

STRATEGIC APPROACH TO PRODUCT DESIGN AND DEVELOPMENT PROCESS, AND EFFECTIVENESS OF INDUSTRIAL DESIGN PRACTICES

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ABSTRACT

Emerging economies face international competition and moreover, similar technology applies to organizations in the relevant industry. Therefore companies must strive to keep their market positions or create new business opportunities. Novel and innovative strategies are required in either case, which depends on differentiation in the market. Recognized as a value for sustainable competitive advantage and commercial success, industrial design (ID) has an essential role. This paper proposes that strategic approach to product design and development process is beneficial for the effectiveness of ID practices. Context of the research in the study is divided into two sections. The first section derived from a study previously conducted in Poland and aimed to observe whether Turkish companies recognized ID as a strategic tool for differentiation. A comparison of the results was made with the results obtained in Poland. The second section of the research context focuses on Turkish companies. To explore how strategic approach to product design and development process impacts on ID practices; factors and hypotheses were generated through principal components analysis prior to regression analysis to analyze the relationship. 198 companies from textile, furniture, and home appliances industries took part in the research. Major indications of the research show that strategic effect of teamwork has a central role in effective ID practices.

Keywords: *Industrial Design, Strategic Innovation, Product Development*

ÜRÜN TASARIM VE GELİŞTİRME SÜRECİNE STRATEJİK YAKLAŞIM VE ENDÜSTRİYEL TASARIM FAALİYETLERİNİN ETKİNLİĞİ

ÖZET

Gelişmekte olan ekonomilerdeki işletmeler, hiç kuşkusuz bir yandan uluslararası rekabet koşullarıyla öte yandan aynı alanda faaliyet gösteren diğer işletmelerin aynı teknolojiyi kullanmasının yaygınlaşmasıyla mücadele etmek durumundadır. Bu nedenle örgütler pazardaki konumlarını korumak ve yeni iş fırsatları geliştirmek durumundadır. Her iki durumda da pazarda farklılaşmaya dayanan yeni ve inovatif stratejiler gerekmektedir. Sürdürülebilir rekabet avantajı ve ticari başarı için bir değer olarak kabul gören endüstriyel tasarımın bu açıdan önemli bir rolü bulunmaktadır. Bu çalışma kapsamında ürün tasarım ve geliştirme sürecine stratejik yaklaşımın endüstriyel tasarım uygulamaları için yararlı olduğu görüşü

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ortaya konmaktadır. Araştırma kapsamı iki bölüm dahilinde düşünülmüştür. Birinci bölüm, kaynağını daha önce Polonya'da yapılmış bir araştırmadan almakta ve Türk işletmelerinin farklılaşmak adına endüstriyel tasarımı ne ölçüde bir stratejik gereç olarak gördüklerini gözlemlemeyi amaçlamaktadır ve Polonya'daki araştırma bulguları ile karşılaştırılmış bulgular sunmaktadır. İkinci bölüm ise Türk işletmelerine odaklanmakta ve ürün tasarım ve geliştirme sürecine stratejik yaklaşımın endüstriyel tasarım uygulamalarını nasıl etkilediği ele almaktadır. Faktör analizi sonucunda endüstriyel tasarım boyutunda üç faktör (endüstriyel tasarımın diğer iş süreçleri ile uyumu, estetik ve ergonomik uygunluk) ile stratejik ürün geliştirme boyutunda üç faktör (takım çalışması, sürekli inovasyon ve pazara odaklanma) ortaya çıkmış ve bu faktörler regresyon analizi ile incelenmiştir. Tekstil, mobilya ve ev aletleri alanlarında faaliyet gösteren 198 işletme araştırma kapsamına dahil edilmiştir. Takım çalışmasının etkisinin endüstriyel tasarım uygulamalarında önemli rolü olduğu temel bulgu olarak söylenebilir.

Anahtar Kelimeler: *Endüstriyel Tasarım, Stratejik İnovasyon, Ürün Geliştirme*

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INTRODUCTION

The use of industrial design (ID) to retain a strategic advantage, particularly in developed countries, has burgeoned over the past decades to provide distinctive products to customers (Hoagland, 2006; Gemser & Leenders, 2001; Kappel, 2001; Lorenz, 1994). Consumers, for their part, have an economic stake in having access to a wide range of competitively priced, safe, reliable products and services; however, they might also be able to claim some sort of stake of authenticity (Reed,2002). In fact, this notion involves a wide range of issues: from environment-friendly manufacturing to the appearance of the product. From a factual standpoint, contemporary organizations need more powerful practices to develop and launch new products by providing consistent customer value throughout the company's global markets (Feigenbaum,2007). For this reason, the strategy and investment should be regarded as a whole plan with the support of core competences in order to maintain the authenticity and distinctiveness.

