

**Design as an Element of Innovation:
Evaluating Design Emphasis and Focus
in New Technology-Based Firms.**

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Abstract

Design is increasingly gaining recognition as a fruitful means to improve business performance and competitiveness. There is significant opportunity for research on design as an element of innovation and a lack of a consistent methodology for evaluating design in this context. This paper develops a model to evaluate firms' design emphasis and design focus. The model is based on a synthesis approach to innovation in both services and manufacturing and a definition of design which encompasses the dimensions of visceral, behavioural and reflective design.

Empirical evidence based on a survey of new technology-based firms is presented. The data shows that there is no significant difference in design emphasis and design focus across the spectrum of business activities ranging from manufacturing to services. This supports a synthesis approach to innovation in manufacturing and services. Design emphasis is found to vary considerably among the firms studied and a general tendency to focus on the behavioural (functional) dimension of design is observed.

Introduction

There is increasing recognition that in today's highly competitive markets, where differentiation based on technological factors alone is not sufficient to insure competitive advantage, design may provide a realistic means to avoid the debilitating effects of commoditization and improve performance (Ridderstråle and Nordström 2002; Trueman and Jobber 1998; Lorenz 1994; Walsh et al. 1992; Kotler and Rath 1984; Tschang 2005; Ulrich and Eppinger 2003; Black and Baker 1987). Empirical evidence is presented by Gemser and Leenders (2001), Hertenstein et al (2005), Walsh et al (1992) and Roy and Riedel (1997) to support the thesis that design effectiveness is related to business performance.

Design is not always viewed as an element of innovation, instead it is more commonly studied in the context of marketing and seen as relevant only for the promotion and selling of products and services (Christensen 1995). According to Perks et al (2005) and Von Stamm (2003), design is appropriately viewed as having a far-reaching, and even leading, role in innovation.

Perks et al (2005), Trueman and Jobber (1998), and Gemser and Landers (2001) suggest that the nature of the role of design in innovation is under-investigated. A number of researchers have addressed the challenge of evaluating a firm's technical innovation capability and performance (e.g. Goswami and Mathew 2005; Chiesa et al 1996; Ulrich and Eppinger 2003). Chiesa et al (1996) develop a technical innovation audit framework for auditing performance and processes for technological innovation. Chiesa et al include industrial design in the product development segment of their audit scorecard, however they also express the opinion that this element is highly subjective and difficult to measure. There is significant opportunity for research on design as

an element of innovation and the need for a realistic methodology to evaluate design in this context.

The goal of this study is to contribute to the field of innovation management by developing a model to evaluate the emphasis on, and focus of, design as an element of innovation in new technology-based firms. Classification of firms according to design emphasis and design focus could be used as a tool to select firms from a large set, such as the one used as a basis for the study reported in this paper, for in-depth research (Miles and Huberman, 1994). Evaluating design emphasis and focus is an important prerequisite for studying the impact of design on performance. Additionally, a model for evaluating design emphasis and focus could be useful for managers and practitioners in taking stock of the current design emphases and foci of their firms and identifying the gap between the current situation and a desirable state.

This research takes technology-based firms as its subject of study because technology-based firms (including, but not limited to "high tech" firms) are an important source of technological innovation and economic progress both directly and indirectly (Smith 1999). As argued above, design constitutes an important means for achieving differentiation which, in turn, increases the success of innovation. The opinion that design is too expensive to justify is held by some firms (Hertenstein et al 2005; Gemser and Leenders 2001). This view can be expected to be more pervasive in new firms than in more established firms since new firms are generally more resource constrained than established firms (Murray and Lott 1995; Garnsey 1995). At the same time, the ability to use design is particularly important for small companies because they seldom have the ability to compete on price, since this generally requires economies of scale (Black and Baker, 1987). This study examines these resource-constrained firms' view of design as an element of innovation.

Hughes and Wood (2000) found that technology-based firms, whether in manufacturing or services, exhibit strong similarities in innovative behaviour which is substantially different from the behaviour seen in other firms. Therefore, it can be expected that limiting this study to technology-based firms will result in a rather homogeneous set of subjects. The differences observed in innovative behaviour can be assumed to be significant without having to take into account the possibility that the differences may be due, to a greater or lesser extent, to the simple reason that the firms observed come from a very heterogeneous population.

