Effects of Organizational Innovations on Firm's Production Performance

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Abstract – **In the literature, various papers investigate the effects of the technological (product and process) innovations on firms performance. However, research on the effects of organizational innovations is rare. Furthermore, the performance of the firms is usually measured in terms of financial criteria such as the return on assets or equity and the research on the effects of innovations on production performance is limited. The objective of this paper is to explore the role of different innovation types as well as the organizational innovations on the firm's production performance based on an empirical study covering 184 manufacturing firms in the Northern Marmara region within Turkey. A significant positive relationship between organizational innovations and the firm's production performance is determined.**

Keywords – **Innovation, Production Performance, Organizational Innovation**

I. INTRODUCTION

Innovation is considered to be the successful development and application of new knowledge, with the purpose of launching newness into the economic area. Innovation can be conceived as the transformation of knowledge to profit. Drucker [1] defined innovation as the process of equipping in new, improved capabilities or increased utility.

Innovation as a term is not only related to products and processes, but is also related to marketing and organization. Schumpeter [2] differentiated between five different types of innovation: new products, new methods of production, new sources of supply, the exploitation of new markets, and new ways to organize business. In the OECD Oslo Manual [3], four different innovation types are introduced. These are, *product innovation*, *process innovation*, *marketing innovation* and *organizational innovation*.

In the OECD Oslo Manual [3], *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 the product innovation and the process innovation are closely related to the concept of technological developments and usually referred to as the *technological innovations* 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. Some authors prefer the term administrative innovation [4, 5].

In the literature there are various studies that investigate the performance of the innovations to firm's performance. Majority of these papers investigated the effects of technological innovations and utilizes return on equity or assets as performance measures (for a review of the innovation and its effects on the performance please refer to [6]).

Damanpour and Evan, argued that the impact of management innovations on firm performance is often underestimated and neglected by the researchers [7]. Lin and Chen [5] conducted an empirical survey through telephone calls and investigated the effects of administrative innovation among other types of innovation. They concluded that the administrative innovation is the most crucial type of innovation in explaining the sales; hence, the companies should pay more attention to it. However, their research didn't include the effect of administrative innovation to the production performance of the firms.

Mol *et al.*[8] also complained from the fact that the researchers mostly concentrate on technological innovations and neglect to study the effects of administrative innovations. They focused to the firm level factors associated with the implementation of the administrative innovations. They also provided some analysis regarding to the effects on firm performance in their study. They measured the firm performance in terms of productivity and determine that administrative performance has small but significant direct effect to the firms' productivity. However, they concluded that it would be very useful to further investigate the relationship and leave such a study as future research.

Even though the significance of the organizational innovations are known as early as the seminal work of Shumpeter, unfortunately the literature on the subject is not sufficient. In this research, we investigate the effect of organizational innovation as well as other types of innovations to the firms' production performance.

In the next section, the data collection and the analysis methodology will be discussed. Later, the results of the data analysis will be provided in section 3. Finally, the major findings and the future work will be discussed in the conclusion section.

II. METHODOLOGY

In order to explore empirically the effect of the organizational innovations on the production performance of manufacturing firms, a questionnaire was developed and a survey was conducted. The questionnaire was pre-tested by 10 pilot interviews in order 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 Regional City Industry Chambers and member lists of various Industry Parks in Northern Marmara region. Out of 1,674 questionnaires mailed a total of 83 questionnaires were processed by the firms 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.

Data was collected during 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. The mail packages contained the questionnaire forms, pre-paid envelopes for return of forms and cover letter for managers. In order to motivate completion, respondents were promised a summary of research findings. It was requested that the questionnaire be completed by a senior officer/executive in charge especially general, plant, production or R&D managers. Note that top managers are critical actors that shape the organization climate and strategies through their decisions, implementations and knowledge. Besides, they have vital roles for setting off innovative behaviors through the organization and assisting to innovativeness policies. Therefore, the real innovative climate of organizations can be observed from the behaviors, supports and attitudes of top managers. The responses indicated that all the respondents completing the questionnaire were from the top management.