Most studies show that referring to design as a core competence is a privilege (Horn & Salvendy, 2006; Mäkinen, 2005). There are tentative examples on the profitable design investments with evidences coming mainly from case studies of "winning" companies or commercially successful projects (Gemser & Leenders, 2001; Svengren, 1994; Mukhopadhyay & Setaputra, 2007; McDermott & Colarelli O'Connor, 2002). However, the expectation that ID should be beneficial for a

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company's strategic initiatives in the competitive markets makes us think over two important dimensions of the argument. Principally, it is apparent that managerial support should be consistent with the context of the strategic management process—in our case, the product design and development, since individuals are required to engage in knowledge gathering, creativity, and development of ideas consistent with their organization's mission and strategic plan (Amabile, 1997; Badke-Schaub, 2004; Cross, 1997; DiPietro & Anoruo, 2006). Thus, profitable design effectively serving the strategic planning initiatives within the organizations drives us to investigate whether companies, which are in need of differentiation in the market by means of ID, really acknowledge the product design and development process a strategic tool. Secondly, contradicting conditions of product development are often claimed—engineers, who have to collaborate under time constraints, are expected to meet high quality requirements in an effective and efficient way (Badke-Schaub & Frankenberger, 1999). Hence, product design, as an essential part of a development project, is expected to comply with all tools, activities and ideas gathered across the organization. This raises the question of how companies can consider customer needs and requirements at the highest possible level while deriving greater benefits from their product design and development process. Attempting to answer this question, this paper involves the development of a view of the relationship between the ID and its use as a means of strategy in the organizations.

THEORETICAL BACKGROUND

Manufacturers in the developed countries have faced increased market volatility, uncertainty and heightened competition since 1980s, thus have come under pressure to restructure their production system in order to improve quality and production flexibility; a trend that marks the transformation from 20th century; Fordism, to 21st century; post-Fordism. This enhanced the use of TQM and several tools related to its philosophy, and tightened the collaborative links with suppliers and buyers (Taplin, 2006; Alfasi & Portugali, 2004). Furthermore, Taplin (2006) argues that markets no longer had to be captured by the promise of meeting needs with standardized and affordable products but could be reached by severing the link between consumption and production through image, novelty, and fashion. Hence production turned out to be innovation-mediated; constantly seeking to anticipate market changes, and to

agitate satisfied customers by innovating continuously the style, appearance and accessory functions of the products. Moreover, Shapiro and his colleagues points out the importance of R&D in the industry: "What is called production in the culture industries is much closer to what is called R&D in other industries and what is production in other industries turning out numbers of the finished product is called 'reproduction' in the culture industries" (Shapiro et al., 1992; Bowring, 2002). Since innovation gained a perpetual role in developing strategy, then how can companies integrate customer needs and requirements into the continuously innovated style, appearance and functions of their products? In fact, there exists an extensive literature on how innovation affects the evolution of an industry, whereas competition in the marketplace selects a dominant product design, and thereafter, product innovation declines and process innovation becomes a more worthwhile investment (Murmann & Frenken, 2006; Baldwin, Hienerth, & von Hippel, 2006). Eventually, similar standards in the use of manufacturing technology and the fairly standardized product quality spread across the industry, and even across the global business world. Having first devoted attention to surviving in the market due to the trend of standardization in the industry, some companies apparently would devote more attention to introducing distinguished products to the market. Thus, ID becomes a feature, which encompasses not only the product but also the organization's industry environment, and this feature would be a useful tool for an organization to demonstrate their difference in the industry and the market (Grzecznowska & Mostowicz, 2004; Kotler & Roth, 1984; Gemser & Leenders, 2001).

Recent research shows that sources of competitive advantage (e.g. core competence) form the competitive advantage, together which influence the choice of competitive strategies particularly in design-oriented industries consisting mainly of small companies (Mäkinen, 2005). Design that becomes the core competence of a company would, therefore, turn out to be a competitive advantage, which influence the company's competitive strategy. Nevertheless, the critical balance between "what the company offers" in terms of creativity and "what the customer wants" must be taken into consideration. Product creativity is an added value for quality; hence, the originality and appropriateness of the product are expected to elicit a positive effect compatible with the judgment of the customer in order to return a positive effect on company performance (Horn & Salvendy, 2006; Prasad, 2001; Gemser & Leenders, 2001). Thus ID, today, is recognized as a value for sustainable

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competitive advantage and commercial success, and research shows that effective ID is related to corporate financial performance even after considering expenditures on ID (Hertenstein, Platt, & Veryzer, 2005; Gemser & Leenders, 2001; Svengren, 1994; Mukhopadhyay & Setaputra, 2007; McDermott & Colarelli O'Connor, 2002). In fact, many business organizations, particularly in developing countries today, are yet to recognize the ID as a strategic tool that helps them survive in the globalized competitive markets. Nevertheless, the effective use of ID depends on issues that are beyond the recognition of the concept as a strategic tool, and here raises the question: "Who conducts the ID process inside or outside of the organization?" In some cases, organizations prefer to recruit designers, therefore keep their creative ideas inside the company, while others refer to ID as a service (out of their scope) to outsource in order to provide specialized help. In either way, industrial designers' focus on improving ease of product use and their graphic and aesthetic capabilities help companies differentiate competitive product offerings and attract customers.