To capture a broad definition of design, but at the same time to impose some bounds to the concept, a three-dimensional view of design (Norman 2004) is used as a basis for measuring design emphasis and focus. The three dimensions are the visceral dimension, the behavioural dimension, and the reflective dimension.

Segmentation of economic activity into manufacturing and services is common, but this research takes a synthesis approach to innovation (Drejer 2004; Coombs and Miles 2000; Hughes and Wood 2000; Sirilli and Evangelista 1998). Adopting the synthesis approach permits using the same measures to evaluate design as an element of innovation for all firms across the spectrum of economic activity.

Following this introduction, this paper is organized as follows. The aspects of the framework for the study are developed followed by a model development. The methodology for the empirical study is described and results are presented using the model developed. The paper concludes with a discussion of the results, general observations about the model and its applicability and suggestions for further research.

Framework and Model Development

This chapter describes the framework for the study and model development and is organized into separate sections dealing with design, the dimensions of design, the synthesis approach to innovation, and finally, introduction of the model.

Design as an Element of Innovation

The term design is quite broad and is frequently used, or equated with, engineering (Veryzer 2005). The term industrial design is narrower, but carries with it connotations tying it to manufacturing. The Industrial Design Society of America (IDSA) defines industrial design on its web site (www.idsa.org) as *“the professional service of creating and developing concepts and specifications that optimize the function, value, and appearance of products and systems for the mutual benefit of both user and manufacturer”*. Since the goal of this paper is to transcend the services-manufacturing dichotomy, the term design is used despite the potential drawback of its broadness.

Design in the context of economic innovation covers both the practical functional aspect of economic offerings and aesthetics. Innovation can be thought of as encompassing both invention and commercialization (Keller 2004). The innovation process is sometimes described as a not entirely harmonious integration of two factions (Marsh and Stock 2003). The first faction is primarily technical in nature (e.g. R&D and engineering), and the second is primarily commercial (e.g. design and marketing). The commercial faction is concerned with providing a bridge from technical functionalities to value in a finished product or service. Thus, design is part of the innovation process and, as defined for the purposes of this paper, it encompasses activities which enhance the value inherent in products or services (Hertenstein et al 2005) and as such encompasses both functionality and aesthetics.

Norman (2004) argues that there is a strong correlation between aesthetic design and usability. Van der Heijden (2003) finds that the perceived visual attractiveness of web sites influences usefulness, enjoyment and ease-of-use, and Lavie and Tractinsky (2004) show that the visual aesthetics of computer interfaces is a strong determinant of user satisfaction. Therefore, functionality and aesthetics should not be viewed as independent but rather as closely intertwined.

The Dimensions of Design

Since the goal of this research is to develop a means to evaluate the emphasis and focus of design as an element of innovation, and given the broad use and understanding of the term design, it is important to select a set of dimensions along which design emphasis can be measured empirically.

Several researchers have suggested various segmentations of design (Dreyfuss 1967; Papanek 1984; Kotler and Rath 1984; Ulrich and Eppinger 2003; Norman 2004). These taxonomies, which are summarized in Table 1, have a great deal in common.

Table 1: *The segmentation of design as defined by selected authorities.*

Dreyfuss (1967)*	Ulrich and Eppinger (2003)	Papanek (1984)	Kotler and Rath (1984)	Norman (2004)
appearance	product differentiation	aesthetics (gestalt, perception)	appearance	visceral design
utility	quality of user interfaces	use, intuitiveness	performance	behavioural design
	appropriate use of resources	method	quality	
	ease of maintenance		cost	
low costs	ability to maintain and repair		durability	
communication	emotional appeal	association, conditioning		reflective design
		needs		
		telesis (nature, society, technological bias)		

*in Ulrich and Eppinger (2003)

Comparison of these taxonomies shows that the three-dimensional taxonomy of design suggested by Norman (2004) provides a convenient and appropriate framework for classifying design focus and evaluating design emphasis since it successfully encompasses all aspects found in the other taxonomies. The three dimensions of design are defined as follows:

