Modeling Innovation: Determinants of Innovativeness and the Impact of Innovation on Firm Performance

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Abstract - **The objective of this paper is to report on the method, analysis, and conclusions concerning two research questions formulated as: *What are the determinants of innovation at firm level?*" and "*what is the impact of innovation on firm performance?*" The results are based on an empirical study covering 184 manufacturing firms in the Northern Marmara region within Turkey. A comprehensive and integrated innovation model is presented composed of two sub-models proposed in line with the two research questions posed. Results and conclusions are presented.**

Keywords - **Firm Performance, Integrated Innovation Model, Determinants of Innovativeness, Manufacturing Industry, Performance Indicators**

I. INTRODUCTION

Innovativeness is one of the fundamental instruments of firms' business strategies to enter new markets, to increase the existing market share and to create competitive advantage. In the last decade, the importance of innovation is largely enhanced and it has become an important contributor to competitive success, since added value of existing products and services are diminishing as a result of rapidly changing technologies and extreme global competition. Hence, innovativeness has turned into a hot topic for academic and industrial research for facilitating the firms to overcome the problems they encounter while striving to achieve sustainable competitive advantage in the global competition [1], [2], [3].

The foremost aim of firms is to survive in the market while generating profit. Principal means of making profit for a firm are provided nowadays by the firm's innovation capabilities, since innovations are among the essential resources through which firms contribute to increased employment, economic growth, and competitive strength. The purpose of innovation is to launch newness into the economic area. As stated by Metcalfe [4], when the flow of newness and innovations desiccate, the firm's economic structure settles down in an inactive state with little growth.

Thus, innovations are required and are indispensable for companies for several reasons such as to apply more efficient and more productive manufacturing processes, to perform better in the market, to increase their reputation as perceived by the customers and to obtain competitive advantage. In fact, the effects of innovations on the performance of a firm differ in a wide spectrum from sales, market share and profitability to productivity and efficiency.

A large number of studies in innovation literature have been carried out in order to find out which factors enhance innovative efforts of firms. But so far, a complete model of innovativeness was hardly ever tested by researchers. The first purpose of this research is to present a comprehensive and integrated model of innovation with its determinants as the inputs and different types of innovations as the outputs. Secondly, the relationships existing among the innovations and the operational performance are analyzed empirically based on data collected from 184 manufacturing firms in the Northern Marmara region within Turkey.

In the next section, an extensive literature review will be presented. Next, an innovativeness model is hypothesized in order to answer mainly two fundamental research questions: "*What are the determinants of innovation at firm level?*" and "*what is the impact of innovation on firm performance?*" In section III, the analysis is briefly presented and the results are discussed in section IV. The concluding remarks are presented in section V.

II. INNOVATION MODEL

A. Definitions of Innovation

According to Porter [5], innovation means technological progress and is a business practice to accomplish firms' activities via better methods and processes. For that reason, companies acquire competitive advantages by being innovative, while developing newest technologies and modern production techniques.

From the managerial point of view, innovation could be defined as the development and creation of new or improved products, business methods or services. Usually, suitable conditions for creating innovation result from certain changes in the environment such as new consumer needs or the new solutions for existing needs [6].

There is a wide spectrum of reasons that triggers innovations. These reasons include cost reduction, improving product and service quality, designing better products, enduring the consequences of shortened product life cycle, responding to customer needs and demands, and therefore developing new services and products. In

the literature, various studies exist, where it is suggested that firms overcome their problems related to competitiveness mainly through innovations [7]. Hence, firms need to be innovative in order to compete better in their target market.

In the Oslo Manual [8], four different innovation types are introduced. These are product innovation, process innovation, marketing innovation and organizational innovation. Product innovation and process innovation are closely related to the concept of technological developments. On the other hand, marketing innovations are strongly related to pricing strategies, product package design, product placement and promotion activities. Finally, organizational innovations are strongly related to the business practices.

B. Theoretical Background

In spite of the increasing interest in innovation both in academia and industry, there are not much empirical verifications in the literature revealing that innovativeness is strictly correlated to firm performance and competitiveness.

Conjectural studies are the pioneers of the innovation literature that has grown and matured by the researches which tried to elucidate the innovation concepts by defining organizational policies, processes, and characteristics whereby companies test and realize their efforts for innovative and creative ideas regarding its products, processes, and markets [2], [9], [10].

In recent years, the subject of innovation determinants has been frequently discussed in the innovation literature. Indeed a central research theme has emerged around the exploration of innovation determinants [9], [11], [12]. These researches hinted that empirical studies are needed from diverse cultures and industries in order to facilitate the understanding of innovation making process with all of its dimensions [13], [14].

