although, all areas of life and the economy are increasingly affected by technology and companies create technology and are simultaneously affected by technological change, this fact is not generally taken account in general management theories. Since, in the past, taking technology into account in the development of management theories was not considered essential (Tschirky, 1996). For many years, technology has been perceived as an environmental factor within the list of factors influencing the enterprise.

The concept of technology management is a recent creation, despite that the fact technology exist since the origin of human. Technology Management as an expression itself was first used at the European Management Forum held in Davos in 1981 (Bueno and Morcillo, 1997). In the papers presented on that forum, technology management was defined as the combination of competences allowing technological capabilities aiding the achievement of business objectives to be promoted and controlled.

A broader definition was made for the concept by the US National Research Council in 1987 report as *linking "engineering, science and management disciplines to plan, develop and accomplish the strategic and operational objectives of an organisation*".

The scope of the technology management concept today ranges from the management of the acquisition and sale of technology, management of R& D, management of production and to management of technology intensive firms with a vast variety of differing approaches. Primary in the technology management concept, however, is the attempt to close the gap between management theory and technological reality. This can be achieved by the development of a *holistic understanding of technology* and also, the establishment of *technology-specific management methods* at all levels of enterprise management. (Tschirky, 1996).

A holistic understanding of technology defines technology in the domain of product and market in relation with concepts of technological progress, quality of life and social efficiency of technology.

In this approach, first of all, product technology determines the environmental sustainability of a product in its use and disposal. Process technologies affect the environmental quality more directly with their operational impact on the environment. Secondly, process technologies affect the quality of work most significantly. Thirdly, technology deployment brings out customer benefits and influences the quality of life the individual. Finally, technical progress is the outcome of technological and social innovations, which influence every element.

2.3. Technology Management Process

Technology management has deserved a great importance in today's highly competitive environment and is increasingly being recognised as a process, which complements other managerial functions in providing the necessary inputs to the decision making process.

Werther and William (1994) have evaluated the changing dynamics of technology management as an evolving paradigm, driven by the search for a competitive advantage. In this evolution, technology as a competitive weapon was once little more than a "black box" arrangement-people, money and other resources went in and technological innovations came out, often in unpredictable ways.

The second phase of the Werther and William's paradigm was called as "control" phase. As the demand for resources grew and the importance of technology increased during the post-World War II period, the "control" paradigm evolved out of the "black box" framework. To meet the growing technological imperatives of competition, management increasingly turned its attention to R&D efforts as the wellspring of new, competitive technologies. In turn, this focus led to greater management involvement and controls, most often in the form of project budgets, timetables, and estimated returns on the corporate R&D investment.

Werther and William (1994) additionally defined a "strategic" approach, which has evolved out of the "control" paradigm in 1980s as third step of paradigm. Referred to as the "Third Generation", this framework argues for an integration of technology with corporate or strategic business unit (SBU), strategy. The strategic paradigm relies on the argument that technology is an essential element of strategy and, therefore, must be integrated into the strategic thinking and planning processes of the firm.

According to Werther and William, the result of strategic approach has been an attempt to elevate technology management to a level of strategic concern even in industries not considered "technology-driven". The "third generation" paradigm demands that technology management adopts a strategy-driven view of the firm's core technology and the potential product streams that can emerge. This strategy-driven approach to technology management is achieved by bringing both technologically knowledgeable executives and the firm's chief technology officer into the strategic formulation processes of the company. Goals are set and results are measured against strategic benchmarks, including both business and technological objectives.

The integration of technology and strategy became widely recognised during the 1980s.To achieve the best return on their investments, today's firms want a technology strategy that is driven by business strategy, and that achieves synergy across the entire enterprise. An optimum overall strategy requires an integrated business/technology planning process, and this in turn requires good alignment between technology and the business.

However, Werther and William (1994) state that a technologically driven sustainable advantage depends on more than just technology and its integration with strategy. Therefore, they defined the "fourth generation" of technology management, which requires the orchestration of technologies, customers, competitors, and the organisation's internal social structures. A sustainable competitive advantage addressed by the "fourth generation" of technology management comes from technologies that are proprietary, customers that are "locked in," and competitors that are "locked out" through high barriers to entry and social structures that support effective strategic execution.

Authors usually have divided the overall process of technology management into various phases. Probert and Gregory (1996) proposed a process model for technology management that included the processes of identifying, selecting, acquiring, protecting, and exploiting the technologies.

They suggested that identification process should include routines for systematic scanning of existing and emerging technologies and the capture of internally generated knowledge. Selection involves determining the relative importance and priority to be given to the identified technologies. Acquisition activity is concerned with access to required technologies and their assimilation into the organisation. Exploitation involves the systematic conversion of technologies into marketable products or alternatively the realisation of their value through sale or joint venture. Protection activity is concerned with the ways in which proprietary product features or services can be protected.

Bueno and Morcillo (1997) have divided the Management of Technology Process into three broad stages: the analysis or diagnosis stage, the definition, formulation and selection of strategies stage, and, lastly, implementation and control stage. The diagnosis phase, which does not exist in the framework of Probert is set crucially important because the choice of the strategy that will affect the company's future will depend on the correct implementation of this phase. The diagnosis comprises an internal analysis and an external analysis. Internal analysis identifies company's own strengths and weaknesses by means of internal assessment and consequently, determines which are its key competences with regard to its competitors. At the same time, the external study will highlight any threats and opportunities in the surrounding environment and will compare the company's competences with the success factors that will prevail in the sector.

Werther and William (1994) defined a strategic framework for technology management in search of a sustainable competitive advantage through superior technology acquisition and deployment. Technology acquisition matches desired outcomes with needed technologies and includes the development of effective social structures that embrace new technologies. Technology deployment goes beyond merely adding value for the customer and preempting competitors by searching for more balanced sources of sustainable advantage.

Singh et al. (1996) developed a flexible framework, which relates actor (business unit), situation and process being the three inseparable components of flexibility with technology management. Singh et al. have divided the overall process of technology management into various phases named as technology forecasting and planning, invention and innovation, development and acquisition, adoption and adaptation, technology transfer, technology diffusion, utilisation of technology and phasing out.

Technology forecasting and planning involves comprehending, estimating, and evolving future technology and its need. Invention includes development of new technology by basic or applied research whereas innovation is the product of an organisation accomplished through idea generation, collection, evaluation, experimentation and construction. Development and acquisition phase denotes the assimilation and application of technologies, which already exist and at times are well known in developed countries.

Adoption and adaptation of technology are concerned with putting to use the new technology and its smooth acceptance and utilisation. Technology transfer involves communication of information that is put to use. Technology diffusion is the sub-process by which is extended to other parts of the organisation. Utilisation of technology is the process that creates added value in the operations of the firm. When technology is no more economical to run, it should be phased out.

Niwa (1995) examined major characteristics in technology management process in a coming information society. He assigned technology management functions to three aspects of organisations; production methods to products, management tools to business activities, and information needed to organisation structures. Niwa identified differences of these assignments in an industrial society and in information society. (Table 2.3.1)

TABLE 2.3.1. Technology management functions, (Niwa 1995)

Function	Industrial society	Information society
Product and production methods	Core products: Industrial goods and hardware Key Process: Manufacturing	Core products: service and software Key process: designing and planning of services and software
Management tools and business activities	Product and process management tools	Human and organisational knowledge management
Information need and business structure	Isolated structure, and no information sharing	Network structure, and information sharing

As the concept of technology management became common, many tools that relate to decision making and support around technology management activities have been developed. These activities are associated with identification, selection, acquisition, exploitation, and protection of technology in the business context. Farukh, Phaal, and Probert (1998) categorised existing tools in the context of strategic technology management. Tools are divided in terms of

a) type,

b) purpose,

c) application,

d) analogy by other disciplines,

e) hard-soft vs. specific-generic,

f) hard-soft vs. static-dynamic,

g) Simple-complex vs. conceptual-applied.

They concluded that although there are a large number of tools available, their communication to a busy industrial community has not been effective. They also pointed out the gaps that are not fulfilled by the list of existing tools. These gaps are defined as:

a) Technology insertion: planning tools to ease the link between ongoing development programs and complex product upgrades. Issues include internal customer requirement capture and technology transfer.

b) Technology strategy development: sufficiently detailed but flexible methodologies to involve a wide cross section of employees in linking technological concerns into business planning.

c) Managing technology interfaces: tools for highlighting and improving the people and technological issues at key boundaries within the organisation.

In summary, various process approaches of technology management have emerged which emphasise on management of technology by proper management of some critical phases. Whichever the emphasis is, the size and magnitude of this process depends on the enterprise type and market requirements and a good alignment between technology and the business is the result of an optimum overall business strategy that is driven by an effective technology management process. Within this perspective, we will investigate the capabilities required for an effective technology management in real business environment in the next section.

3. TECHNOLOGY PROCESSES MANAGEMENT CAPABILITIES PROFILE

A wide range of studies exists in the literature to describe and measure the "technological capabilities" (Tremblay, 1998; Lall, 1992). Moreover, many approaches that can be described, as technique or tools have been developed to integrate technological considerations into business decision making (Probert and Gregory, 1997; Farrukh, Phaal, and Probert, 1998).

In spite of large amount of theoretical studies, conceptualisation of technology management process in practice continues to become a complex issue. This section includes design of a new model set on the basis of an approach linking technology processes with management levels to assess technology management capabilities of both manufacturing and service firms for the purpose of providing a breath to this complexity.

Any model, which was designed to diagnose a problem, has to inevitably involve all the dynamics of the environment where it will be used for the effectiveness. Therefore, Turkish retail and automotive suppliers sectors in which the designed model was applied were analysed in detail.

3.1. An Overview of Retail Business

The retail sector in developed countries (U.S.A., and Europe) has evolved into a concentrated business environment from a fragmented system of local independent retailers, distributors, and manufacturers as a result of rapid change over the past 35 years. Supermarket and hypermarket store formats have dominated this evolution.

Local planning requirements, the degree of retail concentration, and the consumer purchasing power determined the level of domination. Therefore, different European countries are at the different stages of retail lifecycle depending on these three parameters. For example, the northern European countries (France, German, and UK) have a high level of retail concentration and strict planning regulations. On the other hand, the eastern European countries (Czech Republic, Slovakia, Hungary, and Poland) have a low level of retail concentration, and a low level of planning requirements. The southern European and Scandinavian countries (Spain, Portugal, Greece, Norway, and Sweden) fall between the three defining parameters of the northern and eastern European models (Watson, 1995).

Retailers basically compete for customers on the basis of location, services, low prices, or the appeal and quality of product assortment, including fresh products. The concentration of sector, and customer expectations determine core factors that will be used as sources of getting sustainable competitive advantage.

Location was a major protection from price competition. However, increased mobility, and the vast increase in the number of supermarkets in industrialised countries have overtaken this traditional protection to a large extent. Location is now a major choice factor for shoppers.

Service is used as an important competitive tool in U.S.A retailing more commonly than European retailing due to different perception of service. Retailing is understood as a **low-value activity** by European shoppers who are in favour of wide choice, low price, and low service stores. Moreover, as a nature of retailing business, successful service innovations are often and quickly copiable by competitors. Therefore, any new service that attract shoppers successfully (for example, extended opening hours) will soon duplicated the only long-term effect will be to increase costs for all competitors and increase consumer surplus. Thus service in European retailing is used as a differentiator rather than a competitive tool and high service retailers seem only on a very small scale.

Price competition, on the other hand, is a natural tendency in retailing (Corstjens and Lal, 1995). Price, as a competitive strategy, is expensive but difficult to avoid. Because no retail chains can suffer the immediate loss in sales. At that point, another retailing store-format, discounts, comes into force. The discount stores have widespread growth potential especially in price sensitive and low consumer expenditure locations. Today, discount retailing is a serious threat in Europe for supermarket and hypermarket store formats.

Looking at the differences between retail structures in European countries and USA, two systems appear. On the one hand, there are retailers that have become successful by concentrating on a 'price proposition'. This is true in Germany, which is the birthplace of the hard discounters, and France. In contrast, retailers in some countries have developed more of a 'product proposition' where quality and choice in the product offering were developed to give a competitive advantage and usually higher margins. This has been particularly evident within UK and USA. In the future, the primary feature of retailing will be primarily a 'two-tiered' system with some retailers competing on price and others competing on product differentiation. Retailers must know to which of the two camps they belong. Many experts believe that trying to synchronise the two strategies, or changing between two is the cause of many retailing failures (Corstjens, Corstjens, and Lal, 1995).

Whatever the core competition factor is, overall customer satisfaction in retailing business can be brought by having the right goods and services available for the customer at the right time and at the right cost, and by providing these goods and services in a manner that gives customer added value. In order to meet the rapidly changing expectations in the market, retailers must find innovative ways to use technology and other strategic tools to create demanded value for consumers. Speed of ordering and delivery, improved customer service, reduced cost inventory levels are the most critical issues facing profitability and survival of the retail firms.

In discussing the look of the retail industry in the year 2000, retail experts refer to such concepts as vision, employee empowerment, interactive technology, the disappearance of purchase orders, fantasy and entertainment, electronic shopping, and stores with neither inventories nor employees. Demographics, life-style changes and the availability of low-cost, high-efficiency technology are driving those concepts just as they are driving new approaches in every sector of business (Whittemore, 1994).

3.2. Turkish Retail Sector

Turkish retail sector has undergone a period of rapid change over the past 15 years with an increasing number of super and hypermarkets, department stores and shopping malls. The rapid spread of supermarkets and hypermarkets throughout Turkey's leading cities has taken place in parallel with the country's economical development beginning in 2nd half of 1980s.

The causes that have given rise to the changes that the Turkish retail sector has experienced can be classified into two groups:

(1) *Changes that have affected consumer purchasing behaviour*;

- Opening up the domestic market to foreign goods, and services as a result of liberal policies of 1980s;
- Changes in life style (New styles of consumption appeared within high and middle-level income groups, increases in per capita income, increased number of private cars);

- The increase in education levels and in the information that is available to consumers (high cultural level, greater concern for health, the increase of information transmitted by multi-media tools);

(2) *Changes that have affected the retail offer;*

- Technological innovations (scanners and barcodes, use of credit cards, loyalty card applications, electronic shopping)
- The growing internationalisation of retail activities
- Introduction of advanced business practices as a consequence of multinational interest(self-service, merchandising, space management, category management);
- Product specialisation (A change from everything-sold shops to specialised shops)

As a consequence of these changes, the sector exhibited greater dynamism in recent years, and the participation of supermarkets and hypermarkets in terms of number and market share has grown significantly,

The market potential of supermarket-type products is estimated to reach 25 billion dollars in 1999. In spite of that the share of small convenience stores (bakkallar) in retail sector is decreasing continuously, the share of organised retail market whose structure was given in Table 3.2.1 is only 15% (Global Bulten, 1998, Sektor Analizi).