1. Visceral design appeals to the senses (Norman 2004). Berkowitz (1987) conducted studies that demonstrate that the form or shape of a product affects beliefs about the product, and these beliefs in turn are likely to affect consumer preferences. Creusen and Schoormans (2005) confirm the influence of appearance on consumer choice of products based on an empirical study. Yamamoto and Lambert (1994) show that appearance has an influence on customer preference even for industrial products. Dreyfuss (1967), Ulrich and Eppinger (2003) and Kotler and Rath (1984) emphasize the importance of appearance, or the form, line, proportion and colour which are used to integrate a product into a pleasing whole, with the primary goal of product differentiation.
2. Behavioural design is about usability and performance. More specifically, the four components of good behavioural design are function, understandability, usability and physical feel (Norman 2002 and 2004). Dreyfuss (1967) and Papanek (1984) emphasises the importance of utility, or the intuitiveness of user interfaces. Dreyfuss (1967) also emphasises the importance of low costs and ease of maintenance facilitated by design which communicates how products are to be maintained and repaired. Ulrich and Eppinger (2003) expand on Dreyfuss's concern for costs by taking into account environmental factors and unnecessary features. Kotler and Rath (1984) argue that design must take into account cost constraints. Papanek (1984) describes method as the interaction of tools, processes and materials to reach a functional goal. Kotler and Rath (1984) include quality, durability and performance as major elements of design.

3. Reflective design is about message, culture and the meaning of a product or service. Stuart and Tax (2004) define the design of service products as the design of customer experiences, which resonates with Norman's (2004) concept of reflective design. Dreyfuss (1967) argues that product design should communicate corporate design philosophy and mission. Ulrich and Eppinger (2003) discuss emotional appeal which encompasses factors like attractiveness, pride of ownership and the image of quality. Papanek (1984) includes the economic, psychological, spiritual, social, technological and intellectual needs of human beings in his taxonomy of design. Papanek also includes telenesis, the attainment of desired ends by the application of purposeful effort, and a concern for human associations or psychological conditioning.

All three dimensions of design are in essence concerned with aspects of the interface between humans and products or services. Norman (2004) argues that the dimensions are equally important. Therefore, they should all be included in the study of design as an element of innovation.

Synthesis Approach to Innovation

Research on innovation has been characterized by a prevailing emphasis on manufacturing of tangible products (Gallouj and Weinstein 1997). The topic of innovation in services has, however, received some attention (Johns and Storey 1998; De Brentani and Ragot 1996; De Brentanti 1995; Drejer 2004; Coombs and Miles 2000; Hughes and Wood 2000; Sirilli and Evangelista 1998; Gallouj and Weinstein 1997; Sundbo 1997; Atuahene-Gima 1996) and one of the prime areas of discussion in this research is how innovation in manufacturing and services differ and how they are similar (Drejer 2004; Coombs and Miles 2000; Hughes and Wood 2000; Gallouj and Weinstein 1997; Sundbo 1997; Atuahene-Gima 1996).

The boundaries between manufacturing and services, and between tangible and intangible products, are becoming blurred (Von Stamm, 2003; Gallouj and Weinstein, 1997). According to Coombs and Miles (2000), 75% to 85% of all value creation in manufacturing firms, and a similar percentage of costs, involves service activities. When studying technological innovation, Sirilli and Evangelista (1998) found that firms in the service and manufacturing sectors show more similarities than differences.

Coombs and Miles (2000), writing on innovation in service firms, claim that most of the empirical research which has been done on service innovation has either treated services as if dealing with manufacturing, or has treated service innovation as distinctly different from innovation in manufacturing. Coombs and Miles (2000), Gallouj and Weinstein (1997) and Drejer (2003) argue that a synthesis approach is preferable. This synthesis approach is based on the premise that the study of service innovation adds to the knowledge of relevant elements of innovation which have been neglected in the study of innovation in manufacturing.

