

AN INTEGRATED INNOVATION MODEL: HOW INNOVATIONS ARE BORN AND WHAT ARE THEIR IMPACTS ON FIRM PERFORMANCE?*

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ABSTRACT

The main objective of this paper is to present a comprehensive and integrated model of innovation at the firm level and to discuss the effects of firm characteristics on the innovativeness capabilities of companies. The results are based on an empirical survey covering 184 manufacturing firms in the Northern Marmara region within Turkey. In this study, first an integrated model of innovativeness is proposed. Later, the innovation determinants, especially firm characteristics, which have a significant role on innovation development success, are analyzed together with how innovativeness of firms influences their competitiveness and performance.

Keywords: Integrated Innovation Model, Determinants of Innovativeness, Firm Characteristics.

INTRODUCTION

Motivated by increasing competition in global markets, innovativeness started to play major roles to penetrate new markets, to spread out the existing market share and to provide the company an increased competitive advantage. In this aspect, innovation is accepted as an essential element of corporate business strategies and innovativeness has become an important contributor to competitive success. Thus, innovation management has become the focal point of intensive academic and industrial research in order to overcome the business problems encountered by firms for achieving sustainable competitive advantage in the global competition (Drucker, 1985; Hitt et al., 2001; Kuratko et al., 2005).

Nowadays, the objective of innovations is not only reducing the costs but also a wide spectrum of reasons such as improving product and service quality, designing better products, enduring the 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 researches advocate that the modern companies need to be innovative in order to compete better in their market (Evangelista et al. 1998).

Competitiveness of a firm has been typically measured in terms of financial performance. Global competition forces the firms to decrease their manufacturing costs and improve technological ability. Bearing in mind these objectives, companies reengineers their organizational and work structures such

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as focusing on and improving firm's core competencies, developing new structures for responding and reacting better to new market conditions and customer demands, targeting different markets, increasing collaborations with other companies, and investing in innovations (Ulusoy et al., 1999).

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 determinants of the innovativeness in the literature.

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. Secondly, the relationships existing among the innovativeness capability and the firm characteristics is analyzed empirically based on data collected from 184 manufacturing firms within Turkey. Note that due to the space limitations only the major findings of the analyses will be discussed in this paper and the numerical results of these analyses will not be tabulated. Among various factors, firm characteristics are chosen to be emphasized as an example.

This paper has six sections. Introduction precedes the second section, where we briefly present the theoretical background. In the third section, the integrated innovation model that is hypothesized in order to answer mainly two fundamental research questions: "What are the determinants of innovation at firm level?" and "What are the benefits of the innovation to the firms, especially in terms of competitiveness and performance?" will be presented. The fourth section will briefly introduce the methodology utilized in the research and the results of the analysis will be discussed in the fifth section. Finally, the sixth section involves conclusions and concluding remarks.

THEORETICAL BACKGROUND

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 (Stevenson and Jarillo, 1990; Hitt, et al., 2001).

Formally, innovation is considered to be the successful development and application of new knowledge (OECD, 1997). The purpose of innovation is to launch newness into the economic area. Porter (1998) defined innovation as a technological progress and a business practice to accomplish firms' activities via better methods and processes. Drucker (1985) explained the innovation such as the process of equipping in new, improved capabilities or increased utility. The suitable conditions for creating innovation come from the changes such as new consumer needs or new solutions for existing needs (Doyle, 1998).

Salavou (2004) drew attention to the difference between innovativeness and innovation. Innovation seems to incorporate the adoption or/and implementation of "new", whereas innovativeness appears to embody some kind of measurement contingent on an organization's proclivity towards innovation. Akova et al. (1998) defined innovativeness as a critical means by which members of companies diversify, adapt and even reinvent their firms to contest evolving market and technical conditions. Firms acquire competitive advantages by being innovative, while developing newest technologies and modern production techniques.

Hence, innovation is a continuous change of business processes, services and products of the company that is under the pressure of strong competition in order to gain competitive advantage and to upgrade the efficiency of work; especially in the highly dynamic market conditions of today. Innovation has great commercial importance, since it creates opportunities for firms to enter new markets and to provide enhanced competitive advantage in existing markets. It also increases the efficiency and the profitability.

McAdam and Keogh (2004) investigated the relationship between firms' general performance and its familiarity with innovation and research. They found that firms' tendency to innovations in its competitive environment are vital in the sense of installing the connection between innovativeness and competitiveness. Innovation is critical for long-run economic development; it is a dominant clarifying motive behind differences of performance and competition between firms, regions and even countries.

Schumpeter (1934) 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. Yet, in economics, most of the focus has been on the new products and new production methods. In the Oslo Manual (OECD, 1997), four different innovation types are introduced. These are product innovation, process innovation, marketing innovation and organizational innovation.