TABLE 3.2.1. Retail structure of Turkey, 1998

Store Type	Number of Sale Points	Market Share (%)
Small convenience stores(<400 m2)	179.000	%79
Wholesalers	36.000	%6
Small supermarkets(400-999 m2)	487	%9
Big supermarkets(1000-2500 m2)	178	%2,5
Hypermarkets(>2500 m2)	100	%3,5
Total	215.765	%100

Source: ACNielsen.ZET, April 1999, Consumption and Shopping Indicators Report; Global Bulten, 1998, Sektor Analizi.

The market share of top 5 retail firms within the retail sector in 1998 was only 6%. From that figure, it is clear that the concentration of retail sector is low and the sector is in the stage of start up. Retail concentration of Turkey was compared with some European countries in Table 3.2.2.

TABLE 3.2.2. Retail concentration of some European countries

	Turkey	Spain	France	Britain	Germany
Market share five top food retailers –1997	%6	%16	%40	%55	%65
Degree of retail concentration	Low	Moderate	High	High	High

Source: Global Bulten, 1998, Sektor Analizi

The retail sector in Turkey is food-led and the small convenience stores (bakkal), operated mostly by families dominated the retail food structure of Turkey for many years. In recent years, the retail food sector has undergone a stage of restructuring whose reasons were explained above. As a result of this restructuring started in leading of Migros, the biggest retail chain of Turkey, the number of supermarket and hypermarket increased significantly. Moreover, the sector has indicated an accelerating growth trend by the entries of international companies; Metro (German gross-market chain, 1988), Carrefour (The French hypermarket chain, 1991), Spar (Dutch hypermarket chain-1994), Kipa (Belgian-Turkish partnership, 1995). The number of stores of the biggest food retailers was stated in Table 3.2.3 as end of August 1999.

While analysing the advance of retail sector in Turkey, It is necessary to focus on the economic conditions as one the important factors that formed an appropriate environment for retail business. The inflation rate moving between %60 and %80 since the end of 1980s, high level of reel interest rates created non-operational income opportunities for retailers especially by investing in state bonds. Because of high returns of financial investment instruments, firms cut their prices. Therefore, gross profit margins of Turkish retailers are lower than their European counterparts.

The nature of competition and the economic policies in a few years will determine near future of the sector and actions to be taken by retailers. The theory of industrial organisation states that the lower the concentration ratio, the higher the likelihood of price competition. According to this theory, it will not be surprise for retailers in Turkey to engage in price wars in near future, for achieving higher levels of concentration and also achieving higher profitability in the long run. The possible price war will lower the profit margins. However, the current government policy towards decreasing inflation and reel interest rates will cause a fall in retailers' financial incomes. To tolerate this decrease, the firm will eventually increase their profit margins, and so their prices. Another opportunity for retail firms to keep their profits in changing economic environment will be the trend of decreasing share of small convenience stores.

The share of organised retailers in Turkey (supermarkets and hypermarkets) will continue to increase together with %15 sector growth potential per year for the next 5 years. Therefore, the firms making the first attempts will get advantageous competitive position.

TABLE 3.2.3. Number of stores of the biggest Turkish food retailers

Name of the Firm	Number of Stores	Store Formats
MIGROS	259	Supermarket, hypermarket, discount
TANSAS	95	Supermarket, hypermarket
GIMA	60	Supermarket, hypermarket
BEGENDIK	11	Supermarket, hypermarket
KIPA	2	Hypermarket
METRO	5	Hypermarket
CARREFOUR	2	Hypermarket

3.3. Turkish Automotive Suppliers Industry

Turkish automotive suppliers sector, which is an integral part of Turkish automotive industry, has approximately 1300 companies, of which a little over 100 is foreign, employing about 50.000 people. The domestic market absorbs nearly 70-80 percent of the production and the rest is exported. The total amount of sales and export for 1999 was estimated as 3.8 billion and 1.05 billion USD respectively.

The local sector is capable of producing complex components, except spark plugs, carburettors, fuel injection systems, and several transmission parts. In this sector, which grew by 117 percent between 1990 and 1996, there have been significant new investments in order to enhance Turkey's international competitiveness. Turkey's spare parts exporters are expected to increase their market share in the EU countries as a result of Turkey's compliance with EU customs regulations for motor vehicles

The foundation of the sector goes to 1960s, which is the years of import installing Development Model policies in Turkey. These policies have identified automotive industry as the pushing power of industrialisation of Turkey. In 1980s, application of export based development model and liberalism policies have affected the structure of all sectors. The local and foreign investments in automotive sector have increased considerably as a result of these policies and today there are sixteen automotive companies, manufacturing 13 different brands. Nine of these are joint ventures, four are licensing agreements, and one is fully owned subsidiary of an international automotive manufacturer. Turkey currently has the capacity to manufacture over 730,000 automobiles per year.

Foreign capital in the Turkish automotive sector is estimated to be around 40 percent. Turkey's Customs Union with the European Union attracted Far East companies to invest in the market. Toyota was the first to come to invest with the Turkish Sabanci group, followed by Hyundai with the Turkish Assan group. Additionally, Honda with Anadolu Endustri Holding, Nichimen-Kia with the Ihlas Holding, and Mazda with Mermerler have started investing in Turkey.

The number of vehicles per 1000 capita in Turkey is fairly below the world average (Table3.3.1). This shows a great potential for the growth of the sector. However, the increase in the number completely depends on the gross national product per capita. The automotive and suppliers sectors in Turkey will reach a more concrete growth rates as gross national product continues to increase and shared more fairly.

TABLE 3.3.1. The number of vehicles per 1000 person, 1998

Country	Number of Vehicles
USA	761
Italy	602
Japan	564
England	520
Portugal	429
Greece	328
Brazil	114
Turkey	**80**
World Average	120

Source: Global Bulten, 1999, Sektor Analizi

3.4. An Approach Linking Technology Management Processes with Management Levels

The selection of a technology is one of the most critical business decisions. Since, the selection of a technology means consistent and long-term commitment. The risks associated with the nature of technological progress make this decision more complicated. Therefore, the feasibility of deploying a new technology has become a great concern of management.

Tschirky (1996) has argued that the selection and realisation of technologies require specific management abilities, which complement a pure understanding of technology. This means that management plays a role in the development and utilisation of technology. He explained this role with respect to management levels (Figure 1.2.2.) and classified the issues related with these levels into three classes as goals, behaviour, and structures.

The normative level contains the far-reaching issues. In that level, primary decisions must be taken according to the long-term goals of the company. These long-term goals are defined by the company policy. Moreover, the level of awareness of company culture is essential. Because, company culture includes the values held by its employees. These values are expressed in how employees identify with company goals and in the company's policy towards the environment. These values manifest themselves in the company's ability to change and innovate. In addition to normative goals and behaviours, the decision making structure of these long-term issues is vital. The structures of board and top management affect the technology decisions. For the efficiency and effectiveness of technology decisions, top decision making bodies of companies must contain a balanced representation of technical and non-technical abilities (Özgür, 1999).

The strategic level consists of the business strategy, the strategic structures, and strategic behaviours. On that level, company policy is transposed into comprehensible strategies. Organisation and process structures, organisational and individual knowledge, organisational learning are the elements that constitute these strategies.

Finally, the operational level is responsible for transforming strategies into practice in terms of short-term goals (i.e. project goals, production schedules etc.). Organisational structures at operational level and operational behaviour (formal and informal communication, face-to-face management) determine the efficiency of this transformation.

TABLE 3.4.1. Management levels

LEVEL	STRUCTURES	OBJECTIVES	BEHAVIOUR
Normative	Top management, board of directors	Goals set by company policy, and technology policy	Company culture
Strategic	Organisation and process structures	Business strategy	Organisational and individual knowledge, organisational learning
Operational	Operational structures	Project goal, any short term goal	Formal and informal communication, face-to-face management behaviour

The management levels that consist of particular goals, structures, and behaviours shape the processes of the company and technology management process is one of them. In other words, management levels play roles on the technology management process. However, these roles are not easy to define.

In addition, cross effect of levels on the same activity of technology management process makes the issue more complicated. Therefore, it has been decided that division of technology management process into sub-processes would make the analysis of these roles easier. A process model developed by Ozgur (1999), including the processes of technology identification, technology selection, technology acquisition, technology exploitation, technology protection, and technology abandonment was employed.

The sub-processes are composed of particular activities. Goals, structures and behaviours of management levels affect the implementation of these activities within the company.

The determination of activities in each sub-process is highly important for relating them to management levels (Table 3.4.2.).

As it is seen in Table 3.4.2, the strategic level of management is the most important actor in technology management process. Therefore, effective implementation of technology management process within the company requires inevitably sufficient technological capabilities at the strategic level. In addition, it can be argued that technology management is naturally a strategic function, which is carried out in short steps on the operational level of management.

TABLE 3.4.2. Activities of technology management sub-processes in relation with management levels

Sub-Process	Activity	Management Level
Technology Identification	Selection of information sources	Strategic
	Accumulation of information concerning existing and developing technologies	Strategic
	Assessing gathered information	Strategic
Technology Selection	Analysing the effects of company, national, product and market environment factors in selecting among technology alternatives	Strategic
	Determination of the relative importance and priority to be given to the identified technologies	Strategic
	Cost-benefit analysis of technology alternatives	Strategic
	Evaluation of effects of selected technology to customers, suppliers, processes, and employees	Strategic
Technology Acquisition	Determining resources to be used in technology acquisition	Strategic
	Determining methods for technology acquisition	Strategic
	Adoption and adaptation of acquired technology into organisation	Operational
Technology Exploitation	Realisation of values of technologies	Strategic
	Conversion of technologies into marketable products	Operational
Technology Protection	Determining the ways in which proprietary product features or services are protected	Strategic
Technology Abandonment	Analysing economical feasibility of operating technology	Strategic
	Analysing environmental threat and opportunities	Strategic

The strategic level of management is responsible for taking of three basically different decisions with respect to technologies:

1.) Which way to go?

The answer is the result of an extensive analysis based on knowledge of current technology, technology forecasting and technology assessment. Therefore, accumulation of information concerning existing and developing technologies is an important activity in strategic technology management (referred as technology scanning and monitoring).

2.) Make or buy?

The decision is concerned with the question whether the required technologies will be developed in-house or in conjunction with other firms (alliances), or whether they will be purchased completely from other organisations.

3.) Keep or sell?

Third decision deals with whether available technologies are to be applied exclusively for company purposes or can be transferred to other companies.

The effective decision making process requires suitable organisation and process structures which are equipped with sufficient level of knowledge and learning capacity. The suitable organisation chart is the one that brings temporarily or permanently together representatives from R&D, production, marketing and finance and provides carrying joint responsibility for periodic elaboration of strategic technology decisions.

However, it is obvious that over-strategic factors such as company policy and company culture play also a role on technology management function. Both company policy and also company culture can not be expressed in strategic language. This means that limiting technology management to strategic level and operational level of management creates a deficiency in the implementation of technology management function. Therefore, the strategic and operational levels must be evaluated under a higher level called normative.

3.5. Use of Technology and New Product Development Management Questionnaire

Integrated technology management concept is the result of linking management levels with technology management function. In practice, firms that want to be organised around the integrated technology management strategy must have sufficient technological and managerial capabilities at normative, strategic and operational level of its management.

These capabilities are embodied in employees and organisational systems. To determine the availability of these capabilities, we have to evaluate the practices related technology management within the company. For this purpose, the "Technology and New Product Development Management" questionnaire developed by Ozgur (1999) is used to determine the existence of technology management capabilities.

The questionnaire of Ozgur aims to evaluate the practices of manufacturing firms related to technology management. The practices are examined within a process model. The model consists of the following stages: identification, selection, acquisition, exploitation, protection, and abandonment. The questionnaire also includes a section inquiring the results of technology use in order to identify the contribution of new technology use on the operational performance. The last section of the questionnaire questions the effect of various inhibitors on the success of technology management.

The questionnaire commences with a section named "General" where general information about the company is collected. This chapter is used to generate information about the profile of the company. The corresponding chapter of the questionnaire called "identification" evaluates the spread of some practices related to technology intelligence and information gathering. The technology selection part of the questionnaire inquires the impact of various factors on the selection among technological alternatives. The companies are asked to state which sources they have used and to evaluate the efficiency of the sources used in the technology acquisition section.

In the technology acquisition section, companies were asked to indicate the methods they have used and to evaluate the efficiency of the methods used. The efficiency of particular protection methods was questioned separately for product and production technologies in technology protection section. The technology abandonment section includes questions inquiring the cases of technology abandonment separately for product and production technologies. In the operational result part, the companies were asked to answer subjective questions inquiring the changes that were observed as a result of new technology use.

The last section of the questionnaire evaluates possible barriers to the successful operation of the relevant technology management sub-processes.

As a new concept, the questions included in the questionnaire of Ozgur were related with the management levels for the purpose of gathering data about the practices of linking technology management processes with technology management levels (Table 3.5.1.). Every question of the questionnaire was classified according to following criteria;

1.) Process to be analysed

2.) Management level's structure, objective or behaviour that affects the process

Question about quality certification evaluates whether the firm has standardisation in its processes. Having quality certification is a part of business strategy.

The question inquiring the educational background of top executives aims to identify possible links between technology management practices and the background of executives. Therefore, it is related with organisational structure of top management.

The most senior management position that is accountable for product and process technologies implies the importance given to technology management. Business practices prove that higher the management level is, the more the implementation capability is.

The number of the total technical staff and separately the number of technical staff engaged in the development of product and process technologies are questioned. The magnitude of technical staff indicates the capability at the operational level while the magnitude of the R&D staff is an indicator of strategic structure.

Since, innovation expenditures and especially R&D expenditures are major components of technology strategy, it is classified as an objective of strategic management level.

Questions (11 and 12) of subjective judgment related to general strategies, technology strategy and competitive advantages are indicators of objectives as a part of business policy and mission statement and behaviours at normative management level.

The questions in identification part aim to evaluate the organisational structures, mechanisms and information sources for accumulation and assessment of information concerning existing and developing technologies. Therefore, these questions are grouped under the heading of strategic management level.

The question inquiring the critical factors in technology selection analyses the behaviours and structures of strategic level of management.

The questions related with technology acquisitions investigate the organisational structures and methods (behaviours) at the strategic level used for technology acquisition. Moreover, Question 28.3 through 28.6 inquires the adoption and adaptation of acquired technologies at the operational level.

Questions about the exploitation methods are evaluated as a concern of strategic level of management as an indicator of business strategy. Moreover, the questions analysing specific difficulties in the exploitation of technologies were related with different management levels depending on the source of difficulty. Human factor emerging as one of the key factors in the successful internal exploitation of technologies was marked as an operational issue.

