

## **An Empirical Study into the Determinants of Innovativeness in Manufacturing Firms**

Gündüz Ulusoy<sup>1+</sup>, Gürhan Günday<sup>2</sup>, Kemal Kılıç<sup>1</sup> and Lütfihak Alpkan<sup>3</sup>

<sup>1</sup> Sabancı University, Faculty of Engineering and Natural Sciences, 34956 Orhanlı-Tuzla,  
Istanbul, Turkey

<sup>2</sup> TUBITAK Institute for Industrial Management (TUSSIDE), 41401 Gebze, Kocaeli,  
Turkey

<sup>3</sup> Gebze Institute of Technology, Department of Management, 41400 Çayırova Gebze-  
Kocaeli, Turkey

**Abstract.** The main objective of this paper is to report on the findings of an empirical study on the determinants of innovativeness in manufacturing firms. The empirical study covers 184 manufacturing firms located in the Northern Marmara region of Turkey. The types of innovation are taken as product, process, marketing and organizational innovations as suggested in the Oslo Manual 2005 published by OECD. A model is proposed to explore the probable effects and the amount of contribution of the determinants of innovativeness to innovativeness level. Among all possible determinants of innovativeness considered, intellectual capital has the highest impact on innovativeness followed by firm culture.

**Keywords:** Innovation, Determinants of Innovativeness, Empirical Research, Manufacturing Industry

### **1. Introduction**

Increasingly, firms and countries face the hard challenge of global competition and the treachery dynamics of global markets. New product development, increased capability in products and production strategies, new markets, and new trends in supply chain management are some of the tools firms try to adopt in order to survive in such an environment. Recently, innovativeness has become to be appreciated as an instrument of increasing importance for firms when shaping their business strategies to enter new

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<sup>+</sup> Corresponding author. Tel.: +216 4839503; Fax: +216 4839550.  
*E-mail address:* gunduz@sabanciuniv.edu

markets, to increase their existing market share and to generate and sustain competitive advantage. Therefore, innovation management research has received and continues to receive increasing attention in recent years [1], [2].

Innovation is multi-faceted and pervasive throughout a firm and embodies a wide spectrum of facets such as reducing costs, improving product and service quality, designing better products, enduring shortened product life cycle, responding to customer needs and demands and thus developing new services and products, new organization models and new marketing techniques. In the literature, various researchers advocate that a modern company needs to be innovative in order to compete more effectively in its market [3]. Innovativeness is one of the crucial drivers of improvement in firm performance that explains differences in performance among firms [4].

In this research, OECD Oslo Manual [5] which is the primary international basis of guidelines for defining and assessing innovation activities as well as for compilation and use of related data, has been taken as the fundamental reference source to describe, identify and classify innovations at firm level. Oslo Manual is considered as the primary international basis of guidelines for defining and assessing innovation activities as well as for compilation and use of related data. In the Oslo Manual, four different innovation types are introduced. These are, product innovation, process innovation, marketing innovation and organizational innovation.

In the OECD Oslo Manual, product innovation is defined as the introduction of a good or service that is new or significantly improved regarding its characteristics or intended uses. Process innovation is defined as the implementation of a new or significantly improved production or delivery method. Note that product innovation and process innovation are closely related to the concept of technological developments and usually referred to as technological innovation in the literature. A marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. Finally, an organizational innovation is defined as the implementation of a new organizational method in the firm's business practices, workplace organization or external relations.

This paper focuses on detecting various innovation determinants in order to understand how innovations are produced at the firm level and revealing the main factors that shape an innovative atmosphere in manufacturing firms. By discovering important innovation determinants, we claim that the innovativeness capability of a firm can be depicted.

In the next section, research background, with innovation determinants, drivers of innovativeness model and the methodology will be presented. Later, the findings of the

data analysis will be reported in section 3. Finally, in the forth section, conclusions and concluding remarks are provided.

## **2. Research Background**

### **2.1. Innovation Determinants**

In order to lead the competition race, the firms try to differentiate themselves from their competitors in the market by implementing various strategies, such as positioning as the most innovative, as the most cost efficient producer, as the most responsive to market changes, etc. The companies that position themselves as the innovative one in the market, struggle to find out the customer needs that are not met yet and develop new products and services to satisfy these needs. Some companies turn out to be more successful than the others in achieving this objective due to various internal and external factors they possess. These factors that affect the innovativeness, i.e. innovative capabilities, of the companies are referred to as the innovation determinants in the literature.

Conjectural studies are the pioneers of the innovation literature that has been grown and matured by the researches which tried to elucidate the innovation concepts by defining organizational policies, processes and characteristics whereby firms develop innovative and creative ideas regarding its products, processes, and markets [6,1].