Effective Industrial Design Practices

In his book entitled *design in the USA* (1979), Meikle argues that the world of art and the business world began to converge during the 1930's, and referred to ID as a distinctive profession, which helped corporations sell their products in the midst of a devastating period—the Great Depression, and overcome the widespread pessimism that accompanied the era. As for the 1980's, where TQM began to seize the management practices in many organizations, Meikle reveals how the transition to postmodern design took place by emphasizing the electronic digital computer to be the most important agent of change. He argues that its ever-changing software innovations gave users "a feeling of being closer to the source of things, closer to the basic level of the artisan or craftsman, than at any time since the advent of the Industrial Revolution" (Smith, 2006). In fact, it is much in evidence that the variety of definitions for ID reveals the secret transition of product development and manufacturing from the Industrial Revolution through the Information Age. Although the concept reflects different perspectives towards the function of ID, at least a common opinion exists that its role in the product development does not apply only to aesthetics, but also to certain aspects such as ergonomics, user friendliness, ease of manufacture, efficient use of materials, and product performance

(Gemser & Leenders, 2001; Ulrich & Pearson, 1998). Furthermore, the strategic use of design is argued in the literature by describing the concept as matching customer requirements to a product's performance, quality, durability, appearance and price, and a means to communicate corporate image and product integrity (Gemser & Leenders, 2001; Kotler & Roth, 1984; Yamamoto & Lambert, 1994).

When seen as part of the product development process, design happens to be an essential step—an early phase in the process that maintains the presentation of the product in line with production specifications and customer preferences. Many arguments can be made regarding the scope of the design concept while a common signification can be attributed to engineering design, which particularly concerns the functions of the product. To engineers, the product form represents a solution to meet functional structure or production requirements, whereas to designers, this accommodation is one of many necessary conditions when developing the product form. The product to attract the eye of the potential customer and increase the desire for purchasing should be well designed with further features linked primarily to ergonomics and aesthetics (Chang, Lai, & Chang, 2007; Veryzer, 2005; Gemser & Leenders, 2001; Giannini, Monti, & Podehl, 2006). In order to investigate whether organizations appreciate the ID as a strategic tool for differentiation, it is necessary to draw the strategic framework of the effective ID practices in organizations. Taking the wide variety of functions of ID and recent studies (Gemser & Leenders, 2001; Ulrich & Pearson, 1998) into consideration, a broader way to define ID is referred to as the activity that transforms a set of product requirements into a configuration of materials, elements and components, which impacts on static concerns of the product design—*aesthetics, image and ergonomic compliance*, and dynamic concerns—*compliance with other business processes*.

Aesthetics, Image and Ergonomic Compliance

Addressing the emotions of the customers is an approach beyond assuring the quality and simply implementing customer needs and requirements on the product (Crilly, Moultrie, & Clarkson, 2004). Manufacturing-based approach to quality refers to quality as conformance of design specifications with an outcome of engineering and manufacturing practices while product-based approach considers the product's measurable characteristics that reflect differences in quality. In fact, perceived quality based on image and brand name with an outcome

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of subjective assessment of the customer, and aesthetics as a matter of personal preferences are also crucial dimensions to obtain quality products (Sebastianelli & Tamimi, 2002; Garvin, 1987). Recent studies show that measuring the emotional link between the customer's perception and the product characteristics, reinforcing the customer's positive attitude towards the product at first sight, and investing on the product's appearance to attract the customer's attention (e.g. investing on software programs) are challenging but necessary issues to be concerned in line with the design of the product (Waller & Ahire, 1996; Bailetti & Litva, 1995; Jeffries & Sells, 2005; Gemser & Leenders, 2001; Grzecznowska & Mostowicz, 2004; Hammond, 2002; Gotzsch, Chanaron, & Birchall, 2006). The aesthetic impression provided by the product must be followed by its semantic interpretation—what a product is seen to say about its function and qualities, and symbolic association; the personal and social significance attached to the design (Crilly, Moultrie, & Clarkson, 2004). While the image is quite associated with how the organization can spark an interest among consumers particularly through the strength of the brand, it stands as one of the main contributors to the product sales. Requiring a tight coordination with marketing and public relations functions, the design of the product would apparently be a proof of the product's image communicated to the public (e.g. taking part in trade fairs, fashion shows, exhibitions, etc.) (Grzecznowska & Mostowicz, 2004).