Becheikh *et al*. [15] provided a systematic review of empirical articles about technological innovations in the manufacturing sector at firm level, published between years 1993 and 2003. Their main purpose was to integrate the findings of innovation studies and to summarize innovation determinants in order to identify how innovations occur in firms and where the findings about innovativeness converge and diverge.

Actually, it is possible to examine the innovation determinants in two subgroups: in-firm (indigenous) parameters and out-firm (exogenous) parameters. The indigenous parameters include general firm characteristics (such as firm's age, size, ownership status etc.), firm structure (such as intellectual capital, firm culture, firm decision making process and openness of in-firm communication channels, delegation of works, managerial characteristics and leadership, etc.), and firm strategies (such as collaborations, knowledge management, investments strategies and cost strategies, pressure of competition elements, etc.) On the other hand, exogenous parameters are sectoral conditions and relations (such as sector and market structure, public regulations and incentives, external financial funds acquisition, and out-firm barriers to innovation).

C. Model Elements

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.

Fagerberg *et al*. [16] 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, openness to new ideas and solutions is considered indispensable for innovation in early phases in the companies.

Intellectual capital constitutes a valuable asset for firms in their innovation activities. Without availability of ideas, talents, projects and employees' and managers' knowledge base, it is meaningless to talk about innovativeness. Intellectual capital is discussed in the literature under three sub-headings [17]. 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 or purchased by companies as a result of their past innovations. 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.

The key reason for a firm to seek innovativeness is its desire to obtain increased business performance and increased competitive advantage. Companies gain additional competitive advantage and market share in their target market according to the level of importance that they attach to manufacturing strategies prevailing in the market such as price, 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. The continuous improvement and development of process and practice will lead to developing the company's capabilities. These in turn may enhance or change the way it chooses to compete through manufacturing [18]. As a result, innovations bring together new combinations of accessible assets and new knowledge possibilities for future innovations, and so, a continuous innovativeness period settles.

Innovativeness in a firm is a joint outcome, among others, of general firm characteristics, firm structure, firm strategies and external conditions. Provided that a suitable organization climate exists, companies can benefit from the changing business conditions employing their entrepreneurial capabilities. If top managers support the innovation process and create an appropriate in-firm climate, it will result in a sustainable competitive advantage through innovations such as new products, services, and processes [13], [19]. Here, innovativeness is defined as a measure obtained by merging four innovation types performed, namely, product, process, marketing and organizational innovations.

Firm performance is another element of the model proposed. It is a combination of innovative performance (e.g., time to market, number of new products and services), market performance (e.g., market share, customer satisfaction), production performance (e.g., quality, flexibility), and financial performance (e.g., profit, cash flow excluding investment). The performance indicators to evaluate and monitor firm performance are derived based on the elements constituting the components of firm performance as stated above.

D. Model Structure

Based on the discussion in the previous section, *the integrated innovation model* proposed here contains three elements: innovation determinants, innovativeness, and firm performance (***Fig. 1***).

The integrated innovation model is composed of two sub-models in line with the two research questions posed in the Introduction section above. The first sub-model is built to investigate how certain factors called innovativeness determinants indeed determine the innovativeness of a firm as defined above. This sub-model is referred to as *the drivers of innovativeness model*.

The second sub-model of the integrated innovation model is referred to here as *the performance model of innovation*. The performance model of innovation aims to assess the impact of innovativeness on firm performance, which can be measured through performance indicators.