Firms are basic units where innovations occur. Innovations can be created by several ways in firms. Since the research is the main factor of innovations that generates ideas and technical skills, innovation can be in the form of invention. Also, adapting and imitating can also be very useful firm strategies; a company can be innovative by taking an idea from other firms or sectors and adjusting it for its own purposes. To be capable of launching an innovation, a firm usually needs to merge a number of different types of skills, capabilities, knowledge and resources [7].

A large number of studies in innovation literature have been carried out in order to find out which factors enhance innovative efforts of firms [8,9,10,11,12,13,14,15,16,17,18]. But, so far, a complete model of innovativeness was hardly ever tested by researchers. The purpose of this research is to present an innovativeness model in order to explore the probable effects and the amount of contribution of the determinants of innovation to innovativeness level. The determinants of innovation are taken here as the firm characteristics, firm culture, intellectual capital, firm strategies, and market and sector conditions.

These determinants can be grouped in two categories: indigenous and exogenous. The indigenous parameters include general firm characteristics (firm age, size, ownership

status and foreign capital), firm structure (intellectual capital and organization culture), and firm strategies (such as collaborations, knowledge management, investments strategies and operations priorities). On the other hand, exogenous parameters are sector conditions (market structure, public regulations and incentives, and barriers to innovation). To sum up, the innovativeness is a mixed result of general firm characteristics, organizational structure, its strategies and external conditions.

## 2.2. Drivers of Innovativeness Model

Innovativeness in a firm is a joint outcome, among others, of firm characteristics, firm structure, firm strategies and external conditions. These innovation determinants with all their sub-elements are presented by an innovativeness model in **Fig. 1**. Here, innovativeness is defined as a measure obtained by merging four innovation types performed, namely, product, process, marketing and organizational innovations.

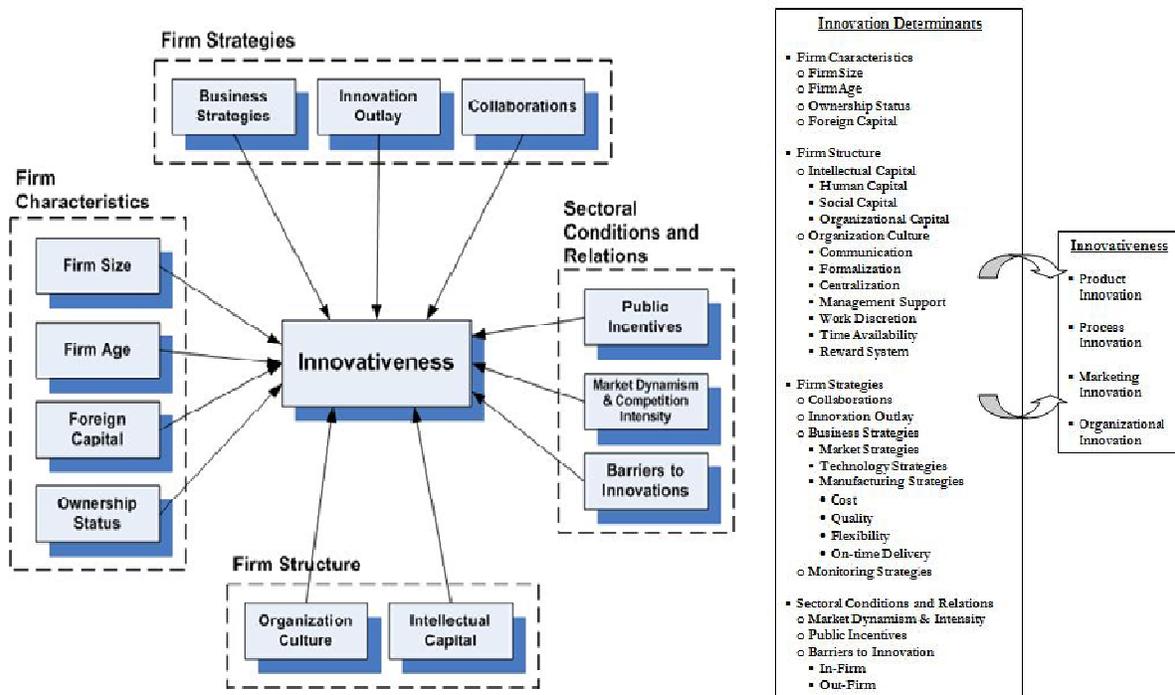


Fig. 1: Drivers of Innovativeness Model

The model is built to investigate how certain factors called innovation determinants indeed determine the innovativeness level of a firm.