As ID is emerging as a key factor for success, business marketers strive to fulfill the customers' diverse functional and aesthetic product requirements with competitive demands for differentiation (Gemser & Leenders, 2001; Bertrand, 1991). Design's goals have evolved not only to include ease of manufacture, reliability, marketability, and appearance, but also to consider more altruistic goals related to improving ergonomics—attention to human factors, and focus on the user interface (Kusz, 2005). This pushes companies to view new product design as a strategic issue, while today's technology creates feature-rich products easy to use. Hence ergonomics plays an essential role in designing products that are comfortable to use and comply with the physical environment, which leads companies to deal with extra costs (Bertrand, 1991; Khalid, 2006; Gotzsch, Chanaron, & Birchall, 2006). Items indicated with *ID.1* through *ID.11* in Table 3 represent the generated items.

Compliance with Other Business Processes

An effective collaboration between the industrial designers, the R&D department and manufacturing engineers would bring the opportunity of efficient (and even trend-setting) production with reasonably lower costs, and impact the financial measures of organizational performance (Hertenstein, Platt, & Veryzer, 2005). Since the design phase constitutes the beginning of a process where a chain of activities impact each other, it is inevitable to ensure the integration of the design into the whole product development process and R&D activities (Veryzer, 2005). As the product development process ends with the determination of the certain production specifications, i.e. preparing the conceptualized product for immediate manufacturing, it is vital that the ID activities are coordinated with successive phases: effective use of raw materials or semi-products, retaining the efficiency and productivity of the manufacturing process, and continuous communication with the R&D and quality assurance departments (Lu & Wood, 2006; Ulrich & Ellison, 2005). The generated items are listed in Table 3 and indicated with *ID.12*, *ID.13*, and *ID.14*.

Strategic Approach to Product Design and Development

The intention and willingness to see the ID as a strategic tool, nevertheless, depends on the exclusive support of top level and functional managers. Above all, while similar technology applies to many organizations in the relevant industry, it is essential for an innovative organization to implement an appropriate and consistent strategy in order to exhibit some kind of difference in the market (Sarkar, Echambadi, & Agarwal, 2006). Organizations today are as filled as they ever were with managers with potentials to be effective strategists, and conceptual skills are needed to operate in an environment filled with ambiguity (Humphreys, 2005; Buhler, 2006). Since top management's basic attitude is shaped by a conceptual perspective towards the organization and its structure, supporting the structure requires two continuously changing issues to be concerned simultaneously: anticipating the industry, and understanding the customer (Stjernholm, 2002). Hence, focusing on the industry to follow developments and improvements, and recognizing each and every customer as different individuals generate the building blocks of the strategic innovativeness—the originality by virtue of introducing new ideas (Haake & Oliver, 2002; Wood, 2007; Turock, 2001; Moingeon & Lehmann-

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Ortega, 2006). Since originality can be regarded as the ability to think and act independently, creativity-related efforts including design apparently play a crucial role. As Picasso once remarked, "every act of creation is first of all an act of destruction", thus the company must enjoy the task of demolishing old paradigms and confronting the defenders of these beliefs (DeWitt & Meyer, 2005). Therefore, the strategic originality of the product design and development would also be related to conduct this dynamic cycle, which should be supported by managers at every level. Depending on the mentioned issues and following the contexts proposed in several recent studies (Miller, 2005; Berber & Pekdemir, 2002; Dewett, 2004; Waage, 2007; Jeong, Pae, & Zhou, 2006; Kingston, 2001); variables regarding the strategic approach to product design and development process were generated as seen in Table 4, coded as *S.1* through *S.12*.

RESEARCH CONTEXT

Purpose

The development of the research derived from a recent study, which was conducted in Poland (2004) by Grzecznowska and Mostowicz from the Institute of Industrial Design in Warsaw. The surveyed Polish companies revealed design's influence on achieving market success, and the study aimed to determine to what degree the surveyed companies raise the competitiveness of their products as a result of investing in design. Context of the research in this paper is divided into two sections. The first section aims to observe whether Turkish manufacturing companies recognize the ID as a strategic tool to achieve differentiation in their competitive markets. Since this question arose from the mentioned study in Poland, a comparison of the findings of this study was made with our findings in Turkey. The second aim of the study is to focus more in details on how strategic approach to product design and development process is related to ID practices in Turkish companies, and to determine the major factors that have impact on this relationship.

Methodology

A sample of Turkish manufacturing companies operating in three different industries, namely furniture, textile, and home appliances, was used. Names were drawn from the membership lists of the relevant chambers located in Istanbul. These three industries were selected

because we were influenced by the previously mentioned study in Poland; however, these industries also provide further implications significant to the context of our research. All three industries deal with products easy to imitate, therefore differentiation through ID happens to be a privilege, and fast changing trends in these industries provide a rich field for designers to exhibit their creative skills.