Protection of product and production technologies is a concern of strategic level of management by making use of patenting and registration of design, and keeping related personnel in the company.

The questions inquiring abandonment of a technology were related with strategic level of management. Because, these questions analyse behaviours and strategies of management at the strategic level while making decisions about the abandonment of a technology.

The questions that inquire the activities about the manufacturing of a new product and new product development such as project team organisation, planning tools, engineering capabilities are related with the firm's operational level of management. Because, these activities purpose to convert the strategies set at strategic level to practice such as production of a new product.

After relating the practices about the technology management with the management levels that affect these practices, we are at the stage of developing a model for assessing these linkages.

TABLE 3.5.1. Technology management questionnaire in relation with management levels

Question No.	Part of Questionnaire	Related Management Level	Relation
3	General	Strategic	Objective (Business Strategy)
4	General	Normative	Structure (Top Management)
5	General	Strategic	Structure
6	General	Strategic	Behaviour
7	General	Operational	Structure
8	General	Operational	Structure
9	General	Strategic	Structure
10	General	Strategic	Objective(Business Strategy)
11.1-11.5	General	Normative	Behaviour (company culture)
11.6	General	Normative	Behaviour (company culture)
12.4-12.7	General	Normative	Objective(Mission)
13.1-13.5	Identification	Strategic	Structure-Behaviour
13.6	Identification	Normative	Behaviour
14	Identification	Strategic	Strategy-Behaviour
15	Identification	Strategic	Structure
16	Identification	Strategic	Structure-Behaviour
17	Identification	Strategic	Structure
22.1-22.2, 22.4-22.7	Selection	Strategic	Behaviour-Structure
22.3	Selection	Normative	Behaviour
23	Acquisition	Strategic	Strategy
24	Acquisition	Strategic	Strategy-Behaviour
25	Acquisition	Strategic	Strategy-Behaviour
28.1-28.2	Acquisition	Strategic	Strategy-Structure
28.3-28.6	Acquisition	Operational	Behaviour
29	Exploitation	Strategic	Strategy
30.1, 30.5, 30.6	Exploitation	Strategic	Behaviour-Strategy

TABLE 3.5.1. (Continued)

Question No.	Part of Questionnaire	Related Management Level	Relation
30.2-30.4	Exploitation	Operational	Behaviour
30.7	Exploitation	Normative	Objective
31.1-31.4	Exploitation	Operational	Behaviour
31.5	Exploitation	Normative	Behaviour
32	Protection	Strategic	Strategy-Behaviour
33	Protection	Strategic	Strategy-Behaviour
34	Abandonment	Strategic	Strategy-Behaviour
35	Abandonment	Strategic	Strategy-Behaviour
36	Manufacturing New Product	Operational	Planning tools
37	Manufacturing New Product	Operational	Structure
38	Manufacturing New Product	Operational	Structure
39	Manufacturing New Product	Operational	Structure
41	New Product Development	Operational	Methods
42	New Product Development	Operational	Structure
43	New Product Development	Operational	Structure
44	New Product Development	Operational	Structure
45	Engineering Capabilities	Operational	Techniques
46	Engineering Capabilities	Operational	Tools
47	Engineering Capabilities	Operational	Tools

3.6. A Model for the Assessment of Technology Processes Management Capabilities (TPMC) of Manufacturing Firms

Relating practices about the technology management with the levels of management is not an end aim. On the contrary, this approach is a means for developing an assessment tool for determining the capabilities of management at normative, strategic and operational levels.

The technology and new product development questionnaire actually inquires these capabilities by questioning practices related with technology management. These capabilities are called as " ***Technology Processes Management Capabilities***" in this study.

The challenge is now to develop a model to determine the sufficiency of these capabilities and to find the source of insufficiencies. These capabilities are embodied in different levels of management organisations. Therefore, the existence of technology processes management capabilities within a firm implies that the firm has sufficient capabilities for integrating technology management with its business strategy and the firm views technology management as an integrated component of its general management organisation.

A scoring table has to be developed firstly to determine the level of sufficiency of technology processes management capabilities. The format used for presenting survey questions has determined the structure of the scoring table. Graphic format with three options was utilised in Ozgur's study (1999). Therefore, the answers to the questions were scored over 3 scales including 0,1 and 2.

Another determinant of the scoring methodology was the nature of questions. There are two types of questions in the questionnaire: questions that are answered quantitatively and, questions that are answered qualitatively. The questions 3, 4,5,6,7,8,9,10 are quantitative type of questions. The other questions are qualitative type of questions because the answers to these questions depend on the judgements of person answering the questions. All the answers to the questions in Table 3.5.1 are scored over total 2 points whatever the nature of the question is.

The answers of quantitative questions 7,8,9,10 are scored according to industry averages. Range of industry is divided into 3 parts as stated in table 3.6.1 and the firm is scored according to the range that belongs.

TABLE 3.6.1. Scoring table of quantitative questions

Range	Score
Smallest <=......< (Smallest)+(Average/2)	0
(Smallest)+(Average/2)<=........<3/2 Average	1
3/2 Average<=.......<=Biggest	2

The answers of the qualitative questions in the questionnaire are given as:

3 circled for stating the activity applied best within the firm, or given the most importance,

2 circled-for stating the activity applied adequately within the firm, or given moderate importance,

1 circled-for stating the activity not applied within the firm, or not given any importance.

These answers are scored as follows:

2 points- for circle 3

1 points- for circle 2

0 points- for circle 0

Using the above scoring principles, answers to each question of Table 3.5.1 are scored and each score is summed within the related management level of its question (Table 3.6.2,3,4).

TABLE 3.6.2. Technology Processes Management Capabilities Scoring Table for manufacturing firms (normative level)

Question No.	Part of Questionnaire	Related Management Level	Total Point
4	General	Normative	2
11.1-11.5	General	Normative	2
11.6	General	Normative	2
12.4-12.7	General	Normative	2
13.6	Identification	Normative	2
22.3	Selection	Normative	2
30.7	Exploitation	Normative	2
31.5	Exploitation	Normative	2
TOTAL POINT AT NORMATIVE LEVEL			16

TABLE 3.6.3. Technology Processes Management Capabilities Scoring Table for manufacturing firms (strategic level)

Question No.	Part of Questionnaire	Related Management Level	Total Point
3	General	Strategic	2
5	General	Strategic	2
6	General	Strategic	2
9	General	Strategic	2
10	General	Strategic	2
13.1-13.5	Identification	Strategic	2
14	Identification	Strategic	2
15	Identification	Strategic	2
16	Identification	Strategic	2
17	Identification	Strategic	2
22.1-22.2, 22.4-22.7	Selection	Strategic	2
23	Acquisition	Strategic	2
24	Acquisition	Strategic	2
25	Acquisition	Strategic	2
28.1-28.2	Acquisition	Strategic	2
29	Exploitation	Strategic	2
30.1, 30.5, 30.6	Exploitation	Strategic	2
32	Protection	Strategic	2
33	Protection	Strategic	2
34	Abandonment	Strategic	2
35	Abandonment	Strategic	2
TOTAL POINT AT STRATEGIC LEVEL			42

TABLE 3.6.4. Technology Processes Management Capabilities Scoring Table for manufacturing firms (operational level)

Question No.	Part of Questionnaire	Related Management Level	Total Point
7	General	Operational	2
8	General	Operational	2
28.3-28.6	Acquisition	Operational	2
30.2-30.4	Exploitation	Operational	2
31.1-31.4	Exploitation	Operational	2
36	Manufacturing New Product	Operational	2
37	Manufacturing New Product	Operational	2
38	Manufacturing New Product	Operational	2
39	Manufacturing New Product	Operational	2
41	New Product Development	Operational	2
42	New Product Development	Operational	2
43	New Product Development	Operational	2
44	New Product Development	Operational	2
45	Engineering Capabilities	Operational	2
46	Engineering Capabilities	Operational	2
47	Engineering Capabilities	Operational	2
TOTAL POINT AT OPERATIONAL LEVEL			32

The answers of a question including sub questions, such as question 28, and 30 is averaged to give each question the same weight. Therefore, each question taken into calculation is weighted in the same proportion by scoring each of them maximum 2 points. The answers of 45 separate questions are scored in the questionnaire. The distribution of questions according to management levels is shown in Table 3.6.5.

TABLE 3.6.5. Distribution of questions over management levels

Management Level	Number of Questions Scored Separately	Total Point
Normative	8	16
Strategic	21	42
Operational	16	32
Total	45	90

At the end, three indices are calculated by dividing the total score of each firm at each level with the maximum total point that can be obtained. The results are called **"Technology Processes Management Capabilities Indexes"**:

a.) **Normative Level Technology Processes Management Capabilities Index**

b.) **Strategic Level Technology Processes Management Capabilities Index**

c.) **Operational Level Technology Processes Management Capabilities Index**

Technology Processes Management Capabilities Index is a measure of the capability of the firm's related level of management on the issues of technology management.

The model that includes a questionnaire of "technology and new product development" and draws a scoring table on the answers of related questions of it and determines the technology processes management capabilities of firms is called "***Technology Processes Management Capabilities Assessment Model***".

The most important characteristic of this model is that it allows us to diagnose the actual source of deficiency in management organisation. Therefore, an action plan on improvement can be put into application faster.

Turkish automotive suppliers' sector and supermarkets sectors whose dynamics were explained in previous sections were chosen for implementation of assessment model. These sectors are significantly different in that the former is manufacturing sector while the latter is service sector. Moreover, the life cycles of sectors are also very much different. Therefore, it will be possible to evaluate the effectiveness of the model by comparing the results in these distinct sectors and make conclusions about the performance of model regardless of the nature of industry in which it is applied.

4. APPLICATION OF THE TECHNOLOGY PROCESSES MANAGEMENT CAPABILITIES ASSESSMENT MODEL IN TURKISH AUTOMOTIVE SUPPLIERS SECTOR

Technology Processes Management Capabilities Assessment Model was applied in Turkish automotive suppliers' industry, which were analysed in detail in previous section. Ozgur (1999) has made a study encompassed a sample of 25 companies which were selected from the Directory of Turkish Association of Automotive Parts and Components Industry (TAYSAD). The companies were chosen considering the field of operation and annual turnover. The fields of operation are electrical components, metal removing, casting, forging, seating and instrumentation. Within these fields the first four or five companies with the highest turnover were selected. Responses were obtained from 21 companies.

4.1. Technology Processes Management Capability (TPMC) Profiles of Turkish Automotive Suppliers' Firms

The data of Ozgur' study (1999) was used for practicing the assessment model. Although 21 companies have responded the questionnaire, because of missing data, 13 companies were considered in the assessment model.

The answers firstly were scored according to the scoring methodology explained, and rules of **Technology Processes Management Capabilities Scoring Table** (Table 3.6.2). For each firm, **Technology Processes Management Capability (TPMC) Indices** at normative, strategic and operational levels were calculated separately. Firms indicated a wide range of capability indexes. Capability indices ranged from 53% to 93% at normative level, from38% to 64% at strategic level and from 32 % to 72% at operational level. The results are summarised in Table 4.1.1.

As it is seen in the table, Turkish automotive suppliers' firms have displayed very different technology management capability patterns. Identification of these patterns is very important for analysing the strategic behaviour of suppliers' firms. A x-y representation of the capability indices versus management levels seemed to be useful for identification of these patterns where y-axis indicates the management capability index ranging 0 to 100 and management levels are shown in the x-axis.

TABLE 4.1.1. Technology Processes Management Capability Indices of automotive suppliers' firms

Firm	Operational Level Capability Index	Strategic Level Capability Index	Normative Level Capability Index
Firm 2	%54	%51	%93
Firm 22	%61	%48	%89
Firm 13	%52	%64	%87
Firm 20	%68	%61	%85
Firm 21	%57	%43	%83
Firm 19	%72	%55	%83
Firm 23	%37	%43	%78
Firm 18	%49	%55	%76
Firm 11	%32	%41	%74
Firm 17	%61	%55	%72
Firm 7	%40	%38	%61
Firm 4	%41	%53	%54
Firm 8	%39	%39	%53
Average	**%51**	**%50**	**%76**

Each firm's capability indices were plotted as seen in Figure 4.1.1. A line that represents a firm's technology processes management capabilities at different management levels is called "**Technology Processes Management Capability Profile**".

At first sight, two types of profiles can be observed: concave and trend type profiles. Concave type profiles are for the firms having a lower index at the strategic level compared with other levels. Trend type of profiles exists for the firms having an increasing index performance at operational, strategic and normative level respectively. In that perspective, Firms 2,7,8,17,19,20,21, and 22 have concave type of **TPMC** profile while firms 4, 11,13,18, and 23 have trend type of **TPMC** profile.

An important characteristic of both concave and trend type profiles is that all profiles reach their maximum point at the capability index corresponding to normative level. This inference is an important implication for managerial behaviours of Turkish automotive suppliers' firms and it will be discussed in the next section more detail.