Fagerberg et al. [7] stressed the importance of firm culture in the innovation making process and claimed that it is necessary to prevent internal resistance in the organization in order to be able to create new practices and work processes. Actually, innovation is the outcome of incessant struggle in the firm, which provides new solutions to particular problems. Hence, the organizational structure, the leadership style of entrepreneurs, the effect of ownership structure are some of the subjects that must be analyzed among the innovation determinants together with firm culture components such as reward system policies, managerial support of idea generation and project formulation, time availability, risk taking for innovativeness and work discretion.

Intellectual capital constitutes a valuable asset for firms in their innovation activities. Intellectual capital is discussed in the literature under three sub-headings [19]. These sub-headings are human capital, social capital, and organizational capital. Human capital is related to talents, specializations, capability of developing new and creative ideas of individuals in an organization. Social capital consists of the relationships among the members of organizations, the sharing of ideas and information, ability to learn together or to teach to each other, and the ability of finding, analyzing and solving common problems. Organizational capital is the sum of organization policies and practices documented in an explicit fashion in procedures, handbooks and databases; and finally the intangibles such as patents and licenses obtained by companies as a result of their past innovations or purchased. By how much the intellectual property protection and associated laws are encouraging firms to be more innovative is a critical question still open for discussion.

Innovation activities in firms also depend on external sources and collaborative applications, which have a positive influence on the innovation process. The more firms manage to become capable of interacting with external sources, the greater becomes the demand of other firms to imitate them. This really enhances innovative capabilities of both individual companies and their entire network.

Similarly, public incentives and other related governmental measures are crucial for the innovation process. Among others, they provide funding and encouragement for R&D activities, tax regulations, financial support for the marketing phase, intellectual property regulations and labor market regulations. On the other hand, market intensity and dynamism, customers' expectations, demands and suggestions, competition in the market, competitors and their investment in R&D, all have undeniable impacts on the policies companies adopt towards innovation.

Companies gain additional competitive advantage and market share in their target market according to the level of importance they attach to manufacturing strategies prevailing in the market such as cost, quality, flexibility, and on-time delivery. These are vital factors for companies to build a reputation in the market and therefore to increase their market share.

### 2.3. Methodology

The unit of analysis is selected as the individual manufacturing firm. Data is collected in the years 2006/2007 within a period of 7 months, via questionnaire forms from 184 manufacturing firms of Northern Marmara region within Turkey. The firms are selected randomly from the database of the Union of Chambers and Commodity Exchange (TOBB), and from the chambers of industry located in the cities of Istanbul, Kocaeli, Sakarya, Tekirdağ, and Çerkezköy. The degree to how much the sample is representative of the population was addressed by carrying out a series of comparative tests regarding firm distributions according to sectors. Out of 1674 questionnaires distributed, 184 useable forms are returned producing a response rate of about 11%.

Responding firms in our resulting sample are distributed among six main business sectors, namely automotive (20.1%), textile (19.6%), metal goods (19%), chemicals (17.9%), machinery (15.2%), and electrical home appliances (8.2%) industries. Responses are given by top managers (CEOs, general managers and owners; 33%), and middle managers (plant managers and functional managers; 67%).

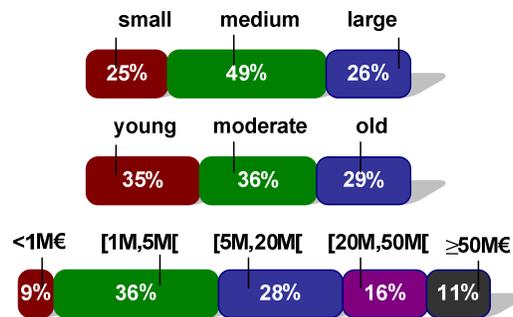


Fig. 2: Sample Profile

Fig. 2 depicts a profile of the resulting sample, illustrating its diversity in terms of firm size, firm age and annual sales volume. Firm size was determined by the number of full-time employees (up to 50: small, 50≤medium<250, ≥250: large) and firm age is determined by the year production started (up to 1975: old, 1975≤moderate<1992, ≥1992:

young). Annual sales volume was divided into 5 ranges; namely, <1M€, [1M€,5M€[, [5M€,20M€[, [20M€,50M€[ and ≥50M€.

For innovation determinants and innovativeness measures, the respondents were asked to indicate to what extent related applications and practices were important / implemented in their organizations respectively relying on five-point Likert scale.

After the data collection stage, statistical analyses were conducted in order to validate the hypothesized model. In order to extract the probable effects and the amount of contribution of innovation determinants to innovativeness level, multivariate data analysis was conducted by means of the statistical software packages SPSS v13 and AMOS v4.