Manufacturing firms commonly have formalized innovation processes. In contrast, Sundbo (1997) found that in service firms innovation is generally an unsystematic search-and-learn process. Rather than developing formal structures for service innovation, service firms tend to approach innovation as an ad hoc process. Therefore, an additional advantage of the synthesis approach is that innovation in services may benefit from the systematic approach which is more common in manufacturing.

Since the goal of this research is to study new technology-based firms across the spectrum of economic offerings, a synthesis approach which permits using the same measures to evaluate design as an element of innovation for all firms is taken based on the research mentioned above.

Model for Design as an Element of Innovation

Norman (2004) argues that all three dimensions of design are necessary to achieve successful design. Roy and Riedel (1997) also argue that a multi-dimensional approach is more successful than a narrow approach to design. This supports examining a firm's combination of design dimension emphases. The strength of each of the three design dimensions can be plotted in a three-dimensional space as shown in figure 1.

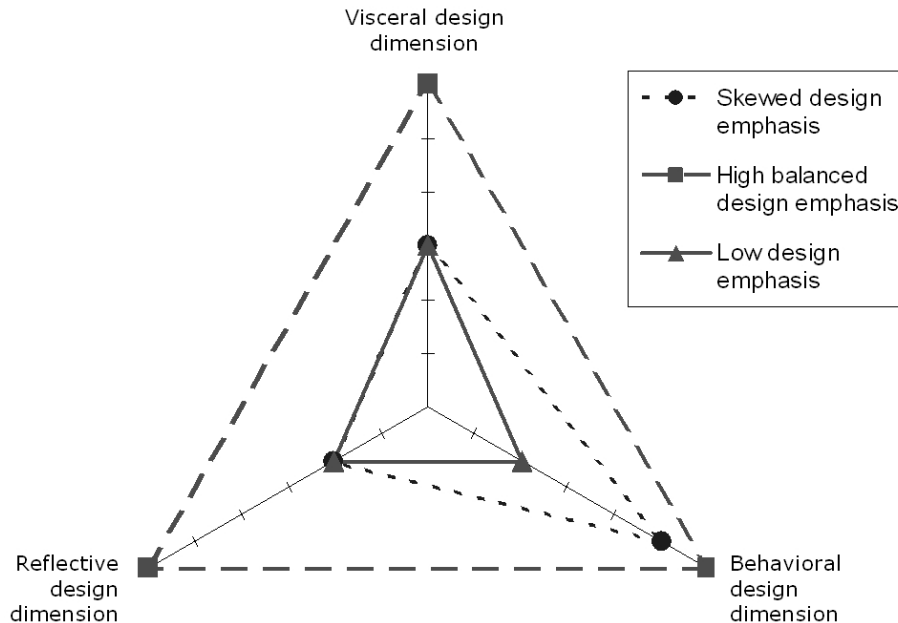


Figure 1: Representation of the three dimensions of design showing three hypothetical example firms. The farther away from the origin, the higher the design emphasis along each dimension.

The model shown in figure 2 can be used to classify firms based on their overall design emphasis as well as their design focus. Overall design emphasis is shown on the y-axis and encompasses all three dimensions of design, visceral, behavioural and reflective with all three dimensions having equal weight. The x-axis is divided into 3 segments, one for each of the three design dimensions. A firm is positioned to represent its primary and secondary design focus. This is done to take into account the possibility that a firm can have more than one strong focus. The closer a firm is to the solid lines between the segments, the more equal are its primary and secondary design foci. The surface of the model should be viewed as a vertically oriented cylinder, as shown in figure 1, to allow for a primary visceral focus and secondary reflective focus, or vice versa.