Determinants of innovation

Firms are basic units where innovations occur. Innovation takes place through a wide variety of business practices. 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 (Fagerberg et al., 2004).

In recent years, the subject of innovation determinants has been frequently discussed and it has become one of the focuses in innovation management research (Damanpour, 1991; Sundbo, 1999; Barringer and Bluedorn 1999; Antoncic and Hisrich, 2001; Belderbos, 2001; Hornsby et al., 2002, Wan et al., 2003; Montalyo 2004, Jaumotte and Pain 2005; Subramaniam and Youndth, 2005, Vinding, 2006). These researches hinted that empirical studies should be involved in diverse cultures and industries to facilitate the understanding of innovation making process with all of its dimensions. 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 (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 sectoral conditions and relations (sector and 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.

Firm characteristics

Results based on empirical studies report that the ownership types of companies slightly influence their R&D functions. For instance, Bishop and Wiseman (1999) declared that foreign capital negatively influences firms' innovative capabilities and R&D functions. But, Love and Ashcroft (1999) claimed that plant size, foreign ownership and the presence of R&D are all positively correlated to innovations. Despite many studies that observed firms with foreign origin are more innovative, findings regarding the direction and intensity of the relation between ownership status and innovation are indefinite.

Similar to ownership status, firm size has also ambiguous effects for innovativeness capabilities. George et al. (2005) examined that the ownership structures of small and medium sized firms influence their tendency to take risks and swell the scope and scale of innovativeness efforts. Peters and Van Pottelsberghe (2003) found that although large firms are better in term of innovation competencies, small firms assign largest share of profits to innovative projects among Belgian manufacturing firms. Surprisingly, both large and small firms have more patents applications and R&D investments than medium sized firms. The authors also stressed that the share of turnover because of incremental innovation is higher within small firms, but technological breakthroughs are more vital within large firms. Finally, they also indicated that foreign firms invest significantly less in R&D than local firms.

Evangelista et al. (1998) studied the innovative firms in different manufacturing sectors in Europe and regarding their size. They found that the percentage of innovativeness is higher for large firms than for smaller ones. Benavente (2006) discovered that larger firms have a higher percentage of innovative sales; and also firms that have larger market share have higher R&D intensities. These results are very suitable to Schumpeterian approach of innovation, according to which innovation is an activity generally embarked by larger firms. However, Lööf and Hesmati (2002) investigated the effect of firm size to R&D expenditure by using an econometric model. They indicated that innovation intensity falls significantly with size. In the studies of Avermaete et al. (2003), some aspects of innovativeness capabilities of firms depend on the age of the company and firm size. However, the research is ambiguous on the relationship between company age and innovativeness.

INTEGRATED INNOVATION MODEL

So far, in the academic literature, a complete model of innovativeness was hardly ever tested by researchers; thus, very few noteworthy results were found. This might be due to the difficulty of finding and acquiring detailed information from firms about their innovative strategies and/or due to using an incomplete innovation model.

The basic elements of our innovation model are exhibited in *Fig. 1*. In the model, in-firm and out-firm innovation determinants settle the innovative capability, which ultimately affects the competitiveness of the firm in its marketplace, and hence, the financial, market, innovative and production performance success of the company.



Figure 1 - Basic elements of the innovation model

Innovativeness in a firm is a joint outcome, among others, of general firm characteristics, firm structure, firm strategies and external conditions. These innovation determinants with all their sub-elements are presented by an integrated innovation model in *Fig. 2*. 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 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. 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.