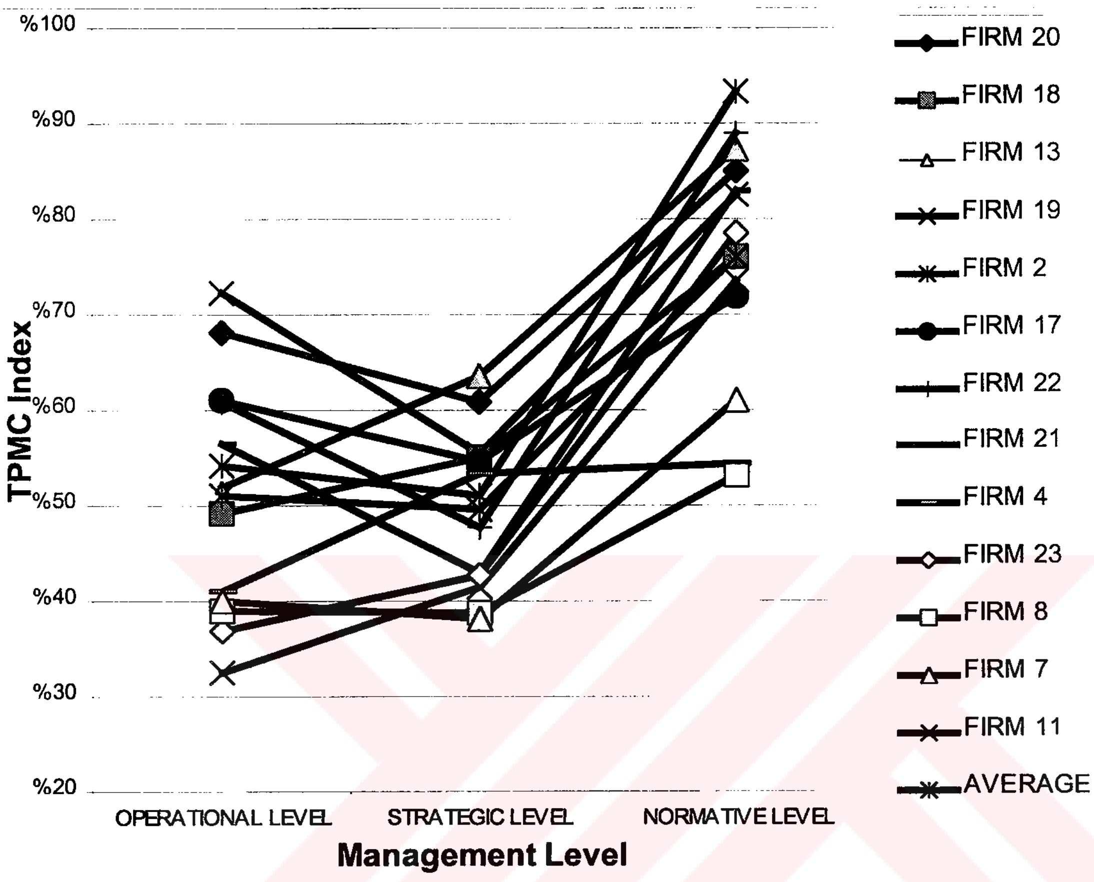

FIGURE 4.1.1. TPMC Profiles of Turkish automotive suppliers' firms

After determining **TPMC** profiles of Turkish automotive suppliers' firms, the questions is now how these profiles can be used for identification of strategic behaviours of these firms. Determination of the firms having similar strategic behaviours is the first step for identification of firms' behaviours.

4.2. Clustering of Turkish Automotive Suppliers' Firms Based on Their TPMC Profiles

There are many different techniques in the literature for identification of strategic groups. The multi-variate techniques led to better results and cluster analysis is the most widely used within these multi-variate techniques (Lewis and Thomas, 1994).

Cluster analysis is a way of categorising a collection of objects into groups. Within cluster analysis, depending on the objective, there are a large number of algorithms. Our objective in this study is the delimitation of the groups of firms depending on their **TPMC** profiles in such a way that both internal homogeneity and heterogeneity between groups is maximised. Therefore, a heuristic that purposes the minimisation of standard deviation within groups has to be used.

The method we have chosen is called k-means methods. The method requires firstly determining in advance how many clusters we want to have. The algorithm has the following steps:

1. Select k starting points. These points can be selected randomly through the objects to be clustered.
2. Compute the similarity of each object with a hypothetical object located at each of the k starting points. Classify each object as "belonging to" the group associated with the most similar starting point.
3. Calculate the means on the variables for each of the newly formed groups of object points. The means define the "centers of gravity" of the new groups.
4. Replace the starting points with the new points corresponding to these new means.
5. Repeat steps 2-4 until no object points are reclassified. When the procedure converges in this way, the points in each group define a cluster.

The k-means heuristic was used for clustering of the firms into 3 groups with respect to each **TPMC** index respectively. 3 groups for each management level **TPMC** index means total 27 different patterns, which are highly sufficient to identify 13 companies. Firms that belong to same group with respect to these three indices were grouped together.

Normative level capability indices of firm 13, firm 2 and firm 8 respectively were chosen as starting points. Then, the distance of each firm's **TPMC** index to selected firms' were calculated. The firms were classified together with the closest starting point. First iteration resulted in cluster 1 including firms 13,20,19,18,17,22,23,21 and 11, cluster 2 consisting of firm 2 and cluster 3 with firms 4,8 and 7.

The means of each newly formed group has become the hypothetical objects' s index from which the distances of firms' normative level **TPMC** index would be calculated. Then, the firms were again grouped together with the closest mean producing cluster 1 with firms 20,19,18,17, 21,23,11 cluster 2 with firms 13,2,22 and cluster 3 with firms 4,7,8.

The heuristic continued with 3rd and 4th iterations also. Since 3rd and 4th iterations gave the same results, the iterations were ended. At the end of convergence, firms 19,18,17,21,23 and 11 formed cluster 1; firms 13,20,2,22 were included in cluster 2 and firms 4,7,8 constituted cluster 3 (Table 4.2.2).

TABLE 4.2.2 K-Means heuristic for clustering Turkish automotive suppliers' firms with respect to Normative Level TPMC Index

Firm	Normative Level Capability Index	Distance from Point 1	Distance from Point 2	Distance from Point 3	Cluster
Point 1.1	%87				
Point 1.2	%93				
Point 1.3	%53				
Firm 13	%87	**0,0000**	0,0599	0,3401	1
Firm 20	%85	**0,0224**	0,0823	0,3177	1
Firm 19	%83	**0,0474**	0,1073	0,2927	1
Firm 18	%76	**0,1125**	0,1724	0,2276	1
Firm 17	%72	**0,1526**	0,2125	0,1875	1
Firm 4	%54	0,3292	0,3891	**0,0109**	3
Firm 2	%93	0,0599	**0,0000**	0,4000	2
Firm 22	%89	**0,0167**	0,0432	0,3568	1
Firm 21	%83	**0,0438**	0,1036	0,2964	1
Firm 23	%78	**0,0880**	0,1479	0,2521	1
Firm 11	%74	**0,1365**	0,1964	0,2036	1
Firm 8	%53	0,3401	0,4000	**0,0000**	3
Firm 7	%61	0,2620	0,3219	**0,0781**	3
Point 2.1	%81				
Point 2.2	%93				
Point 2.3	%56				
Firm 13	%87	0,0652	**0,0599**	0,3104	2
Firm 20	%85	**0,0428**	0,0823	0,2880	1
Firm 19	%83	**0,0178**	0,1073	0,2630	1
Firm 18	%76	**0,0473**	0,1724	0,1979	1
Firm 17	%72	**0,0874**	0,2125	0,1578	1
Firm 4	%54	0,2640	0,3891	**0,0187**	3
Firm 2	%93	0,1251	**0,0000**	0,3703	2
Firm 22	%89	0,0818	**0,0432**	0,3271	2
Firm 21	%83	**0,0214**	0,1036	0,2667	1
Firm 23	%78	**0,0229**	0,1479	0,2224	1
Firm 11	%74	**0,0713**	0,1964	0,1740	1
Firm 8	%53	0,2749	0,4000	**0,0297**	3
Firm 7	%61	0,1968	0,3219	**0,0484**	3

TABLE 4.2.2 (Continued)

Firm	Normative Level Capability Index	Distance from Point 1	Distance from Point 2	Distance from Point 3	Cluster
Point 3.1	%79				
Point 3.2	%90				
Point 3.3	%56				
Firm 13	%87	0,0862	**0,0255**	0,3104	2
Firm 20	%85	0,0638	**0,0479**	0,2880	2
Firm 19	%83	**0,0388**	0,0729	0,2630	1
Firm 18	%76	**0,0263**	0,1380	0,1979	1
Firm 17	%72	**0,0664**	0,1781	0,1578	1
Firm 4	%54	0,2430	0,3547	**0,0187**	3
Firm 2	%93	0,1461	**0,0344**	0,3703	2
Firm 22	%89	0,1028	**0,0089**	0,3271	2
Firm 21	%83	**0,0424**	0,0693	0,2667	1
Firm 23	%78	**0,0019**	0,1135	0,2224	1
Firm 11	%74	**0,0503**	0,1620	0,1740	1
Firm 8	%53	0,2539	0,3656	**0,0297**	3
Firm 7	%61	0,1758	0,2875	**0,0484**	3
Point 4.1	%78				
Point 4.2	%89				
Point 4.3	%56				
Firm 13	%87	0,0968	**0,0135**	0,3104	2
Firm 20	%85	0,0744	**0,0359**	0,2880	2
Firm 19	%83	**0,0494**	0,0609	0,2630	1
Firm 18	%76	**0,0157**	0,1260	0,1979	1
Firm 17	%72	**0,0558**	0,1661	0,1578	1
Firm 4	%54	0,2324	0,3427	**0,0187**	3
Firm 2	%93	0,1567	**0,0464**	0,3703	2
Firm 22	%89	0,1135	**0,0031**	0,3271	2
Firm 21	%83	**0,0530**	0,0573	0,2667	1
Firm 23	%78	**0,0088**	0,1016	0,2224	1
Firm 11	%74	**0,0397**	0,1500	0,1740	1
Firm 8	%53	0,2433	0,3536	**0,0297**	3
Firm 7	%61	0,1652	0,2755	**0,0484**	3

Before clustering of firms with respect to other **TPMC** indices, we will test whether normative level clusters obtained are different. This hypothesis will be accepted only if capability indices present levels that are significantly different.

Ho: Clusters are not different with respect to normative level TPMC index.

We can use the analysis of variance (ANOVA) to test the hypothesis that clusters are not different with respect to normative level of management (Table 4.1.3).

Since $F_{.01,\,2,\,10}$ = 7,56 which is less than F_0 (=51,64), we reject H_0 and conclude that the determined clusters are significantly different.

TABLE 4.2.3 Analysis of variance for Normative Level TPMC Indices of Turkish automotive suppliers' firms

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F_0
Cluster Type	0,18	2	0,0921	51,64
Error	0,02	10	0,0018	
Total Error	0,20	12		

The k-means heuristic was also applied for clustering of firms with respect to both strategic level **TPMC** indices. The heuristic converged at the end of two iterations. The heuristic resulted in cluster 1 with firms 13,20 cluster 2 with firms 19,18,17,4,2,22 and cluster 3 with firms 21,23,11,8,7. (Table 4.2.4)

TABLE 4.2.4 K-Means heuristic for clustering Turkish automotive suppliers' firms with respect to Strategic Level TPMC Index

Firm	Strategic Level Capability Index	Distance from Point 1	Distance from Point 2	Distance from Point 3	Cluster
Point 1.1	%64				
Point 1.2	%51				
Point 1.3	%39				
Firm 13	%64	**0,0000**	0,1245	0,2477	1
Firm 20	%61	**0,0258**	0,0987	0,2218	1
Firm 19	%55	0,0820	**0,0425**	0,1657	2
Firm 18	%55	0,0845	**0,0400**	0,1631	2
Firm 17	%55	0,0891	**0,0354**	0,1586	2
Firm 4	%53	0,1028	**0,0217**	0,1449	2
Firm 2	%51	0,1245	**0,0000**	0,1232	2
Firm 22	%48	0,1589	**0,0344**	0,0888	2
Firm 21	%43	0,2070	0,0825	**0,0406**	3
Firm 23	%43	0,2071	0,0826	**0,0405**	3
Firm 11	%41	0,2205	0,0960	**0,0271**	3
Firm 8	%39	0,2477	0,1232	**0,0000**	3
Firm 7	%38	0,2549	0,1304	**0,0072**	3
Point 2.1	%62				
Point 2.2	%53				
Point 2.3	%41				
Firm 13	%64	**0,0129**	0,1070	0,2274	1
Firm 20	%61	**0,0129**	0,0812	0,2016	1
Firm 19	%55	0,0691	**0,0250**	0,1455	2
Firm 18	%55	0,0716	**0,0224**	0,1429	2
Firm 17	%55	0,0762	**0,0179**	0,1384	2
Firm 4	%53	0,0899	**0,0042**	0,1246	2
Firm 2	%51	0,1116	**0,0175**	0,1029	2
Firm 22	%48	0,1460	**0,0519**	0,0685	2
Firm 21	%43	0,1941	0,1001	**0,0204**	3
Firm 23	%43	0,1942	0,1001	**0,0203**	3
Firm 11	%41	0,2076	0,1136	**0,0069**	3
Firm 8	%39	0,2347	0,1407	**0,0202**	3
Firm 7	%38	0,2420	0,1479	**0,0274**	3

The same hypothesis testing approach was also applied for strategic level of management. The results of analysis of variance are summarised in Table 4.2.5.

TABLE 4.2.5 Analysis of variance for Strategic Level TPMC Indices of Turkish automotive suppliers' firms

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F_0
Profile Type	0,08	2	0,0391	59,17
Error	0,01	10	0,0007	
Total Error	0,08	12		

Since $F_{.01,\,2,\,10}$ = 7,56 which is less than F_0 (=59,17), we reject H_0 and conclude that the determined clusters are significantly different with respect to strategic level **TPMC** profiles.

The k means heuristic again started with operational level capability indices of firm 13, firm 2 and firm 8 respectively as a starting solution. At the end of 4th iteration, it resulted in cluster 1 of firms 13,18,2,21 cluster 2 with firms 20,19,17,22 and cluster 3 with firms 4,23,11,8,7 (Table 4.2.6).