The survey instrument used to collect data was developed as a questionnaire containing both open-ended and close-ended questions. A Likert-type of scale of 1 through 5 was used for the close-ended expressions. Prior to the actual data collection, the questionnaire was pretested with ten managers from the three industries surveyed in this study, and some minor changes were made in the questions resulted from earlier studies and the literature overview on the ID. Necessary definitions were put in the questionnaire in order to retain the common understanding of the expressions. The questionnaire was sent by e-mail to respondents and also face-to-face sessions with managing directors or R&D/development managers, whom were considered most knowledgeable about the context of our research (Gemser & Leenders, 2001), were held at the premises of the respective companies. The questionnaire was divided into four parts. The first part concerned the company profile, including a question asking whether the company recruited employee(s) particularly for their design process, they preferred to outsource the service or they did not consider ID at all. Those who responded negative to this question were invited directly to respond to the final part of the questionnaire including questions about the factors that restrict companies to invest in ID. The second part contained given items compiled from the study in Poland to determine the evaluation of respondents on whether these factors were tools for commercial success. The third and fourth parts contained questions related to the scales of effective ID practices, and strategic approach to product design, respectively.

Statistical Approach

The first section of the research considered whether companies had in-house or external design expertise, and whether they saw ID as a factor of commercial success. Both of these issues were analyzed through frequency of items in order to adapt the analysis to compare with findings of the previously mentioned study conducted in Polish companies.

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Regarding the second section of the research, we used SPSS® v.13 to conduct exploratory factor analysis and extract factors that represent the scales of ID practices and strategic approach to product design and development process. Prior to factor analysis, Kaiser-Meyer-Olkin (KMO) and Bartlett's test was conducted respectively over the two scales of the second section to measure the sampling adequacy and to ratify the use of factor analysis. Then, principal components extraction method with variance maximizing (Varimax) rotation was used to remove unique and error variances during the common variance analysis (Tabachnick & Fidell, 2000; Judgev & Mathur, 2006). To extract reliable factors, eigenvalues over one were taken into consideration. The highest factor loadings for each item were included in the factor groups. Finally, the yielded factors derived from both scales were submitted into regression analysis to explore the effect of strategic approach to product design and development over the characteristics determined for ID practices.

Preliminary Analyses

A total number of 198 companies took part in the research. Among these were 68 furniture companies, 104 companies in the textile industry, and 26 companies in the home appliances industry. The participant companies employed from 12 to 500 people ($\mu=73$, $\sigma=79$), and were all located in either of the two major industrial zones of Istanbul. 28.3% of these companies informed that they did not consider any ID practices at all. Thus, for the analysis sections of effective ID and strategic approach to product design, these companies were excluded, which remained us 142 companies identifying design needs. 42.2% of the respondents indicated that new designs were developed by production engineers, while the rest of the companies had either in-house or only external design expertise. Since the study in Poland consisted of 161 companies (of which 61% identified design needs), which included 54 furniture companies, 73 companies in the textile industry, and 34 companies in the home appliances industry, we have decided to compare these two cases before proceeding to the second section of the research. Table 1 exhibits the profile of the response set including a comparison with the figures of the study in Poland.

For further investigation, respondents were also asked to evaluate the factors restricting their product design and development efforts. These factors were also gathered from the study conducted on the Polish

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companies. More than 85% of the respondents affirmed that low profitability of production and high manufacturing costs were restricting investments in ID and developing products. 75% of the Polish companies demanded legal protection of ID and neutralization of unfair competition effectuated by foreign companies. Turkish companies admitted the same problem even at a higher level (83.43%) particularly indicating the competition derived from cheap, low quality import products.

Table 1: Sample Profile

	Turkey (%) n=198	Poland (%) n=161^a
In-house design expertise	29.6	30
External design expertise	28.2	13
Design developed by production engineers	42.2	65
Design needs identified	71.7	61
No ID practices at all	28.3	39

^a Source: Grzechnawska and Mostowicz, 2004.

RESULTS

Recognizing ID as a Factor of Commercial Success

Table 2: Factors of Commercial Success (n=198)

	%
Precise adjustment of products to customer requirements	91.55 ^a
Market position through competitive prices	87.04 ^b
Prompt and punctual delivery	84.79
High-quality work	83.10
<i>Differentiation through product design</i>	<i>81.41^c</i>
Quality of after-sale services	66.48
Long-term contracts with retailers	47.48
Compliance with international warranty and quality standards	32.96
Good cooperation with foreign partners	28.73
Receiving national and international awards	24.23

For Polish companies: ^a 77%; ^b 60%; and ^c more than 40%. (Grzechnawska and Mostowicz, 2004)

As previously mentioned, the first section of the research aimed to determine to what degree respondent companies recognized ID as a

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factor of commercial success. Table 2 presents the results. Similar to the findings on the Polish companies, production is customized to the orders of clients and the quality of products depends heavily on customer preferences. In addition, market positioning through competitive prices is also essential. In the case of Turkish companies, we should also notify that product design is becoming an important factor for commercial success.