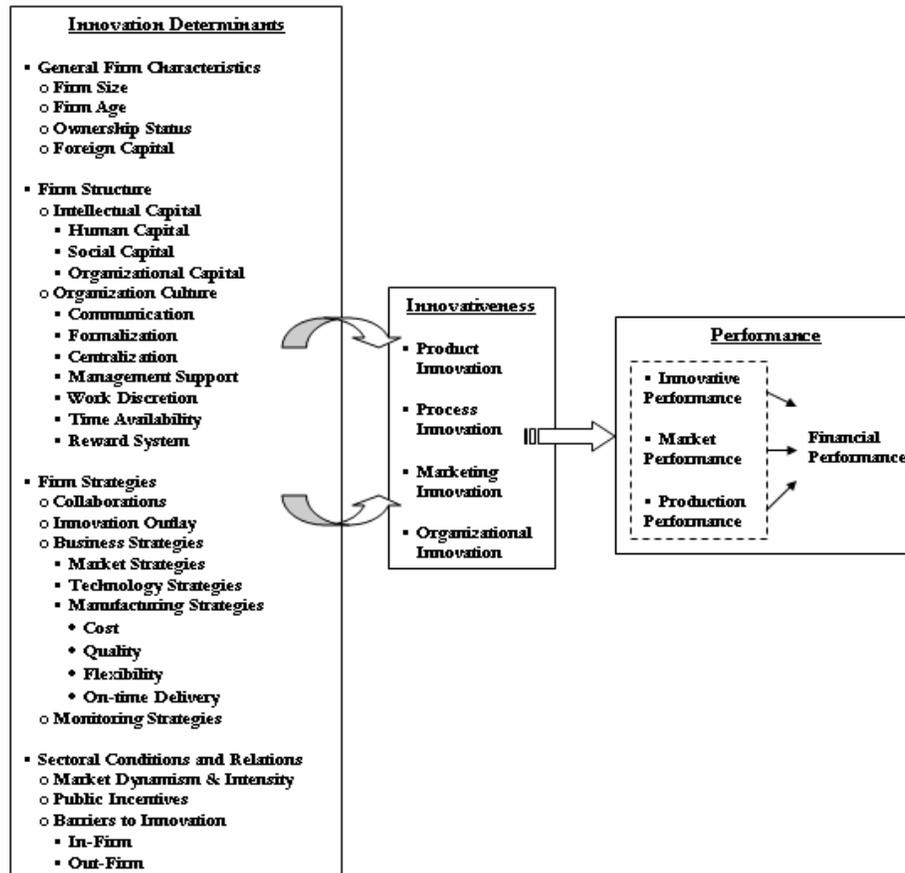


Figure 2 - The integrated innovation model

RESEARCH METHODOLOGY

In order to collect the required data and to discover how innovations are born and what the impact is of firm characteristics on innovativeness as well as the impact of innovations on the firm performance, we utilized an empirical survey methodology. A questionnaire was developed to be filled in by the upper managers of companies in selected industries in order to assess the determinants of innovations and their structural associations to firm competitiveness and performance. The questionnaire was pre-tested by 10 pilot interviews to ensure that the wording, format and sequencing of questions were appropriate. Then, it was applied to the larger sample of manufacturing firms through a hybrid system of mail surveys and face-to-face interviews.

The questionnaire was developed by considering both similar questionnaires utilized in prior studies and both the determinants and the measures met in the up-to-date academic literature, which were not covered by the prior studies. The survey is used particularly for collecting data in order to evaluate the determinants of the innovation at firm level, to find out the influence of innovativeness on the firms and to determine the relation between innovativeness, competitiveness and performance. The

questionnaire form can be summarized under eleven modules, which are: *General Firm Information, Market Properties and Competition Structure, Firms' Strategies, Implementation Level of Innovation Types, Intellectual Property, Public Incentives, Organizational Culture, Barriers to Innovation, Collaboration, Performance, and Quantitative Firm Performance Data.*

For innovation determinants and innovativeness measures, the respondents were asked to indicate what extent related applications and practices were important / implemented in their organizations respectively relying on five-point scales. Similarly, for performance measures, respondents were asked to indicate what extent they are successful in the latest three year comparing to the previous years relying on five-point scales.

Firms were selected for the survey randomly from the database of the Union of Chambers and Commodity Exchange (TOBB) and Istanbul, Kocaeli, Tekirdag Cerkezkooy and Sakarya Industry Chambers and member lists of various Industry Parks in Northern Marmara region within Turkey. 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 1,674 questionnaires mailed and received, a total of 83 questionnaires were completed 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 over a 7 months period, using a self-administered questionnaire that was distributed to firms' upper level manager operating in six different manufacturing sectors (namely textile (20%), chemical (18%), metal products (19%), machinery (15%), domestic appliances (8%) and automotive industries (20%)) in Northern Marmara region within Turkey, where the percentages reported correspond to the percentage of the firms surveyed in each sector within the total 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 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 categories namely <1M€, [1M€,5M€[, [5M€,20M€[, [20M€,50M€[and ≥50M€.

After the data collection stage, statistical analyses were conducted in order to validate the hypothesized model. In order to explore how innovativeness influences firm performance and 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. During the analysis, the overall innovativeness was measured by merging four innovation types performed; namely product, process, marketing and organizational innovations.

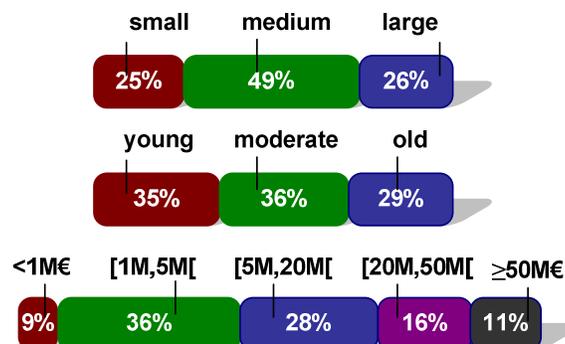


Figure 3 - Sample profile

The multivariate data analysis, which was conducted in order to extract the relationships presented in the integrated innovation model, was performed at 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) in order to determine, if 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 unidimensionality 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. Note that due to space limitations the statistical results and numerical findings of these analyses will not be reported here but among the innovation determinants only firm characteristics are selected to be discussed in some detail.