TABLE 4.2.6 K-Means heuristic for clustering Turkish automotive suppliers' firms with respect to Operational Level TPMC Index

Firm	Operational Level Capability Index	Distance from Point 1	Distance from Point 2	Distance from Point 3	Cluster
Point 1.1	%52				
Point 1.2	%54				
Point 1.3	%39				
Firm 13	%52	**0,0000**	0,0224	0,1299	1
Firm 20	%68	0,1615	**0,1391**	0,2914	2
Firm 19	%72	0,2040	**0,1816**	0,3339	2
Firm 18	%49	**0,0286**	0,0510	0,1013	1
Firm 17	%61	0,0899	**0,0675**	0,2198	2
Firm 4	%41	0,1091	0,1316	**0,0208**	3
Firm 2	%54	0,0224	**0,0000**	0,1523	2
Firm 22	%61	0,0887	**0,0663**	0,2186	2
Firm 21	%57	0,0456	**0,0232**	0,1755	2
Firm 23	%37	0,1505	0,1730	**0,0206**	3
Firm 11	%32	0,1955	0,2179	**0,0656**	3
Firm 8	%39	0,1299	0,1523	**0,0000**	3
Firm 7	%40	0,1196	0,1420	**0,0103**	3
Point 2.1	%51				
Point 2.2	%62				
Point 2.3	%38				
Firm 13	%52	**0,0143**	0,1020	0,1409	1
Firm 20	%68	0,1758	**0,0595**	0,3024	2
Firm 19	%72	0,2183	**0,1020**	0,3450	2
Firm 18	%49	**0,0143**	0,1306	0,1124	1
Firm 17	%61	0,1042	**0,0121**	0,2308	2
Firm 4	%41	0,0949	0,2112	**0,0318**	2
Firm 2	%54	**0,0367**	0,0796	0,1634	1
Firm 22	%61	0,1030	**0,0133**	0,2296	2
Firm 21	%57	0,0599	**0,0564**	0,1866	2
Firm 23	%37	0,1363	0,2526	**0,0096**	3
Firm 11	%32	0,1812	0,2976	**0,0546**	3
Firm 8	%39	0,1156	0,2319	**0,0110**	3
Firm 7	%40	0,1053	0,2216	**0,0214**	3

TABLE 4.2.6 (Continued)

Firm	Operational Level Capability Index	Distance from Point 1	Distance from Point 2	Distance from Point 3	Cluster
Point 3.1	%52				
Point 3.2	%64				
Point 3.3	%38				
Firm 13	%52	**0,0020**	0,1180	0,1409	1
Firm 20	%68	0,1635	**0,0435**	0,3024	2
Firm 19	%72	0,2061	**0,0861**	0,3450	2
Firm 18	%49	**0,0265**	0,1465	0,1124	1
Firm 17	%61	0,0920	**0,0280**	0,2308	2
Firm 4	%41	0,1071	0,2271	**0,0318**	3
Firm 2	%54	**0,0245**	0,0955	0,1634	1
Firm 22	%61	0,0907	**0,0293**	0,2296	2
Firm 21	%57	**0,0477**	0,0723	0,1866	1
Firm 23	%37	0,1485	0,2685	**0,0096**	3
Firm 11	%32	0,1935	0,3135	**0,0546**	3
Firm 8	%39	0,1279	0,2479	**0,0110**	3
Firm 7	%40	0,1175	0,2375	**0,0214**	3
Point 4.1	%53				
Point 4.2	%66				
Point 4.3	%38				
Firm 13	%52	**0,0099**	0,1360	0,1409	1
Firm 20	%68	0,1516	**0,0255**	0,3024	2
Firm 19	%72	0,1942	**0,0680**	0,3450	2
Firm 18	%49	**0,0384**	0,1646	0,1124	1
Firm 17	%61	0,0800	**0,0461**	0,2308	2
Firm 4	%41	0,1190	0,2452	**0,0318**	3
Firm 2	%54	**0,0125**	0,1136	0,1634	1
Firm 22	%61	0,0788	**0,0473**	0,2296	2
Firm 21	%57	**0,0358**	0,0904	0,1866	1
Firm 23	%37	0,1604	0,2866	**0,0096**	3
Firm 11	%32	0,2054	0,3316	**0,0546**	3
Firm 8	%39	0,1398	0,2659	**0,0110**	3
Firm 7	%40	0,1294	0,2556	**0,0214**	3

The clusters obtained with respect to operational level **TPMC** index are also significantly different (Table 4.2.7).

TABLE 4.2.7 Analysis of Variance for Operational Level TPMC Indices of Turkish automotive suppliers' firms

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F_0
Profile Type	0,17	2	0,0862	48,39
Error	0,02	10	0,0018	
Total Error	0,19	12		

($F_{.01,2,10} = 7{,}56 < F_0 = 48{,}39$)

After clustering the firms with respect to technology processes management capability indices, it is time to cluster the firms with respect to the combination of results. The firms that were included in the same cluster with respect to all **TPMC** indexes were grouped together as a strategic group. By using this methodology 3 different clusters could be obtained (Table 4.2.8). 6 of 13 firms were included in these clusters.

TABLE 4.2.8 Strategic groups of Turkish automotive suppliers' firms

Group Name	Firm Name	Operational Level Capability Index	Strategic Level Capability Index	Normative Level Capability Index
Group A	Firm 19-Firm 17	%67	%55	%77
Group B	Firm 23-Firm 11	%35	%42	%76
Group C	Firm 8-Firm 7	%39	%38	%57
AVERAGE OF 13 FIRMS		*%51*	*%50*	*%76*

4.3. Characterisation of the TPMC Profiles of Turkish Automotive Suppliers' Firms

The firms that make up each profile group appear in Table 4.2.8. With the aim of characterising the different profiles groups that have been obtained, we will analyse their positioning in the main aspects of scope of the business activities.

The relation between the position of the firm in the business activity and the level of its **TPMC** index creates a new opportunity for getting explanations about the management behaviours of the firm.

To make clear the relation between business activity level and **TPMC** index, a correlation analysis was performed. The results are shown in table 4.3.1. The most important fact of the analysis was that firms' technology process management capability indices indicate moderately high correlation with the volume of business activity. This statistical finding implies that as the business volume of firms that can be measured by figures of total sales, number of workers etc. increases the firm is more equipped to integrate its business strategy with its technology management. The converse of the finding is not necessarily true. That is, if a firm does not have adequate **Technology Processes Management Capabilities**, the firm is not necessarily is a small-scale firm.

Moreover, the productivity indicators (sales/employee, sales/direct worker) show low correlation with management levels' **TPMC** indices. Although it is a strong argument, productivity of a firm itself is not enough to make a statement about the firm's management approach towards technology. In other words, high level of employee efficiency in a firm does not imply that the firm has well equipped with technology management capabilities. Real business world is full of firms doing wrong things rightly (efficient but not effective).

TABLE 4.3.1 Correlation coefficients of TPMC Indices and business activity dimensions

Dimension	Operational Level TPMC Index	Strategic Level TPMC Index	Normative Level TPMC Index
Total Sales	0,52	0,59	0,47
Number of Employees	0,42	0,52	0,53
Sales/Employee	0,21	0,13	-0,29
Number of Direct Workers	0,36	0,46	0,52
Sales/Direct Worker	0,13	-0,14	-0,37

Before discussing each group, it has to be noted that Turkish automotive suppliers' firms in average have adequate capabilities at normative level for integrated technology management. However, it is an interesting conclusion that there is a considerable gap between the normative and strategic level **TPMC** indices, and normative and operational level indices respectively for all profile groups.

*1. Firms operating with adequate **TPMC** indices (Group A)*

This group includes big scale[1] firm 17 and small-scale firm 19. It has the maximum **TPMC** indices at each level of management among all groups. **TPMC** profiles of group-A firms are concave type reaching its minimum **TPMC** index at strategic level of management (Figure 4.3.1). Although strategic level **TPMC** index of group A is over industry average, these firms should balance strategic level technology processes management capabilities with those of normative and operational levels. Group A is the best candidate to align its business strategy with its technology strategy because of its adequate technology processes management capabilities at all levels of management organisation. The firms are the nearest ones to get competitive advantage by integrating technology to their business strategies.

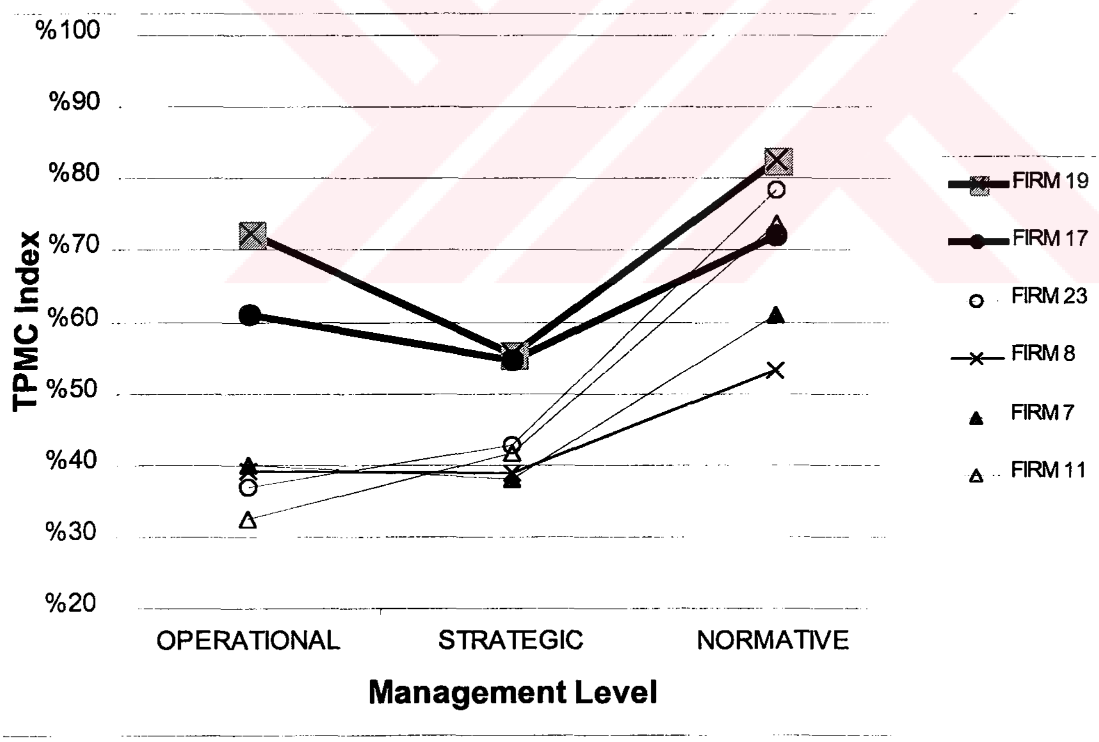

FIGURE 4.3.1.TPMC Profiles of group-A firms

[1] The term big scale in this study is used for firms having total sales more than \$100 million, while small scale used for firms having total sales less than \$40 million.

2. *Firms operating with high **TPMC** index gap at normative level(Group B)*

Group B includes two small-scale firms, 23 and 11. The most important characteristic of this group is that the gap between the capabilities of normative and of other levels of management reaches maximum in this group. Both operational level and strategic level **TPMC** indexes are considerably lower than the industry averages despite its high level of normative level capabilities (Figure 4.3.2). The firms in this group have to be concentrated on especially operational and strategic management levels. They should invest in those levels to apply a strategy that integrates technology management into business strategy.

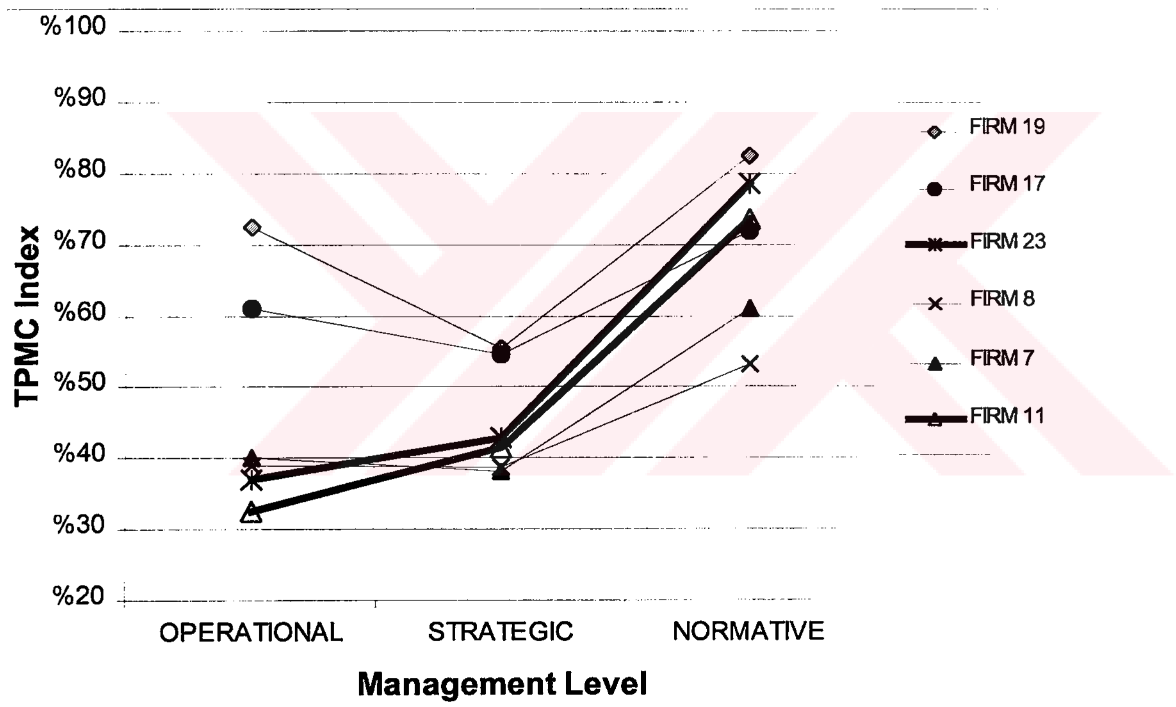

FIGURE 4.3.2. TPMC Profiles of group-B firms

3. *Firms operating with low **TPMC** indices (Group C)*

Group C consists of firm 8 and firm 7. This group has the minimum technology processes management capabilities at all levels of management compared to other groups. Therefore, group-C firms should invest in all levels of its management but especially at the operational and strategic level. The relative sizes of the gap between the capabilities of normative and of other levels of management reflect the general characteristic of the sector (Figure 4.3.3). The firms of group C are far away from integrating technology to their management organisations. Therefore, they have to seek conventional ways of getting competitive advantage in the market rather than technology until they complete their investments to equip with adequate technology processes management capabilities. Adequate technology processes management capabilities are the primary requirements to integrate technology management into business strategy.

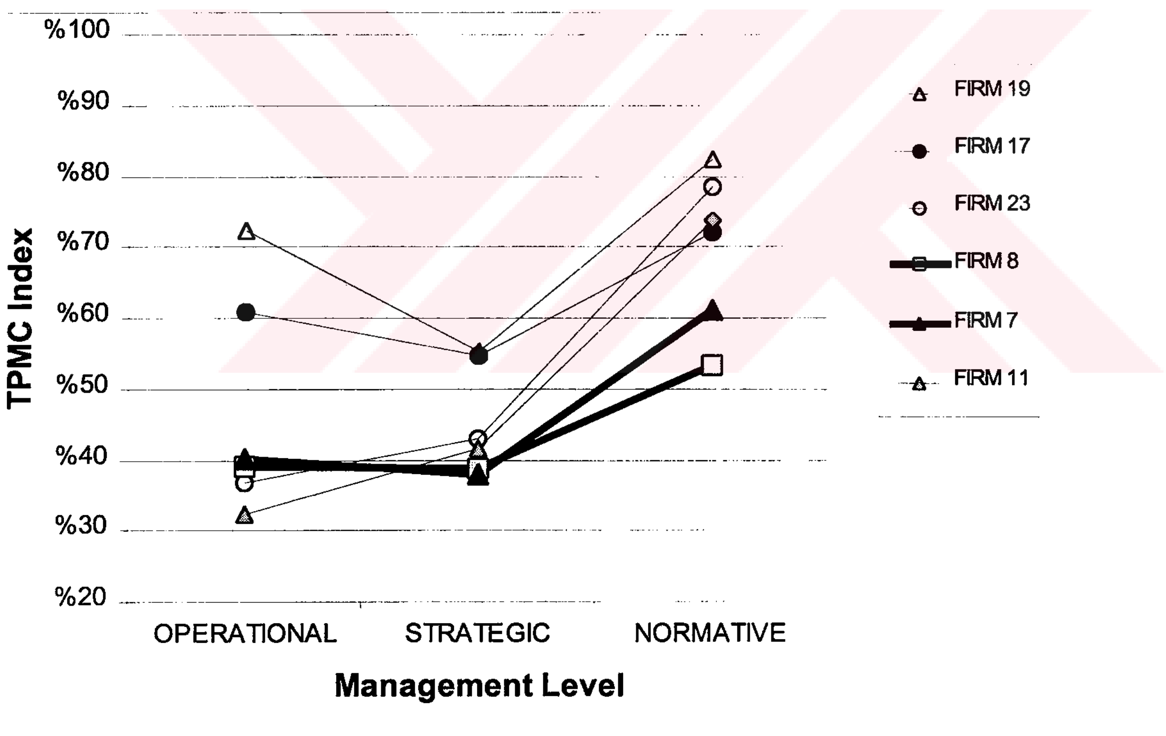

FIGURE 4.3.3. TPMC Profiles of group-C Firms

Measuring capabilities of firms with respect to each level of management organisations individually allows diagnosing the actual source of deficiency in management organisation.