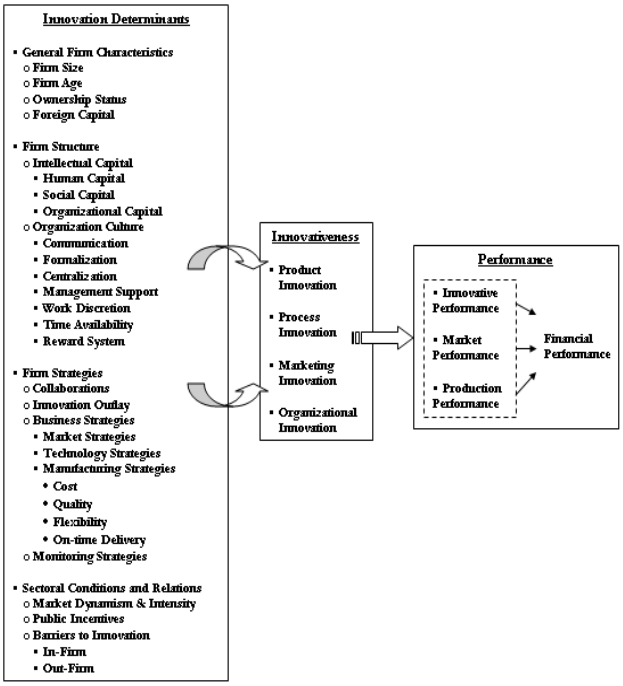

Fig. 1: Integrated innovation model

III. METHODOLOGY

In order to explore empirically how innovations are born and what the impact of innovations is on the performance of manufacturing firms, a questionnaire was developed and a survey was conducted. The questionnaire was pre-tested by 10 pilot interviews to ensure that the wording, format and sequencing of questions were appropriate. Afterwards, the questionnaire was applied through a hybrid system of mail surveys and face-to-face interviews to the larger sample of manufacturing firms drawn from six manufacturing sectors: textile, chemical, metal products, machinery, electrical home tools and equipments (domestic appliances) and automotive industries in Northern Marmara region within Turkey.

For building the sample, firms were selected randomly from the database of the Union of Chambers and Commodity Exchange (TOBB) and Istanbul, Kocaeli, Tekirdag Cerkezkoy and Sakarya Industry Chambers and member lists of various Industry Parks in Northern Marmara region. Out of 1,674 questionnaires mailed and received, a total of 83 questionnaires were processed by the firm and returned after two follow-ups. All the questionnaires were either complete or had a few missing data and thus none was eliminated. That means that the overall response rate for mailing was 4.83%. The surveying of the remaining 101 firms were accomplished

through face-to-face interviews. These firms were randomly selected from the list of firms already compiled.

After the data collection stage, statistical analyses were conducted in order to validate the hypothesized model. For that purpose, statistical software packages SPSS v13 and AMOS v4 were used. Occasional missing data on variables was handled by list wise deletion using the appropriate function of SPSS v13. The percentage of missing data across all data was calculated to be negligible.

Data was collected in the years 2006/2007 within a period of 7 months, using a self-administered questionnaire that is distributed to the firms' upper level managers operating in the six sectors designated. ***Fig. 2*** illustrates these sectors and the percentage of the firms surveyed in each sector within the total sample. The degree to how much the sample is representative of the total population of firms in that region was addressed by carrying out a series of comparative tests regarding firm distributions according to sectors.

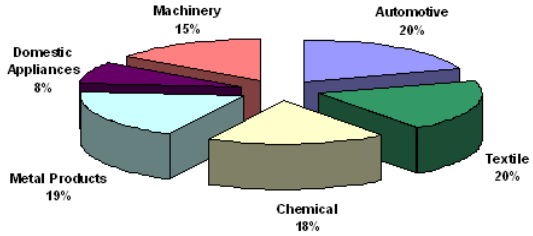

Fig. 2: Sector distribution of the sample

Fig. 3 depicts a profile of the resulting sample, illustrating its diversity in terms of annual sales volume, firm size (in terms of number of employees) and firm age. Firm size is determined by the number of full-time employees (up to 50: small; between 50 and 250: medium; 250 and above: large) and firm age is determined by the year production has started (before 1975: old; between 1975 and 1992: moderate; 1992 and later: young). Annual sales volume is divided into 5 categories: less than 1M Euro; between 1M Euro and 5M Euro; between 5M Euro and 20M Euro; between 20M Euro and 50M Euro; and 50M Euro or more.

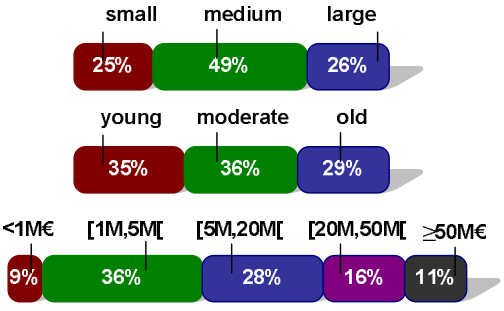

Fig. 3: Sample profile

The multivariate data analysis for extracting the two-level relationships presented in Figure 1 was performed at four stages. The first stage was about extracting the factor structure. An exploratory factor analysis (EFA) using principal component analysis with varimax rotation was conducted to find out the underlying dimensions of innovations and firm performance. Then, it was followed by a confirmatory factor analysis (CFA) in order to determine whether the extracted dimensions in EFA offer a good fit to the data. This stage was concluded by exploring internal consistency and reliability of factors (constructs) via Cronbach alpha and unidimensionality tests. The second stage involved the relationships between the factors and included the correlation and regression analyses. In the third stage, path analyses were conducted in order to depict final relationship between factors. Finally, the results of additional numerical analysis using ANOVA and t-tests were conducted in stage four.