ID Practices: Factor Analysis Results

To explore the effectiveness of ID practices, respondent managers were asked to rate the previously mentioned items on a five point scale. The KMO value of the scale was determined as 0.773 with Bartlett's test significance of 0.000, and Cronbach's Alpha value of 0.848. Thus, the factor analysis was determined suitable. In fact, the exploratory factor analysis yielded five factors that represented variables of the ID practices with a total variance of 75.88%, where communalities varied between 0.600 and 0.853. Table 3 presents the rotated component matrix for the variables of ID practices.

The first of the five factors of ID practices that emerged was labeled as "compliance of ID with other business processes" (*FID.1*). Depending on the literature review, we expected the dimension to emerge as one of the two factors. However, the factor was loaded with two more items (*ID.7* and *ID.8*) in addition to its already existing three, which supposedly belonged to the dimension of aesthetics and ergonomic compliance. So, this emerged factor consisted of five items and had a Cronbach's Alpha of 0.848 ($\mu=2.97$, $\sigma =1.12$). This factor explains 25.57% of the total variance and shows the importance of coordination across departments of the organization during the product design process. As for the ergonomic compliance costs, financing and production departments should collaborate in order to provide feature-rich products that focus on the user interface (e.g. Kusz, 2005). Marketing appeared to have a more effective part when regarded together with other business processes as a whole. In other words, the effectiveness of coordination with the marketing department during the design process is more important for other business processes than for only aesthetics and image issues.

Table 3: Rotated Component Matrix of ID Practices

	1	2	3	4	5
ID.14 Continuous coordination with R&D/ development department during the design	0.884				
ID.13 Continuous coordination with production department during design	0.849				
ID.12 Efficient use of raw materials	0.832				
ID.7 Continuous coordination with marketing department during design	0.745				
ID.8 Compensation of ergonomic compliance costs	0.630				
ID.3 Quality perception at first sight		0.854			
ID.2 Considering customer's emotional link to product characteristics		0.762			
ID.1 Investing on aesthetics		0.684			
ID.9 Physical appropriateness of the design with where product is used			0.843		
ID.11 Supporting ease of use by market and technology research			0.708		
ID.5 Participating in trade fairs, etc.				0.785	
ID.6 Compliance with social environment				0.776	
ID.10 User's direct apperception					0.845
ID.4 Integrity of product's image					0.673

Extraction method: Principal component analysis; Rotation method: Varimax with Kaiser normalization; Rotation converged in 6 iterations; Cutoff: 0.40; items with highest loadings given only.

The second factor was labeled as "aesthetics" (*FID.2*), which consisted of three items that were already included in the aesthetics, image and ergonomic compliances dimension depending on the literature review. The factor had a Cronbach's Alpha of 0.776 ($\mu=4.04$, $\sigma=0.97$), and explained 15.82% of the total variance. The factor signifies the essential role of aesthetics and its prompt attractiveness to the eyes and feelings of the customer. However, the emphasis made by Kusz (2005) was approved here.

It was interesting to see the items related to aesthetics break away from ergonomic compliances, which went on to set up a separate factor loaded by two items. Signifying the essence of ergonomic compliances that designers should put efforts on designing user-friendly and physically appropriate products; the third emerged factor was, therefore,

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entitled "ergonomic compliances" (*FID.3*), which explained 12.73% of the total variance with a Cronbach's Alpha of 0.560 ($\mu=2.51$, $\sigma=1.01$).

The fourth and the fifth latent constructs were disregarded since they had very low Cronbach's Alpha values. The three factors already emerged explained 54.12% of the total variance—we have decided that these three factors are sufficient to submit to ongoing analysis as new ID performance dimensions.

Strategic Approach to Product Design and Development Process: Factor Analysis Results

In order to preview the strategic approach to product design and development process, respondents were again asked to rate items on a five point scale. The scale was found to have a KMO value of the scale was determined as 0.830 with Bartlett's test significance of 0.000, and Cronbach's Alpha value of 0.895. Therefore, factor analysis was found useful. This time, the exploratory factor analysis yielded three factors representing variables of the strategic approach to product design and development process with a total variance of 68.98%, where communalities varied between 0.511 and 0.847. The rotated component matrix is given as Table 4.