Another benefit of **Technology Processes Management Capabilities Assessment Model** is the measurement of technology management capabilities of firms, which is an accumulation of mostly intangible factors.

The analysis of the strategic behaviour of firms has been the subject of extensive study in the literature on business management. These studies have mostly identified the behaviours of firms on the basis of financial ratios and volume of business activities such as liquidity of investments, intensity of personnel expenses and so on. Therefore, it is not a strong idea that the classification of firms with respect to technology processes management capabilities measured by **TPMC Assessment Model** is a new concept in business management.

5. ADAPTATION OF THE TPMC MODEL TO SERVICE INDUSTRY: THE CASE OF TURKISH SUPERMARKETS

Firms in the service industry have traditionally done little R&D of their own but have been heavily affected by service technologies (Betz, 1994). Because, technology management has become for years a poorly understood process for service firms.

This section addresses many of critical points for providing a conceptualisation of technology management in service industries. For this conceptualisation, firstly "Technology and New Product Development Management" questionnaire designed by Ozgur (1999) for manufacturing firms focusing on mainly automotive suppliers' firms has to be adapted to service industry.

Turkish supermarket industry, which is one of emerging sectors in Turkey, was chosen as service sector to focus on and to apply **TPMC** assessment model.

The section also puts into consideration the challenges of a research on technology management in service sector in Turkey.

5.1. Technology and New Customer Service Applications Development Management Questionnaire

Competitive factors for firms in retail industry include (1) location, (2) brand franchises, (3) inventory control and logistic capability, (4) price-sensitive advertising, (5) after-sales service, (6) point-of-sale information systems, and (7) computerised communication with customers (Watson, 1995; Corstjens, Corstjens, and Lal, 1995).

Research and development in these firms usually focus on development of customer service applications and development of logistic and scheduling technologies (Betz, 1994). Advances in service technologies such as logistics, computerised information, and communications affect their competitive capabilities. In the light of these inferences and dynamics of retail sector, the questions in the questionnaire of Ozgur (1999) were adapted to retail sector.

While one of main focuses of technology management in manufacturing is new product development, the design and implementation of new services is the equivalent process in service sector.

Service design is among the least studied and understood topics in service industries (Tax, and Stuart, 1997). Therefore, adapting the questionnaire of Ozgur (1999) into service sector firstly required the clarification of what constitutes a new service from the perspective of retail business.

Several classifications of services have been proposed. Carman and Langeard (1980) identify new services as either core (directly provide customer benefits) or peripheral (support or improve a core service). Moreover, they have described new services from a strategic perspective as multi-site (new sites providing the same service to the same customer segment), multi-segment (using the same site and service but attracting new customer segments), and multi-service (adding new services to the same site for the existing customer base).

Scheuing (1989) has classified new services as representing a "modification", "differentiation", "market creation", "market expansion", "market extension" or "diversification" based on new customer/new service categorisation.

Tax and Stuart (1997) defined new service as any change to the service system that requires different competencies from the existing operation. Prahlad and Hamel (1990) analysed these competencies along three separate dimensions:

1. The degree to which the new process is fundamentally different from the existing process.
2. The degree to which the skills and knowledge of new service participants are different from the existing service.
3. The degree to which the physical facilities (layout, required space etc.) of the new service are fundamentally different than those required from the existing ones.

While questioning the technology management capabilities of supermarket firms, the concept of new service development has to be clarified for getting answers correctly from firms.

The nature of technologies used in retail business defines the limits of technology management. Technologies in retail business can be perceived as technologies used in customer service applications such as loyalty card, and logistic technologies such as electronic data interchange (EDI).

The first consideration in adaptation of Ozgur questionnaire to supermarket industry was that product and process technologies dominate the automotive suppliers' sector, while customer service applications and logistic technologies dominate the retail business.

Moreover, the background of personnel allocated for development activities in the retail business is also different from that of manufacturing. While most of personnel responsible for R&D activities has an engineering and technical background in manufacturing, personnel with planning and computer science background directs the R&D studies in retail business.

The importance given to strategic factors also change from business to business. Sale function is one the most important functions in retail business. Sale of products requires additional efforts compared to other sectors. The atmospheres of stores, the display, timing and, stocking of products have great impact in sales.

Manufacturing high quality product is one of concerns of manufacturing firms. Offering high quality products to customers is the equivalent strategy in retail business.

Factors that determine the selection of technologies among alternatives also change depending on the nature of business. The geographic locations of stores and customer service development rate are the factors that do not exist in the case of manufacturing.

In the reference of these inferences, the questions of "Technology and New Product Development Management Questionnaire" was adapted to retail business. The obtained questionnaire is called "**Technology and New Customer Service Applications Development Management Questionnaire**" (Appendix).

For the application of Technology and New Customer Service Applications Development questionnaire, 4 supermarket firms, of 1 operating regionally were contacted, but 2 of them have answered the questionary fully, 1 has answered partially.

The answers were scored on TPMC scoring table with the same scoring rules used in the case of automotive suppliers' firms.

5.2. Technology Processes Management Capability Profiles of Turkish Supermarket Firms

The answers of 3 supermarket firms firstly were scored according to rules of **Technology Processes Management Capabilities Scoring Table** (Table 3.6.2). For each firm,

Technology Processes Management Capability (TPMC) Indices at normative, strategic and operational levels were calculated separately (Table 5.2.1).

TABLE 5.2.1. Technology Processes Management Capability Indices of Turkish supermarket firms

Firm	Operational Level Capability Index	Strategic Level Capability Index	Normative Level Capability Index
Firm 1	%32	%38	%61
Firm 2	%22	%54	%70
Firm 3	Not Available	%37	%51
Average	**%27**	**%43**	**%61**

As it is seen in Table 5.2.1, supermarket firms have maximum **TPMC** index at their normative level. This result coincides with the case of automotive suppliers' firms. The profiles of firm 1 and firm 2 are trend type with increasing TPMC indices at operational, strategic and normative level respectively (Figure 5.2.2).

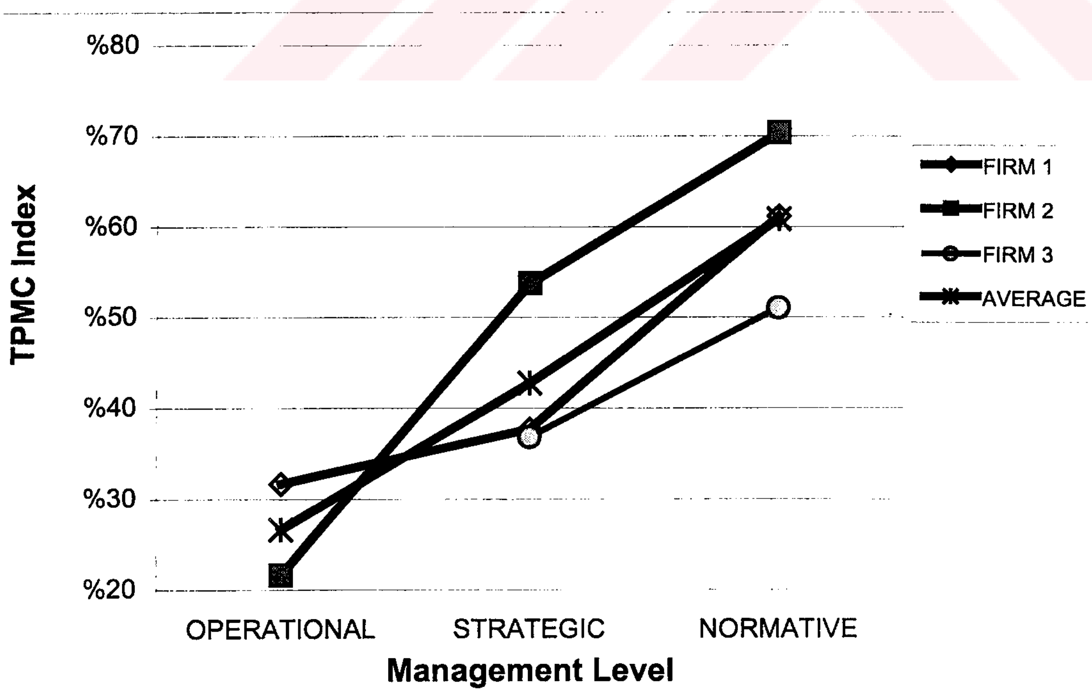

FIGURE 5.2.1. TPMC Profiles of Turkish supermarket firms

Operational level capability indices of supermarket firms are very low and there is a considerable gap between strategic level TPMC indices and other level TPMC indices in average. This low operational TPMC index is an indication of insufficiency of the sector in completing necessary capabilities at operational management level. Since, the retail business is accepted as a low-value activity (Corstjens, Corstjens, and Lal, 1995), it can be argued that the nature of supermarket business is one the reasons for this low level TPMC indices.

Difference between operational and strategic level TPMC indices of firm 1 is smaller than that of firm 2. However, firm 2 has higher TPMC indices at normative and strategic management levels compared to those of firm 1.

Firm 1 has to invest in especially at operational and strategic management levels while firm 2 should invest in operational management level. The profiles show that the supermarket firms are far away from integrating technology to their management organisations until they complete the required capabilities at related management levels.

Firm 3 has the smallest normative and strategic level TPMC indices and should do more compared to firm 1 and firm 2. Firm 3' s operational level TPMC index is not available because of missing answers. However, the characteristic of sector can help in estimating operational level capability. According to the nature of TPMC profile of the sector, the operational level index of firm 3 is possibly less than 37%.

It is noteworthy to state that adaptation of TPMC Assessment Model to supermarket sector was a challenging issue. Because, there was no much information supplied to public by supermarket firms. Some firms did not answer the questionary because of their managerial behaviour for not providing information.

Moreover, the sector does not employ capable personnel for R&D and technology management functions. This situation appeared clearly in answering the questions of "Technology and New Customer Service Application Development Questionnaire", and actually, the results obtained with limited number of firms are proof of these disabilities.

6. CONCLUSION

A technology-intensive 21st century requires firms to distinguish themselves from competitors by innovation instead of traditional competition weapons of 1900s such as efficiency, quality and flexibility. The competitiveness of firms is inevitably becoming more and more dependent on their ability to develop new technologies and products (or services) regardless of sector in which they operate. Therefore, management of technology and new product development has become the vital issue in firms' overall management.

Management of technology and new product development is not an isolated process within the firm. On the contrary, the global and dynamic business environment makes necessary integrating technology management process with business strategy to create and sustain competitive strengths. Therefore, this study firstly quantified the linkages between technology management specific concepts and general management concepts.

However, integrating technology management process with whole management is not an easy objective in practice. Firms must have capabilities embodied in different levels of management for integrating technology management to their overall management strategies.

This study has shown itself to be appropriate for understanding of the capabilities required integrated technology management. Technology Processes Management Capability Assessment Model developed for understanding these capabilities has two fundamental advantages. On the one hand, it allows the determination of Technology Processes Management Capabilities of firms regardless of the sector in which they operate. On the other hand it shows the real sources in the organisation, which prevent the integration of technology management process with business strategies successfully.

TPMC Assessment Model was applied in two fundamentally different sectors. First of all, automotive suppliers' industry is a manufacturing sector while the supermarket sector is service oriented. In addition, the former is nearly in stage of maturity while the latter is in growing stage in Turkey.

When average profiles of supermarket firms and automotive suppliers' firms are compared (Figure 6.1.1), it can be concluded that automotive suppliers industry is more equipped with technology management capabilities compared to supermarket sector in Turkey. Because, average TPMC indices of automotive suppliers' firms are higher than those of supermarket firms.

This may be due to the nature of businesses because the former is a service sector while the latter is a manufacturing sector or may be is the result of firms' strategies independent of the sector. This conclusion together with comparison of their abroad counterparts will prove whether the result is related with the nature of business activities or not.

Another result in comparison of two sectors' profiles is that the size of gap between operational level and strategic level TPMC indices for supermarket sector is considerably high while there is no gap for automotive suppliers' industry. The operational level capabilities of supermarket firms are very low compared to automotive suppliers' firms. Insufficiencies at the operational management level in supermarket sector prevent firms for using technology management as a competitive weapon. Therefore, they continue to use traditional ways of competition such as location, price and quality etc.