IV. RESULTS

The results indicate that innovations exert positive impact on innovative and production performances of a firm. It is also found that all three performance factors (innovative, production and market performance) have significant positive effects on financial performance. Therefore, our findings support the fact that innovation strategy is an important major predictor of firm performance [20].

Moreover, the results show that innovation determinants such as firm culture, intellectual capital, strategies, collaborations, market dynamism, public incentives, size, and innovation outlay have all significant positive effects on innovative capability of a firm. Indigenous barriers on innovation, on the other hand, have significant negative effects on innovative capability. 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 of innovation and innovativeness is not significant either.

The largest part of firms' expenditure for innovation is linked to the adoption of technologies through machinery and equipment purchases, which absorbs 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.

Finally, it is also found that all three performance indexes (innovative, production, and market performances) have significant positive effects on financial performance.

However, a certain amount of time might be necessary to observe the reflection of innovations on firm performance measures. A lag effect between innovations and financial performance is already stated in the literature [20], [21], [22]. This fact explains why top

managers frequently complain about stating they do not harvest enough positive results of their innovative efforts. Boston Consulting Group's Annual Innovation Reports [23] following a senior management survey indicates the same fact. Although innovation remains a top strategic focus for the majority of company and the spending on innovation has an increasing trend year by year, many executives -over half of those surveyed- remain unsatisfied with the financial returns on their company's investments in innovation.

Nonetheless, our research has clearly revealed that innovative firms are rewarded by higher firm performance. It is also observed that firms, which are more innovative, have higher total sales and higher total exports. Finally, despite the time lag, increased operation performance by innovations has significant positive effects on financial performance.

V. DISCUSSION

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 innovations and firm performance.

The results point out that innovations performed in manufacturing firms have positive and significant impacts on innovative and production performance. These findings tend to substantiate our conceptual model and offer several managerial implications. First, managers of firms should give additional emphasis to innovations as they are important instruments for achieving sustainable competitive power and better performance in the global competition. Improved operational performance is contingent upon the degree of implementation of innovations.

High level of implementation of innovations results in a better operational performance. Although a strong direct link is not found between innovations and market performance, it is seen that market performance is supported with innovative and production performance indicators. Firms that are endowed with resources to improve their innovative capabilities could expect a much significant improvement on their operational performance in return of a high level of innovation activities are encouraged and implemented.

The analyses noticeably emphasize that intellectual capital is the most important determinant of innovativeness. Human capital, which covers the skills, creativity and experience of individuals, is found to be the most valuable resource for innovation. Companies should invest in human capital by improving training and learning opportunities and also they should develop innovation skills of their staff. Therefore, firstly, firms should work with qualified and competent employees. 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 doing collaborations. 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.

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 the least important barrier is external difficulties (such as difficulties of finding necessary components, materials, technological services, difficulty of adopting new products by customers, etc.). However, the findings point out that internal resistance is statistically the most important barrier. Indigenous barriers significantly hinder innovative capabilities, but there are not enough findings to claim that exogenous barriers obstruct innovativeness. Firms should look inside and solve their internal problems in order to be more innovative.

Among firm characteristics, only firm size is significantly correlated to innovativeness. All of findings indicate medium and large sized firms are more innovative than small ones. The relation between firm size and innovativeness is almost linear rather than U-shaped as would be expected. These results should be assessed by bearing in mind that the firms included in this study are manufacturing firms and the manufacturing sectors covered are either low or medium level technology sectors.

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. Large-sized companies outperform the others both in terms of their success in implementing innovations and in achieving high operational outcomes covering also financial performance.

VI. CONCLUSION

In this research, a survey is designed and conducted and various multivariate statistical procedures are conducted on the data gathered in order to examine the

model's hypotheses and to extract the relationship between innovation determinants, innovation types, innovativeness, and firm performance. As a result, it is not only found that innovative firms are rewarded by higher operational performance including financial performance, but also that it is possible to predict innovativeness level of a firm through innovation determinants within small error bounds.

The key contribution of this study is the empirically tested integrated innovation model, which managers can employ in using innovations for boosting their firms' operational performance. Having a clear understanding of the exact nature of innovations will help the firms to prioritize their market, production and technology strategies, which are then to be followed by appropriate subsequent action plans.

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