The questionnaire is prepared . The questions about the firm's production performance are asked by 5 points Likert scale in which, 1 indicates very unsuccessful, 2=unsuccessful, 3=similar, 4=successful and 5=very successful. Such subjective measures possibly bring in manager bias, but are widespread practice in researches [9]. The reason behind of using this subjective scale is that firms are reluctant to disclose exact performance records, and managers are less willing to give objective performance data [10, 11]. Conversely, top managers who are well-acquainted with performance data could present a precise subjective evaluation [12]. Moreover, objective measures could limit the comparability and accuracy of responses [13, 14]. Table 1, presents the questions used in the questionnaire regarding the firm's production performance.

TABLE I
QUESTIONS REGARDING THE FIRM'S PRODUCTION PERFORMANCE

	How would you rate the level of achievement of the following production performance items in your organization in the last three years compared to the previous years? (Five-point scales ranging from 1= 'very unsuccessful' to 5= 'very successful')
Q#	**Variables**
1	Production quality
2	Production cost
3	Production flexibility
4	Production and delivery speed.

In order to measure the extent of the innovations that are implemented in the company, again a five-point scale is utilized. Table 2 presents the question used in order to measure the *product innovation*.

TABLE II
QUESTIONS USED IN ORDER TO MEASURE THE EXTENT OF THE PRODUCT INNOVATION

	"To what extent were the following product innovation items implemented in your organization in the last three years? (Five-point scales ranging from 1= 'not implemented', 2= 'imitated from national markets', 3= 'imitated from international markets, 4= 'current organizational practices were improved', 5= 'original organizational innovations were implemented')
Q#	**Variables**
1	Increasing manufacturing quality in components and materials.
2	Decreasing manufacturing cost in components and materials.
3	Developing new products leading to improved ease of use for customers and to improved customer satisfaction.
4	Developing new products with technical specifications and functionalities totally differing from the current ones.
5	Developing new products with components and materials totally differing from the current ones.

Note that the text of the question is presented only in Table 2 as an example. The same question modified accordingly is asked to the respondent for other types of innovations as well. Table 3, Table 4 and Table 5 presents the questions used in order to measure the *process*, *marketing* and *organizational innovations* respectively.

TABLE III
QUESTIONS USED IN ORDER TO MEASURE THE EXTENT OF THE PROCESS INNOVATION

Q#	Variables
1	Determining and eliminating non value adding activities of production processes.
2	Decreasing variable cost components in manufacturing processes, techniques, machinery and software.
3	Increasing output quality in manufacturing processes, techniques, machinery and software.
4	Determining and eliminating non value adding activities of delivery related processes.
5	Decreasing variable cost and/or increasing delivery speed in delivery related logistics processes

TABLE IV
QUESTIONS USED IN ORDER TO MEASURE THE EXTENT OF THE MARKETING INNOVATION

Q#	Variables
1	Renewing the design of the current and/or new products through changes in such as appearance, packaging, shape and volume without changing their basic technical and functional features.
2	Renewing the distribution channels without changing the logistics processes related to the delivery of the product.
3	Renewing the product promotion techniques employed for the promotion of the current and/or new products.
4	Renewing the product pricing techniques employed for the pricing of the current and/or new products.
5	Renewing general marketing management activities.

TABLE V
QUESTIONS USED IN ORDER TO MEASURE THE EXTENT OF THE ORGANIZATIONAL INNOVATION

Q#	Variables
1	Renewing the routines, procedures and processes employed to execute firm activities.
2	Renewing the supply chain management system.
3	Renewing the production and quality management systems.
4	Renewing the human resources management system.
5	Renewing the in-firm management information system and information sharing practice.
6	Renewing the organization structure to facilitate teamwork.
7	Renewing the organization structure to facilitate coordination between different functions such as marketing and manufacturing
8	Renewing the organization structure to facilitate project type organization.
9	Renewing the organizational structure to facilitate strategic partnerships and long-term business collaborations.