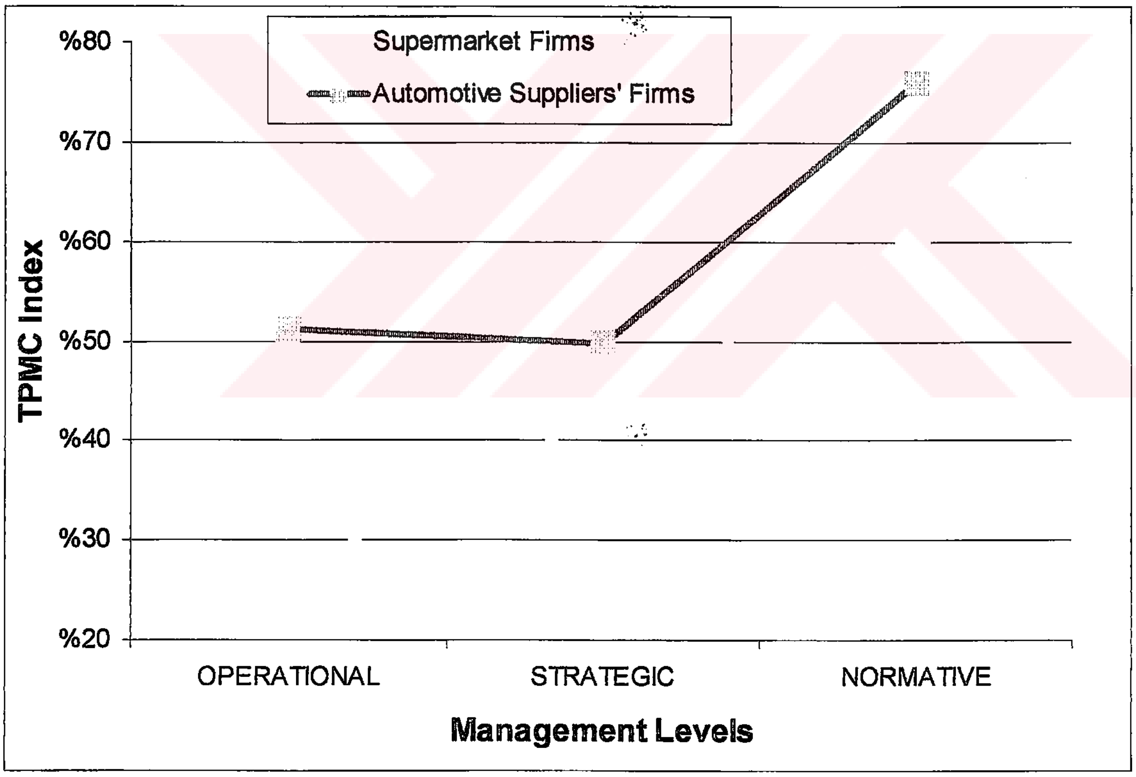

FIGURE 6.1.1. Average TPMC Profiles of Turkish supermarket firms and automotive suppliers' firms

Supermarket sector is similar to automotive supplier sector in that TPMC indices reach their maximum point at normative level of management and there is a considerable gap between normative level TPMC index and other management level's TPMC indices.

Both sectors are somehow adequate normative level capabilities for integrating technology management into their business strategy. However, an effective and efficient integration can be implemented if both sectors have completed required capabilities at operational and strategic management levels. In this perspective, Turkish supermarket sector should do more compared to automotive suppliers' sector.

The grouping of automotive suppliers' firms on the results of TPMC Assessment Model is also a new concept in business management. The analysis offers additional and better rewards than traditional clustering systems, which take the number of employees, the sales volume of the firm, the liquidity of investments, the intensity of personnel expenses, etc, as a reference. The approach allows us to determine the similarities or differences between the firms that can be not be identified by traditional ways of classifications. The strategic grouping on the TPMC, for example, classified big-scale firm 17 and small-scale firm 19 in the same group. It could not be possible to get the same result with traditional classification systems.

The Technology Processes Management Capability Assessment Model has been developed after a careful and detailed study related to integrated technology management process. The model constitutes a good basis for future studies in the area of integrated technology management. There is a need to repeat the application in automotive suppliers' industry in future for a number of times to analyse time perspective and the changes in TPMC profiles of firms. There is also need to use the model in other sectors to adopt the evolving approaches in the area of integrated technology management to the model.

APPENDIX

A.1. Technology and New Customer Service Applications Development Management Questionnaire

GENERAL

1. Please fill in the following table by considering the last three years of your company.

	1996	*1997*	*1998*
Total sales	USD	USD	USD
Total imports	USD	USD	USD
Private label[1] sales	USD	USD	USD
Total number of employee[2]			
Total number of store employee			
Number of stores			

2. The percentage of foreign ownership (if applicable) %___________

3. Quality certification status of the company;

a. ISO-9000 certificate :
- Yes, we have; ISO9001 ISO9002
- No we don't have, but we plan to apply in 2000
- We don't have a plan to obtain a certificate

b. Other quality certificates;

....

....

4. Please state the educational background of senior managers.
1. Business administration ____________________people.
2. Economics ____________________people.
3. Social sciences ____________________people.
4. Engineering ____________________people.
5. Others:________________________ ____________________people.

5. *Technology executive*

Please state the most senior management position that is accountable for development of new customer service applications and technologies[3].

____

[1] The product labels produced and sold only at the your stores.

[2] The total number of personnel employeed in stores as end of year including management stuff of stores.

[3] Because of the nature of the supermarket sector, the term techonolgy in the questionnaire should be perceived as technologies used in customer service applications, and logistic technologies. For example, loyalty card is a customer service application. Moreover, Electronic Data Interchange(EDI) is an example of logistic technologies. Technologies in customer service applications and logistic technologies are subjects of interest.

6. Taking into account the state of that position in the last three years, please, select one of the followings,
   1. The position is occupied by the same person
   2. ___________________changes occurred.

7.Technical personnel[4]

Please give the current number of technical personnel by classifying into the following categories.

	Number
1. Planning personnel[5]	
a. With graduate degree	______________
b. With undergraduate degree	______________
2. Information systems personnel	______________

8. *Technical personnel data*

	Avg. experience[6]	*Avg. duration in the company*	*Avg. annual training*
Planning personnel	Years	Years	Hours
Information systems personnel	Years	Years	Hours

9. Please state the number of technical personnel that are engaged in the development and improvement of work processes and customer service applications.
____________________people.

10. *Innovation expenditures*

	1996	*1997*	*1998*
R&D expenditures[7]	USD	USD	USD
External technology acquisition expenditures[8]	USD	USD	USD
External equipment acquisition expenditures[9]	USD	USD	USD

11.*General evaluations*

Please answer the following questions by taking into account the last three years.

1- Do not agree	2-Partly agree	3-Strongly agree

[4] Personnel employed at departrments of Planning, R&D, Information Systems, Automation and so on.
[5] Personel employed at departments accountable for implementation of planning, research and and development functions
[6] Average experience after graduation
[7] R&D includes activities made to get new scientific and technological information, use of this information for the improvement of existing work flows and customer service applications, development of new customer service applications. R& D services provided from out of firm is also included in R&D.
R& D expenditures are the expenditures allocated for above activities. Patent, licences and market researches are main examples of the actitivities whose expenditures should not be added to R&D expenditures.
[8] External technology acquisition expenditures are the expenditures allocated for purchasing licence, patent, know-how and technical consultation.
[9] External equipment acquisition expenditures are the ones made for purchasing of equipment, hardware and software.

1. The company has a stable and consistent strategic management.__________ 1 2 3
2. The company has a systematic process for strategic planning activities____ 1 2 3
3. The senior managers responsible for marketing and technology participate to strategic planning activities.____________________________ 1 2 3
4. The company has a systematic process for technology planning and strategy development.______________________________________ 1 2 3
5. The company utilises customer and suppliers' firms feedback in the formulation of its technology strategy.____________________________ 1 2 3
6. The company supports learning by experience.______________________ 1 2 3
7. The general planning horizon of the company is_ years.

12. *Strategic analysis*

1. Please select one of the followings.
   a. In the last three years the primary objective of the company was profit maximisation.
   b. In the last three years the primary objective of the company was market share increase.

2. Please select one of the followings.
   c. In the next three years the primary objective of the company will be profit maximisation.
   d. In the next three years the primary objective of the company will be market share increase.

Please indicate the importance given to the following factors in the last three years.

1- Do not agree	2-Partly agree	3-Strongly agree

3. Low price____ 1 2 3
4. Offering customers high quality products
   a. Conformance to specifications _____________________________ 1 2 3
   b. Durability for non-food products_____________________________ 1 2 3
   c. Reliability____ 1 2 3
   d. Serviceability for non-food products__________________________ 1 2 3
   e. Image / brand____ 1 2 3
   f. Display package of products__________________________________ 1 2 3
   g. High range of products_____________________________________ 1 2 3
5. Sales
   a. Displaying products at the right place of stores ____________________ 1 2 3
   b. Having stock at the right time__________________________________ 1 2 3
   c. Having adequate amount of stock _______________________________ 1 2 3
   d. Store atmosphere ____ 1 2 3
6. Flexibility
   a. Customer service applications flexibility[10]_______________________ 1 2 3
   b. Technology flexibility[11] ____________________________________ 1 2 3
7. Customer services[12]____ 1 2 3

Please indicate the importance given to the following factors in the last three years.

1- Do not agree	2-Partly agree	3-Strongly agree

8. Technology leadership ____________________________________ 1 2 3

[10] Ability to develop new customer service applications, to make changes in existing applications, to adapt service applications to customer needs.

[11] bility to change the logistic technologies used in various work processes.

[12] Help desk, problem solution etc.

9. Technology followership______ 1 2 3
10. Shortening of development time for new customer service application____ 1 2 3
11. Development of more efficient processes for existing customer services.___ 1 2 3
12. Small modifications in the existing customer service applications supplied to existing markets.______ 1 2 3
13. Development of new customer service applications for existing markets.___ 1 2 3
14. Introduction of existing customer service applications to new markets.____ 1 2 3
15. Development of new customer service applications for new markets______ 1 2 3

IDENTIFICATION

13. *Identification of information needs*

Please answer the following questions by taking into account the process of identifying and gathering information related to customer service applications and logistic technologies.

1- Do not agree	2-Partly agree	3-Strongly agree

1. The company has defined procedures for technology monitoring and development.______ 1 2 3
2. The technologies used in the company are defined in the form of a portfolio[13] .______ 1 2 3
3. The development associated with the existing technologies are monitored._ 1 2 3
4. The development associated with the technology intended for use in the future are monitored .______ 1 2 3
5. Technology practices and development projects of competitors are monitored .______ 1 2 3
6. Senior management is informed about the developments in science and technology.______ 1 2 3

14. *Selection of information sources*

Please indicate the frequency of use and the contribution of each of the following information sources.

Frequency	1- Never	2-Sometimes	3-Often
Contribution	1-Little	2-Moderate	3-Great

	Frequency			Contribution		
1. Scientific and technical publications	1	2	3	1	2	3
2. Scientific and professional meetings	1	2	3	1	2	3
3. Trade fairs	1	2	3	1	2	3
4. Disclosed patents	1	2	3	1	2	3
5. Customers	1	2	3	1	2	3
6. Suppliers	1	2	3	1	2	3
7. Related companies	1	2	3	1	2	3
8. Companies from other sectors	1	2	3	1	2	3
9. Universities	1	2	3	1	2	3
10. Benchmarking	1	2	3	1	2	3
11. Consulting companies	1	2	3	1	2	3
12. Professional associations	1	2	3	1	2	3
13. Chambers of commerce / industry	1	2	3	1	2	3

[13] Identification of technologies individually, and documantation in the form of a list.

14. Others:________________________________ 1 2 3 1 2 3

15. *Information gathering*

Please answer the following questions by taking into account the technology monitoring activities.

1- Do not agree	2-Partly agree	3-Strongly agree

1. We have personnel responsible for technological monitoring.____________ 1 2 3
2. We utilise consulting firms for technological monitoring.______________ 1 2 3

16. *Information analysis*

1. Information analysis is carried out in accordance with a procedure________ 1 2 3
2. Compiled information is reported and sent to relevant personnel._________ 1 2 3
3. A computer system is used for storage of gathered information.__________ 1 2 3
4. Employees have access to gathered information._____________________ 1 2 3

We evaluate the impact of new and emerging technologies:

5. We evaluate the impact of new and emerging technologies on the sector.___ 1 2 3
6. We evaluate the impact of new and emerging technologies on the company .________________________________ 1 2 3
7. We evaluate the commercial potential of new and emerging technologies._ 1 2 3

17. *Organisational issues*

1. Technology intelligence function is explicitly defined and included in the job description of the related personnel.______________________ 1 2 3
2. The services provided by the technology intelligence function are known by the other functions._____________________________________ 1 2 3
3. Technology intelligence activities are budgeted._______________________ 1 2 3
4. Technology intelligence function has clearly defined objectives.__________ 1 2 3
5. The performance of technology intelligence function is regularly evaluated. 1 2 3
6. Important information is periodically reviewed and if necessary follow up activities are initiated.________________________________ 1 2 3

SELECTION

18. *Company factors*

Please state the impact of the following factors on the selection among technological alternatives.

1- No impact	2-Little impact	3-Great impact

1. Cost ____ 1 2 3
2. Cash flow____ 1 2 3
3. The level of store personnel' capabilities______________________ 1 2 3
4. The level of management capabilities_________________________ 1 2 3
5. The level of information system infrastructure ___________________ 1 2 3
6. Related firms____ 1 2 3
7. Company culture_______________________________________ 1 2 3

19. National factors

Please state the impact of the following factors on the selection among technological alternatives.

1- No impact	2-Little impact	3-Great impact

1. Loan obtaining possibilities and terms________________ 1 2 3
2. Infrastructure costs ________________ 1 2 3
3. Government incentives________________ 1 2 3
4. Other laws and regulations________________ 1 2 3

Please state the impact of personnel recruitment issues on the selection among technological alternatives.

Reason	1- Ease of recruitment		2-Difficulty of recruitment
Impact	1- No impact	2-Little impact	3-Great impact

	Impact			Reason	
5. Ability to recruit low-paid workers________	1	2	3	1	2
6. Ability to recruit skilled workers________	1	2	3	1	2
7. Ability to recruit low-paid technical staff________	1	2	3	1	2
8. Ability to recruit skilled technical staff________	1	2	3	1	2
9. Ability to recruit low-paid managers________	1	2	3	1	2
10. Ability to recruit skilled managers________	1	2	3	1	2

20. *Product and market environment*

Please state the impact of the following factors on the selection among technological alternatives.

1- No impact	2-Little impact	3-Great impact

1. Customer relations________________ 1 2 3

   Customer complaints   Decrease in the number of customers   Providing fast service   Others:

2. Location of stores________________ 1 2 3

   Wide geographical distribution   Intensifying in a specific location   Others:

3. Competition intensity________________ 1 2 3

   Many competitors   Few competitors   No competitors   Others:

4. Customer service development rate________________ 1 2 3

   Rapid customer service development rate   Slow customer service development rate   Others:

5. Market size________________ 1 2 3

   Big size   Small size   Other:

6. Market growth______________________________1 2 3

Growing market Stagnant market Shrinking market Others:

7. Political and economic environment__________________1 2 3
Reason: ....

21. *Economic analysis*

Please state the methods used for the economic analysis of technological alternatives.

1- Never utilised	2-Sometimes utilised	3-Often utilised

1. Scoring models______________________________1 2 3
2. Net present value analysis______________________1 2 3
3. Pay back period analysis_______________________1 2 3
4. Internal rate of return analysis___________________1 2 3
5. Others:____________________________________1 2 3

Please indicate the qualitative factors that were explicitly included in the economic analysis.

1- Do not agree	2-Partly agree	3-Strongly agree

6. Increase in the number of customers ________________1 2 3
7. Increase in customer satisfaction __________________1 2 3
8. Increase in inventory turnover rate _________________1 2 3
9. Learning and experience ________________________1 2 3
10. Others:___________________________________1 2 3

22. *Critical factors in technology selection*

Please evaluate the following factors related to technology selection.