The multivariate data analysis, which was conducted to extract the relationships presented in the integrated innovation model, was performed in four stages. The first stage was extracting the factor structure. An exploratory factor analysis (EFA) using principal component analysis with varimax rotation was conducted in order to find out the underlying factors of innovations and firm performance. Then, it was followed by a confirmatory factor analysis (CFA) to determine whether the extracted factors in EFA offered a good fit to the data. This stage was concluded by exploring internal consistency and reliability of factors (constructs) via Cronbach alpha and the average-variance extracted (AVE) tests. The second stage was associated with the relationships between the factors and involved correlation and regression analysis. In the third stage, path analyses were conducted in order to depict the final relationship between the factors. Finally, the results of additional numerical analysis using ANOVA and t-tests were conducted in stage four.

### **3. Findings**

The findings visibly stress that intellectual capital is the most important determinant of innovativeness. Organizational capital and human capital are determined to be the most valuable resources for innovation. Firms should invest in human capital by improving education, training and learning opportunities and also they should develop innovation skills of their staff. Such a high quality human capital will result in higher social capital and consequently organizational capital of the firm will increase.

In terms of organizational culture, high correlation of management support to innovativeness capability emphasizes the importance of managerial encouragement to idea generation and their support to new projects for innovative capabilities.

An important finding of the study is that the firms do not widely prefer to collaborate. Vertical collaborations (with customers and suppliers) and operational collaborations are relatively common but the real positive impact for innovativeness comes from R&D

collaboration that firms mostly fail to realize. In our sample, large firms are more likely to be involved in collaborations; more likely to invest more on R&D and finally they are more likely to be more competent in intellectual property management. Contrary, small and medium sized firms have weak results for patent applications, collaborations, use of public incentives and R&D investments.

Regarding the barriers to innovation, firms complain mostly about internal limitations (such as time and financial limitations, higher risk and cost of innovation) and internal deficiency (lack of technical information and experience, lack of qualified employee and R&D manager, etc.). In contrast, they affirm that external difficulties (such as difficulties of finding necessary components, materials, technological services, difficulty of adopting new products by customers, etc.) constitute the least important barrier to innovation. However, analysis shows that internal resistance is indeed the most important barrier. In order to become more innovative firms should look inside and solve their internal problems.

It is shown that the components of the manufacturing strategy -cost, quality, flexibility, and on-time delivery- display a hierarchical structure. The findings re-confirm the cumulative nature of the relationship among these components rather than a trade-off among them and they strengthen the results of Ferdows and De Meyer (1990), and Roth and Miller (1992) suggesting that firms may be competent in multiple operations priorities. Highly innovative firms are found to excel in all aspects of manufacturing strategies.

It is interesting to note that although firms with foreign direct investment reach on the average a higher level of innovativeness but not at a statistically significant level.

The largest part of firms' expenditure for innovation is linked to the adoption of technologies through machinery and equipment purchases, which absorb 48% of firms' innovation costs. R&D activities are also an important ingredient of firms' innovation outlay, which on the average account for 33% of total innovation expenditure. Other activities such as purchasing of patents, know-how and licenses account for 10% and managerial counseling (except financial counseling) for 9% of firms' total innovation expenditure.

#### **4. Conclusion**

This paper reports on an innovativeness study in the Turkish manufacturing industry, drawing on a sample of 184 manufacturing firms. It has empirically tested a framework identifying the relationships among innovativeness and determinants of innovation.

The results show that innovation determinants such as firm culture, intellectual capital, market, technology, and manufacturing strategies, collaborations, monitoring for

innovations outside the firm, innovation outlay, market dynamism, public incentives, and firm size all have significant positive effects on the innovative capability of a firm. Indigenous barriers on innovation and centralization of decision making, on the other hand, have significant negative effects on innovative capability of a firm. Firm characteristics such as firm age, firm ownership status, and the existence of foreign capital in a firm do not reveal any significant effects on innovativeness. Similarly, the relationship between exogenous barriers on innovation and innovativeness is not significant.

Innovation is a complex process that involves many players such as firms, customers, competitors, suppliers, research centers and governmental regulations. A successful innovation process adds value to manufacturing and industrial processes, improves the range and delivery of services, and creates growth, new markets and efficiencies to the work processes of firms. Similarly, innovation making process depends on many internal and external factors, which sustain a firm's innovative capabilities with a different perspective and with a diverse amount of contribution.

### **Acknowledgement**

This study was supported by a grant from The Scientific and Technological Research Council of Turkey (TUBITAK-SOBAG-105K105). We would like to thank to Prof. M. Atilla Oner and Dr. Cagri Bulut for their contribution in the initial phases of this research.

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