After the data collection stage, statistical analyses were conducted in order to validate the hypothesized model. For this 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 degree to how much the sample is representative of the population is addressed by carrying out a series of comparative tests regarding firm distributions according to sectors. The percentage of missing data across all data was calculated to be negligible.

III. RESULTS

The data analysis is performed in three stages. The first stage is about extracting the factor structure. An exploratory factor analysis (EFA) with varimax rotation is conducted to find out the underlying dimensions of innovations. Then, it is followed by a confirmatory factor analysis (CFA) in order to determine, if the extracted dimensions in EFA offered a good fit to the data. This stage is concluded by exploring internal consistency and reliability of factors (constructs) via Cronbach alpha and unidimensionality tests. The second stage involves the relationships between the factors and includes correlation and regression analysis. Finally, in the third stage, path analyses are conducted in order to depict final relationship between the factors.

A. Factor Structures

Factor analysis is useful to observe the underlying patterns or relationships for a large number of variables and it determines whether the information can be condensed or summarized in a smaller set of factors or components.

EFA using principal component analysis with varimax rotation is performed on the innovations data in order to extract the dimensions of each construct. “Eigenvalue (the amount of variance accounted for by a factor) greater than 1” criterion is taken into consideration to set the number of extracted factors.

The EFA on innovations extracted 4 factors with eigenvalues greater than 1. These four factors are respectively labeled based on the items included in each. The factors perfectly included the items as designed. The total variance explained is 59%. For Cronbach α values greater than 0.70, the scale is accepted as reliable [15, 16, 17]. The Cronbach α values for the underlying factors range from 0.90 to 0.76 which suggest the satisfactory levels of construct reliability.

CFA is performed using maximum likelihood estimation, where the constructs of innovations tested using the first order confirmatory factor model to assess construct validity. The results consistently support the factor structure for all the factors in the EFA stage. It is found that all t-values in the CFA are statistically significant at 0.01 levels. Also, all the factor loadings have high (>0.50) and significant ($p<0.01$) loadings [18].

TABLE VI
GOODNESS OF FIT INDICES

Goodness of fit indices	Construct (Innovations)	Reference value
χ^2 / degree of freedom	2.209	$1< \chi^2 / df <5$
CFI (Comparative Fit	0.968	0.9<CFI<1
NFI (Normed Fit Index)	0.943	0.9<NFI<1
RFI (Relative Fit Index)	0.930	0.9<RFI<1
IFI (Incremental Fit Index)	0.968	0.9<IFI<1
TLI (Tucker-Lewis Fit	0.961	0.9<TLI<1
RMSEA (Root Mean Square Error)	0.081	RMSEA<0.08

The results of CFAs are evaluated by the goodness of fit indices as well. The overall fit statistics for the performance and innovation factors in Table 6 demonstrate a level of overall fit very close to 1, which denotes a perfect fit. Therefore, the factor structures are concluded to be valid. Recall that, CFA evaluates the measurement properties of EFA.

B. Relationship Analysis

In order to identify the relation among the innovation types and the production performance relationship analysis, i.e., correlation analysis and regression analysis is conducted.

The result of the correlation analysis is tabulated in Table 7. The correlation analysis indicates the strong correlation between the factors. That is to say, there is a significant ($p<0.01$ or $p<0.05$) positive relation between all types of innovations and the firm's production performance.

TABLE VII
THE CORRELATION ANALYSIS OF THE INNIVATION TYPES AND PRODUCTION PERFORMANCE

	Prod. Innov.	Proc. Innov.	Mar. Innov.	Org. Innov.	Prod. Perf.
Prod. Innov.	1	0.524*	0.531*	0.496*	0.227*
Proc. Innov.		1	0.419*	0.600*	0.198*
Mar. Innov.			1	0.580*	0.153°
Org. Innov.				1	0.188°
Prod. Perf.					1