1- Do not agree	2-Partly agree	3-Strongly agree

1. We establish consensus among all parties that will be influenced by the selected technologies.______________________1 2 3
2. In the selection of technologies requiring large investment, strategic issues dominate economic considerations.____________1 2 3
3. Senior management leads technology selection.____________1 2 3
4. In the selection of technologies we evaluate the impact on customers.______1 2 3
5. In the selection of technologies we evaluate the impact on suppliers.______1 2 3
6. Technology selection is carried by a multi-functional team. __________1 2 3
7. In the selection of technologies we evaluate the compatibility with the existing work processes. ________________________1 2 3

ACQUISITION

23. *Internal technology sources*

Please indicate the technology sources that were utilised in the last three years.

Use	1-Not utilised		2-Utilised
Efficiency	1-Not efficient	2- Moderately efficient	3-Extremely efficient

	Use		Efficiency		
1. R&D / Planning Departments	1	2	1	2	3
2. Department of Information Systems	1	2	1	2	3
3. Others:	1	2	1	2	3

24. *External technology sources*

Please indicate the technology sources that were utilised in the last three years.

Use	1-Not utilised		2-Utilised
Efficiency	1-Not efficient	2- Moderately efficient	3-Extremely efficient

	Use		Efficiency		
1. Related companies	1	2	1	2	3
2. Other companies	1	2	1	2	3
3. Universities	1	2	1	2	3
4. R&D institutions	1	2	1	2	3
5. Supplier companies	1	2	1	2	3
6. Consulting companies	1	2	1	2	3
7. Publications	1	2	1	2	3
8. Trade fairs, conferences	1	2	1	2	3
9. Others:	1	2	1	2	3

25. *Methods in technology acquisition*

Please indicate which of the following methods were utilised in technology acquisition.

Efficiency	1-Not efficient	2- Moderately efficient	3-Extremely efficient

	Number	Efficiency		
1. Developed completely by the company		1	2	3
2. Purchase of license		1	2	3
3. Establishment of joint-venture		1	2	3
4. Subcontracting of R&D to other companies and research institutions		1	2	3
5. Joint R&D with universities		1	2	3
6. Technology development partnership		1	2	3
7. Hiring of experts		1	2	3
8. Technology intelligence activities		1	2	3
9. Purchase of technology as part of work processes		1	2	3
10. Acquisition of small high-tech firms		1	2	3
11. Others:		1	2	3

26. *Reasons for acquisition of technology from internal sources*

Please state the impact of the following factors for acquisition of technology from internal sources.

1- No impact	2-Little impact	3-Great impact

1. Internal R&D is less expensive than acquisition from external sources.____ 1 2 3
2. R&D area is close to existing technical capabilities.____ 1 2 3
3. The company wishes to gain expertise in a particular technology____ 1 2 3
4. The company wishes to keep its technological capability confidential.____ 1 2 3
5. The company culture fosters the belief that the only good technology is developed internally.____ 1 2 3
6. The technology acquired is a basic technology[14].____ 1 2 3
7. The technology acquired is a key technology[15].____ 1 2 3
8. The technology acquired is a pacing technology[16].____ 1 2 3
9. Others:____ 1 2 3

27. *Reasons for acquisition of technology from external sources*

Please state the impact of the following factors for acquisition of technology from internal sources.

1- No impact	2-Little impact	3-Great impact

1. Time constraints exist.____ 1 2 3
2. The need to reduce uncertainties related to the cost, timing, and performance of the new customer services and logistic technologies.____ 1 2 3
3. The company does not have the skills to develop the technology.____ 1 2 3
4. External acquisition is less expensive than internal development.____ 1 2 3
5. R&D function is over occupied with incremental improvements.____ 1 2 3
6. Disappointment with the past performance in R&D area.____ 1 2 3
7. The technology acquired is a basic technology.____ 1 2 3
8. The technology acquired is a key technology.____ 1 2 3
9. The technology acquired is a pacing technology.____ 1 2 3
10. Others:____ 1 2 3

28. *Critical factors in technology acquisition*

Please answer the following questions by taking into account the technology acquisition activities in the last three years.

1- Do not agree	2-Partly agree	3-Strongly agree

1. The technologies acquired are tried and accepted technologies.____ 1 2 3
2. Technology acquisition is carried out by a multi-functional team.____ 1 2 3
3. During technology acquisition, intensive communication between all parties is insured.____ 1 2 3
4. Face to face communication is preferred in technology acquisition.____ 1 2 3

---

[14] Basic techologies- fundamental technologies used widespread by all firms in the related business area.

[15] Key technologies-technologies that are in stage of widespread but only owned by a few number of firms and that provide competitive advantage.

[16] Pacing technologies-new technologies that are in the stage of development and have possibly become key technology in future.

5. The employees who will use the technology are included in the acquisition process.___ 1 2 3
6. The employees who will use the technology are informed in detail about the benefits of it.___ 1 2 3

EXPLOITATION

29. *Strategies for technology exploitation*

Please indicate the strategies that were applied for technology exploitation.

Efficiency	1-Not efficient	2- Moderately efficient	3-Extremely efficient

	Number	Efficiency		
1. Using in own work processes and customer services		1	2	3
2. Collaboration with other companies for marketing		1	2	3
3. Joint-venture		1	2	3
4. Licensing-out		1	2	3
5. Consulting		1	2	3
6. Sale of the technology		1	2	3
7. Others:		1	2	3

30. *Difficulties in the exploitation of technologies*

Please indicate the factors that constituted barriers to successful technology exploitation.

1- Do not agree	2-Partly agree	3-Strongly agree

1. Lack of managerial knowledge and experience___ 1 2 3
2. Lack of technical expertise.___ 1 2 3
3. Resistance to use of new technology by employees.___ 1 2 3
4. Insufficient training programs.___ 1 2 3
5. Incompatibility of the new technology with the existing technologies.___ 1 2 3
6. Lack of complementary technologies and systems.___ 1 2 3
7. Poor infrastructure.___ 1 2 3
8. Others:___ 1 2 3

31. *Critical factors in technology exploitation*

Please evaluate the following factors related to technology exploitation.

1- Do not agree	2-Partly agree	3-Strongly agree

1. Sufficient training is given to employees about the use of new technologies.___ 1 2 3
2. Economic incentives are given to employees for the use of the new technology.___ 1 2 3
3. Job security is assured in the transition to new technologies.___ 1 2 3
4. Employee suggestions are collected and evaluated about the use of new technologies.___ 1 2 3
5. Management supports employees for the use of new technologies.___ 1 2 3

PROTECTION

32. *Protection of customer service applications and technologies related to these applications*

Please indicate the methods applied to protect your competitive advantage insured through customer service applications and technologies related to these applications.

Efficiency	1-Not efficient	2- Moderately efficient	3-Extremely efficient

	Number	Efficiency		
1. Patenting / utility model		1	2	3
2. Licensing		1	2	3
3. Assurance of secrecy		1	2	3
4. Lead time advantage due to early introduction		1	2	3
5. Keeping the related personnel in the company		1	2	3
6. Others:		1	2	3

33. *Protection of logistic technologies*

Please indicate the methods applied to protect your competitive advantage insured through production technologies.

Efficiency	1-Not efficient	2- Moderately efficient	3-Extremely efficient

		Efficiency		
1. Patenting		1	2	3
2. Licensing		1	2	3
3. Assurance of secrecy		1	2	3
4. Lead time advantage due to early introduction		1	2	3
5. Keeping the related personnel in the company		1	2	3
6. Others:		1	2	3

ABANDONEMENT

34. *Abandonment of technologies related to customer service applications*

Please indicate the number of technologies related to customer service applications abandoned in the last three years.

____

Please indicate whether the following factors influenced the decision to abandon technologies.

Reason	1-No	2-Yes	
Importance	1-Less important	2-Important	3-Very important

	Reason		Importance		
1. Explicit demands of customers to shift to new technologies.	1	2	1	2	3
2. Explicit demands of suppliers to shift to new technologies.	1	2	1	2	3
3. Shift of competitors to new technologies.	1	2	1	2	3
4. Shift to technologies providing cost advantage.	1	2	1	2	3
5. Insufficiency of demand about customer service applications supported by existing technologies .	1	2	1	2	3
6. Shift to technologies providing flexibility in Developing new customer service applications.	1	2	1	2	3
7. Shift to customer service technologies that will create a quality image in customers.	1	2	1	2	3

Abandonment of existing technologies due to:

	Reason		Importance		
8. Becoming cost disadvantageous.______	1	2	1	2	3
9. Becoming inadequate in regard to technical specifications.______	1	2	1	2	3
10. Becoming inadequate in regard to service rate.______	1	2	1	2	3

35. *Abandonment of logistic technologies*

Please indicate the number of logistic technologies abandoned in the last three years.

____

Please indicate whether the following factors influenced the decision to abandon technologies.

Reason	1-No		2-Yes
Importance	1-Less important	2-Important	3-Very important

	Reason		Importance		
1. Explicit demands of supplier firms to shift to new logistic technologies.______	1	2	1	2	3
2. Shift of competitors to new logistic technologies.______	1	2	1	2	3
3. Shift to logistic technologies providing cost advantage.______	1	2	1	2	3
4. Shift to new logistic technologies to insure compatibility with other existing technologies.______	1	2	1	2	3
Abandonment of existing production technologies due to:					
5. Becoming cost disadvantageous.______	1	2	1	2	3
6. Becoming inadequate in regard to technical specifications.______	1	2	1	2	3
7. Becoming inadequate in regard to supply rate.______	1	2	1	2	3
8. Becoming inadequate in information flow .______	1	2	1	2	3
9. Becoming inadequate in regard to safety.______	1	2	1	2	3
10. Becoming inadequate in regard to environmental regulations.______	1	2	1	2	3

IMPLEMENTATION OF NEW LOGISTIC TECHNOLOGIES

36. *Activities for implementation of new logistic technologies*

Please indicate whether the following activities are performed for implementation of new logistic technologies that include big innovation[17] in the last three years.

Reason	1-No		2-Yes
Importance	1-Less important	2-Important	3-Very important

	Reason		Importance		
1. Financial analysis.______	1	2	1	2	3
2. Identification of all processes where new logistic technologies will be used.______	1	2	1	2	3
3. Feasibility analysis of existing machine and equipment.______	1	2	1	2	3
4. Training of personnel.______	1	2	1	2	3

[17] Logistic technologies that include big innovation: change the flow, performance measures, and inputs of a work process significantly.

37. *Implementation projects of new logistic technologies*

Please indicate whether any planning method is used in implementation of new logistic technologies.

1-Never	2-Sometimes	3-Always

Is there any formal project organisation and management procedure followed while implementing new logistic technologies?

1-Yes	2-No

If the answer is yes, is this formal procedure distributed all related personnel?

1-Never	2-Sometimes	3-Always

38. *Project team*

Please indicate the number of core project team personnel[18] and the departments they work for in a typical implementation project of a new logistic technology.

Department/Function	Number of personnel
Store/sale	
Investment	
R&D/Planning	
Marketing	
Purchasing	
Finance	
Information systems	
Other	

39. *Project organisation*

Please indicate the type of project organisations used in implementation project of a new logistic technology.

Organisation	Never	Sometimes	Always
Functional organisation[19]			
Matrix organisation[20]			
Project organisation[21]			
Other			

[18]Core project team personnel is the stuff who takes part in the project from beginning to end.

[19] Functional organisation: Members of project team perform their project tasks individually. There is no team work. Persons are organised according to their expertise and task.

[20] Matrix organisation is a combination of functional and project organisation. Members of the project team report to both project manager and also to their department chief.

[21] Project organisation: All members of the team are directed by project manager. Project manager is the chief of team members.

DEVELOPMENT OF NEW CUSTOMER SERVICE APPLICATIONS

40. *New customer service application ideas*

Please indicate the frequency of use and the contribution of each of the following information sources in formation of new customer service applications ideas in the last three years.

Efficiency	1-Not efficient	2- Moderately efficient	3-Extremely efficient

1. Customers	1	2	3
2. Supplier firms	1	2	3
3. Suggestions of employees	1	2	3
4. Competitors	1	2	3
5. Consulting firms	1	2	3
6. Universities	1	2	3
7. Legal regulations	1	2	3
8. Research institutes	1	2	3
9. Professional meetings/magazines	1	2	3
10. Trade fairs	1	2	3
11. R&D department	1	2	3
12. Marketing department	1	2	3
13. Stores	1	2	3
14. Top management	1	2	3
15. Other:	1	2	3

41. *New customer service application development process*

Please indicate whether the following activities about customer service applications development process are performed considering new customer service application development projects that include big innovation[22] in the last three years.

Activities performed before development stage	Perfection Level			Out-sourcing
	Poor	Adequate	Good	
Preliminary elimination of new customer service application ideas				
Preliminary assessment of market				
Preliminary technical assessment				
Preliminary financial analysis				
Customer needs and demand search				
Competition analysis				
Market analysis				
Macro environmental analysis				
Identification of service application				
Detailed technical assessment				
Concept test				
Detailed financial analysis				

[22] New customer service application including big innovation: an application which is significantly different from existing ones from the point of view of service rate, target customer profile, and inputs used.

Development stage activities	Perfection Level			Out-sourcing
	Poor	Adequate	Good	
Design of customer service application				
Design of service application process				
Design of quality system				
Planing customer tests				
Development of marketing plan				

Testing and verification activities	Perfection Level			Out-sourcing
	Poor	Adequate	Good	
Testing in special environment				
Customer tests				
Revision of sales and marketing plans				
Revision of financial projections				
Offering to customers				

42. *Implementation projects of new customer service applications*

Please indicate whether any planning method is used in implementation of new customer service applications.

1-Never	2-Sometimes	3-Always

Is there any formal project organisation and management procedure followed while implementing new customer service applications?

1-Yes	2-No

If the answer is yes, is this formal procedure distributed all related personnel?

1-Never	2-Sometimes	3-Always

43. *Project team*

Please indicate the number of core project team personnel and the departments they work for in a typical implementation project of a new customer service application.

Department/Function	Number of personnel
Store/sale	
Investment	
R&D/Planning	
Marketing	
Purchasing	
Finance	
Information systems	
Other	

44. *Project organisation*

Please indicate the type of project organisations used in implementation project of a new customer service application.

Organisation	Never	Sometimes	Always
Functional organisation			
Matrix organisation			
Project organisation			
Other			

TECHNICAL CAPABILITIES

45. *Methods and techniques*

Please indicate how many times the following techniques and methods are used in projects with their perfection levels.

Method/technique	Not used	Number of projects used	Perfection level		
			Poor	Adequate	Good
Value analysis					
Failure mode effects analysis					
Simulation techniques					
Benchmarking					

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