The first of the three latent constructs was labeled as "strategic effect of teamwork" (*FS.1*), which consisted of seven items, and had a Cronbach's Alpha of 0.881 ($\mu=3.72$, $\sigma=0.89$). The factor explains 32.04% of the total variance and shows the essence of teamwork for organizations to maintain long-term existence in the market and sustainable competitive advantage. Thus projects should be continuously improved and enriched with diverse ideas generated by creative individuals. The following latent construct was labeled as "continuous innovation" (*FS.2*), which provides the organization with an innovative company identity; particularly an organization devotes its assets to innovation in order to be different in the market and the industry. This factor explains 22.22% of the total variance. It consisted of three items, and had a Cronbach's Alpha of 0.820 ($\mu=3.38$, $\sigma=1.06$). The third and final latent construct was labeled as "focusing on market forces" (*FS.3*), which consisted of two items and had a Cronbach's Alpha of 0.697 ($\mu=4.38$, $\sigma=0.73$). This factor explains 14.73% of the total variance and signifies the fact that it is necessary to understand the customer needs and requirements, and to follow how competitors fulfill their needs.

Table 4: Rotated Component Matrix of Strategic Approach to Product Design and Development Process

	1	2	3
S.6 Synergy of projects	0.841		
S.7 Compliance of projects with corporate strategy and mission	0.765		
S.1 Cross functional team structure to support diversity	0.729		
S.3 Empowering project leaders	0.682		
S.2 Recruiting individuals with creative skills	0.662		
S.4 Effective and efficient allocation of resources	0.648		
S.10 Following macro-environmental issues	0.559		
S.8 Maintaining continuity of innovation projects		0.908	
S.5 Innovation culture of voluntary participation in process		0.810	
S.9 Consistency of simultaneous projects		0.622	
S.11 Following recent developments in the industrial environment			0.870
S.12 Continuously following customer needs, requirements, and trends			0.805

Extraction method: Principal component analysis; Rotation method: Varimax with Kaiser normalization; Rotation converged in 5 iterations; Cutoff: 0.40; items with highest loadings given only.

In order to assess the link of the strategic approach to product design and development process to the performance of ID practices, three hypotheses relevant to our expectations depending on the theoretical background presented in this paper were developed in terms each emerged factor of the strategic approach. Hence, the first two hypotheses would state a positive relationship, while the third hypothesis would reflect a negative relationship due to our literature review (quality depending on customized production; e.g. Grzecznowska & Mostowicz, 2004) and preliminary analyses. Therefore:

Hypothesis 1 (H1). Strategic effect of teamwork is positively related to ID performance.

Hypothesis 1 (H1). Continuous innovation is positively related to ID performance.

Hypothesis 1 (H1). Focusing on market forces is negatively related to ID performance.

Table 5: Regression Analysis and ANOVA Results

Model (constant)	<i>R</i>	<i>R</i> ²	Adjusted <i>R</i> ²	σ_{est}	Coefficients	β	<i>t</i>	ANOVA	Sum of squares	<i>df</i>	Mean square	<i>F</i>
1 (FID.1)	0.711 ^a	0.506	0.495	0.793	<i>FS.1</i>	0.494	6.027**	Regression	88.983	3	29.661	47.127**
					<i>FS.2</i>	0.328	4.034**	Residual	86.855	138	0.629	
					<i>FS.3</i>	- 0.223	-3.506**	Total	175.838	141		
2 (FID.2)	0.666 ^a	0.443	0.431	0.732	<i>FS.1</i>	0.374	4.298**	Regression	58.983	3	19.589	36.571**
					<i>FS.2</i>	0.340	3.932**	Residual	73.920	138	0.536	
					<i>FS.3</i>	0.035	0.515	Total	132.689	141		
3 (FID.3)	0.298 ^a	0.089	0.069	0.979	<i>FS.1</i>	0.288	2.585 [‡]	Regression	12.843	3	4.281	4.471*
					<i>FS.2</i>	- 0.019	- 0.171	Residual	132.129	138	0.957	
					<i>FS.3</i>	0.056	0.647	Total	144.972	141		

^a Predictors: (constant), FS.1, FS.2, FS.3; [‡]p ≤ 0.05; * p ≤ 0.01; ** p ≤ 0.001

Table 5 presents the relationship of each strategic approach dimension to each ID dimension. Statistically significant F -test scores for each regression model was computed, therefore the models possess good explanatory power.

The regression results Hypothesis 1, which predicted a positive relationship between strategic effect of teamwork and ID performance is supported on all the three ID performance dimensions; compliance with other business processes ($\beta=0.494$, $p<0.001$), aesthetics ($\beta=0.374$, $p<0.001$), and ergonomic compliances ($\beta=0.288$, $p<0.05$). In fact, strategic effect of teamwork is the only strategic approach dimension to be related to all the three ID performance dimensions. This indicates that strategic effect of teamwork constitutes a major component for the effectiveness of the ID performances. Predicting the relationship between continuous innovation and Hypothesis 2 is supported on two ID performance divisions; compliance with other business processes ($\beta=0.328$, $p<0.001$), and aesthetics ($\beta=0.340$, $p<0.001$) and support on relationship with ergonomic compliances was not found significant. The third hypothesis, which predicted a *negative* relationship between focusing on market forces and ID performance was only supported on compliance with other business processes ($\beta= -0.223$, $p=0.001$) but not aesthetics or ergonomic compliances.