***:** Correlation is significant at the 0.01 level; **°:** at the 0.05 level;

TABLE VIII
REGRESSION ANALYSIS OF PRODUCTION PERFORMANCE

Independent variables	Standard beta	p value
Product Innovation	0.157	0.097
Process Innovation	0.068	0.481
Marketing Innovation	-0.016	0.871
Organizational Innovation	0.069	0.505
R^2 = 0.056 ; p=0.040		

In order to test the probable effects of innovations on the firm performance, multiple linear regression method is employed. The regression model that investigates the effects of innovation types on production performance is presented in Table 8. Note that the R^2 value indicate how much of the dependent variable (production performance) can be expressed by independent variables (types of innovations). The regression model is significant ($p<0.05$) and confirm the positive relationship between all innovation types but the marketing innovation and the firm's production performance.

C. Structural Equation Modeling

Despite the fact that multiple linear regression model is significant, when independent variables are considered jointly, only some of them are observed to have significant positive effects on the dependent variable. This situation might arise when one innovation type, which has dominant effect on the dependent variable, reduces or sometimes even eliminates the effect of other independent variables. This fact is called as a mediating effect [19]. Mediating effect is present when a relation between the variables is reduced or eliminated after a mediator variable has entered the model. In such cases, it is necessary to carry on the regression analysis of the dependent variable by structural equation modeling (SEM) approach and path analysis with the intention of exposing the direction of the mediation effects.

In order to avoid the multi-collinearity and measurement errors, while addressing the cause-effect relationships among the research constructs, a variance-based structural equation modeling approach is conducted. SEM procedure obtains weights, loadings and path estimates while performing an iterative scheme of multiple regressions until a solution converges on a set of weights used for estimating the latent variables scores.

The determined path model is depicted in Fig. 1. The regression weights are all found to be significant ($p<0.01$). The model has one endogenous variable (dependent variable), which is labeled as the production performance and four exogenous variables (independent variables), which are labeled as innovation types. This model essentially evaluates the impact of all four exogenous variables on the innovative performance. Here, while the estimates (numbers) on the single headed arrows are regression weights, the estimates on the box corners are the squared multiple correlations.

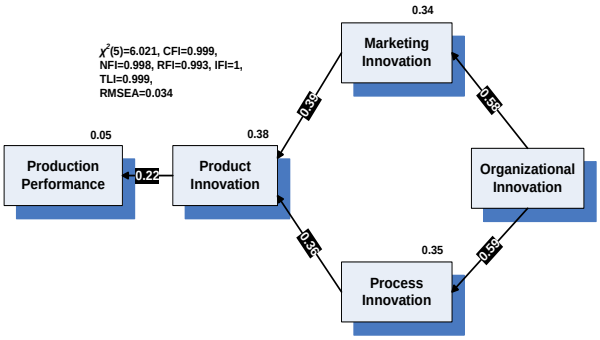

Fig. 1 Results of the production performance path model

The path analysis supports the hypothesis that *all* of the innovation types positively affect the firm's production performance. In the confirmed path model, the production performance is directly affected by the product innovation. Hence, the effect of the process and the marketing innovation is through the product innovations. The organizational innovation is the basis for both marketing and process innovations. These results are aligned with the previous conjectures about the foundational role of the organizational innovations on the firms' performance.

IV. CONCLUSION

In this paper, the relationship between different types of innovations (*product, process, marketing and organizational*) and the firms' production performance is investigated. Therefore, the major contributions of this paper are twofold. First of all, the innovations are not limited only to the technological innovations but organizational innovations are also included. Even though the significance of the organizational innovation is well known, there is a lack of research regarding to its effect on firm's performance.

Secondly, in the literature, the firm's performance is usually measured with the financial measures such as return on assets or marketing measures such as sales. However, the companies might avoid these measures due to privacy issues. Furthermore, these measures might be misleading because of their fluctuation due to the economical or industrial conditions. On the other hand, the production performance would be a robust measure of the competitiveness of the company in the long run.

For this purpose, an empirical survey is conducted and data from 184 manufacturing companies are collected. The results of the data analysis support that all innovation types positively affect the production performance. The organizational performance acts as the basis and significantly affects the other innovation types.

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