RESULTS AND DISCUSSION

The key reason for firms to seek innovativeness is their desire to obtain increased business performance and competitive advantage. Companies gain additional competitive advantage and market share according to the level of importance they give to innovations, which are vital factors for companies to build a reputation in the market and therefore to increase their market share.

Innovation is a complex and nonlinear 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. These improvements are the occasion of achieving better operational and financial performance for companies.

Main findings about the drivers of innovativeness model

The findings visibly stress that intellectual capital is the most important determinant of innovativeness. Human capital, which covers the skills, creativity and experience of individuals, is determined to be the most valuable resource 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.

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.

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, statistical 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.

Consequently, 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. On the other hand, indigenous barriers to innovation have significant negative effects on innovative capability. But, the relationship between exogenous barriers to innovation and innovativeness is not significant.

Main findings about firm characteristics

Among firm characteristics, only firm size is significantly correlated to innovativeness. The relation between the firm size and innovativeness is almost linear rather than U-shaped as would be expected (Bound et al., 1984). The analysis of firm size effect was performed by one-way ANOVA test and innovativeness level of small, medium and large firms is compared. Findings report that innovativeness level of these three groups significantly differ ($p < 0.05$) and large- and medium-size companies are performing better than the small-size companies in implementing innovations (Table 1).

Table 1 – Effects of firm size on innovativeness level

<i>Firm Size</i>	<i>%</i>	<i>Mean of Innovativeness Level</i> Subset for $\alpha=0.05$	<i>p value</i>
Small	25	2.510	
Medium	49	2.914	0.040
Large	26	3.031	
<i>Total</i>	<i>100</i>	<i>2.843</i>	

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. On the other hand, firm characteristics such as firm age, firm ownership status, and existence of foreign capital in a firm do not have significant effects on innovativeness.

In our sample, large firms are more likely to be involved in collaborations, more likely to invest more on R&D and more likely to be more competent in intellectual property management. Contrary, small and medium sized firms demonstrate weak results for patent applications, collaborations, use of public incentives and R&D investments.

The analysis about R&D employees indicated that the firms having at least five R&D employees have better marketing and financial performance ($p < 0.05$) and are more innovative ($p < 0.01$) especially at incremental product innovation, and process and organizational innovations than other firms.

Main findings about the performance model of innovation

High level of implementation of innovations results in better innovative and production performance. Although a strong direct link is not found between innovations and market performance, it is observed 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 more significant improvement on their operational performance in return of a high level of innovation activities are encouraged and implemented. Finally, it is also found that financial performance can be expressed as the combined result of the innovative, the production and the market performance. All of these three performance indices have significant positive effects on financial performance. Thus, our findings support the fact that innovation strategy is an important major predictor of firm performance (Zahra and Sidhartha, 1993).

These findings tend to substantiate our conceptual model and offer a vital managerial implication: Managers of firms should give additional emphasis to innovations as they are important instruments for achieving sustainable competitive power and better performance in the face of global competition. Improved operational performance is contingent on the degree of how innovations are implemented.

However, a certain amount of time might be necessary before observing the reflection of innovations on firm performance measures. A lag effect between innovations and financial performance is already stated in the literature (Zahra and Sidhartha, 1993; Teece, 1988). This fact actually explains why top managers frequently complain that they do not harvest enough positive results in return of their innovative efforts. Boston Consulting Group's Annual Innovation Report (Andrews et al., 2007) underlines the same fact based on a senior management survey. Although innovation remains a top strategic focus for the majority of the companies and the spending on innovation has an increasing trend throughout the years, many executives (i.e., 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 noticed 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.

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 determinants of innovation and firm performance through the innovativeness construct.

In this research, a questionnaire is designed and conducted and various multivariate statistical procedures are performed in order to extract the relationships between innovation determinants, innovativeness and firm performance. It is found not only that the innovative firms are rewarded by higher operational performance including financial performance, but also it is possible to predict innovativeness level of a firm through innovation determinants within small error bounds.

A key contribution of this study is the empirically tested determinants of innovation that managers should recognize and manage to boost their operational performance. Having a clear understanding of the exact nature of innovations will help firms to prioritize their market, production and technology strategies, to be followed by appropriate subsequent action plans.

As a future work, modeling the innovation process and innovation relationship network by using system dynamics tools may enhance the analysis and causality part of this research.

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