DISCUSSION AND CONCLUSIONS

This study found that the benefits of ID practices in challenging competitive business environments depend on whether individuals carrying out the product design and development process work under conditions that allow their capabilities to contribute to the strategy of their organizations.

Primarily, we sought to explore whether, like their counterparts in Poland (Grzecznowska & Mostowicz, 2004). Turkish companies recognized ID as a strategic tool. 72% of respondents in Turkey indicated the use of design, while this figure was found 61% in Poland. As determined in the first section of the research, precise adjustment of products to customer requirements was seen as a superb tool for commercial success in Turkey (almost all respondents), as well as in Poland. Introducing competitive prices was also found to be effective. In fact differentiation through product design was appreciated in Turkey, this figure was not found that promising in Poland just as Grzecznowska and Mostowicz state in their article (2004), although half of the respondents recognized ID as a main factor in market development, most

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of the Polish enterprises did not have sufficient financial means to invest in design and new technologies. The fact that this study was conducted right before Poland became a member of the European Union, which led the domestic market to facing the international competition, may constrain the opportunity for a definite comparison, and conditions might have changed rapidly since 2004. However, this comparison allows us to witness that surveyed companies in both countries with emerging economies similar results, which forms the basis of the second section of our research: Customized production and competitive pricing still dominate strategic decisions rather than striving in the market with design as a differentiation strategy. Therefore, we have assumed that concentrating only on the customer orders and competitor products keep companies from the use of design practices as a strategic weapon, which they certainly need. This was approved in Turkish companies that focusing on the customer needs and competitor products was negatively related to the compliance with other business processes. Companies should realize the benefits of differentiation, and an effective product design and development process must be adopted into strategies (Allen & Helms, 2006). For example, a report on the future of the textile and clothing industry released in 2003 by the Commission of the European Communities declared that the sector's only sustainable strategy is to concentrate on innovation, research, fashion and *design*, and the use of new technologies, together with positive industrial relations (Smith, et al., 2005). Hence, networks of small and medium sized companies and regional clustering of companies are encouraged and investing on innovation and design becomes a competitive advantage in the market.

The concept of ID serves to focus attention on the aesthetics and ergonomic compliances of the product, and on effective coordination with other business functions according to the findings of this study. Although none of the various definitions of ID has been universally accepted (Gemser & Leenders, 2001), we have decided to consider the concept in a general way comprising several issues from the product appearance and user friendliness to efficient use of materials and ease of manufacture. However the principal components analysis presented us the three dimensions mentioned above. Thus, in our opinion, at least within the context of this paper, a definition for ID as a dynamic concept can be made as "considering customer's emotional link to the remarkable characteristics of user-friendly products, which are obtained through actions integrated with other business processes."

More than 80% of the surveyed Turkish companies indicated that ID was a strategic tool to attain commercial success. However, research revealed that these companies were focusing strategic attention on the integration of product design and development process with other business processes. According to the findings, strategic effect of teamwork is likely the central component for a company's strategic approach to product design and development process. Thus, the results suggests generation of cross functional teams consisted of diverse individuals with creative skills, and this will encourage new product initiatives. Moreover, the design process will not be isolated from other business processes; specifications of customer needs, use of raw materials or the product features will be incorporated into the design.

The study also revealed the importance of the continuity and consistency of the innovation projects. As companies focus on innovative projects, this is concerned by other business processes. Transformation is necessary to compete in the complex and dynamic markets and establish novel strategies (e.g. Murray & Greenes, 2006; Foreman, 2006); thus, we may propose that the continuation of a growing interest in developing new products will affect the overall organization and transform it into a company with an image of innovator rather than outsourcing contractor or imitator. Continuous innovation was also found to be related to aesthetics, but not to ergonomic compliances. This supports a relevant argue in the literature (Kusz, 2005) that aesthetics still has a major role in the design and ergonomic compliances are yet to incorporate in ID.

A limitation of this research is the issue of generalizability from a study limited to a sampling of three industries. Recent developments in technology and changing economic circumstances also impact the context of the research; therefore, conducting the research in unusual environmental conditions (e.g. economic crisis) might extend the results dramatically.

In conclusion, emerging economies face international competition and companies must keep their market positions or create new business ecosystems. Either way requires novel strategies, which depends on differentiation in the market. Design, in this case, has an essential role: it allows companies to introduce products that may be similar to those produced by their counterparts; however, touching the feelings and attracting the attention of customers brings a privilege in the market. ID is a complex process; hence it should be embraced by not only the R&D departments or designers but the whole organization as a strategic tool for differentiation.

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