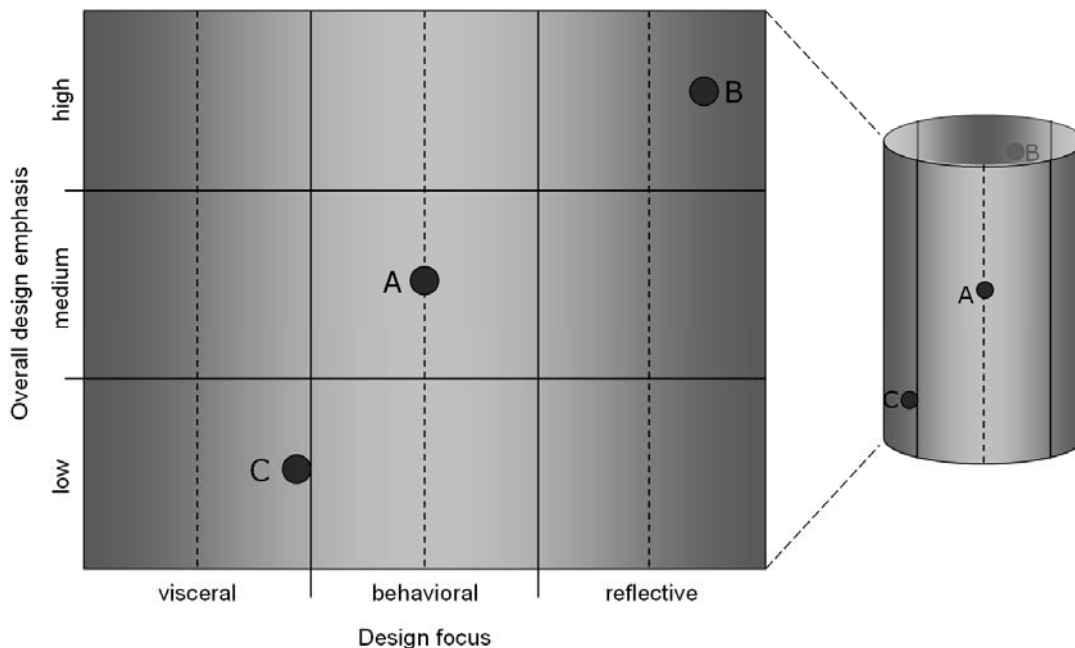


Figure 2: Cylindrical model for classifying firms based on design emphasis and design focus in innovation. Three hypothetical example firms are shown in the model, represented by the points labelled A, B and C.

Three hypothetical example firms are shown in the model. Firm A has medium overall design emphasis and its primary design focus is behavioural. Its secondary design focus is much weaker than the behavioural focus and thus the corresponding point is situated in the middle of the behavioural focus segment. Firm B has high overall design emphasis and its primary design focus is reflective and its secondary design focus is visceral. Firm C has low overall design emphasis and its primary design focus is visceral. Its secondary design focus is behavioural, and there is little difference between the strength of its primary and secondary foci, and thus the corresponding point is situated close to the solid line separating the visceral and behavioural segments.

Methodology for Empirical Study

To empirically test the model developed, a survey of new technology-based firms in Iceland was conducted in 2005. A list of firms founded after 1999, which were classified as technology-based firms according to their ISAT¹ codes and which paid salaries in September 2004, was obtained from the Icelandic National Registry. About 80 firms were selected for study, about 10 had gone out of business when contacted, and the result was 65 participating firms. The survey consisted entirely of structured questions and was administered in face-to-face interviews with the CEOs of the firms.

Hertenstein et al (2005), when evaluating the effectiveness of firms' industrial design efforts, asked a panel of experts in industrial design to rank the firms. The expert rankings were intended to reflect the cumulative industrial design reputation of a firm's products. This approach is not feasible when studying new firms whose products and services may not be fully developed and which are unlikely to have built a reputation. Therefore, this research focuses on design

¹ The Icelandic National Registry classifies firms according to the ISAT 95 coding system, which is based on the European Union's NACE 1 coding system.

emphasis and focus rather than design effectiveness and is based on CEOs' own evaluations.

Prior to data collection, a draft version of the questionnaire was pre-tested on four managers from four different firms. A few minor changes to wording were made following the pre-test.

Respondents were asked to rate the emphasis their firms place on various design aspects, each one falling under one of Norman's (2004) design dimensions, when defining and developing new products or services. The possible responses ranged along a 5-point Likert scale from "very little emphasis" to "very much emphasis". Pine and Gilmore (1989 and 1999) argue that a firm's true economic offering is the economic offering for which the firm charges its customers. To attempt to more accurately capture the surveyed firms' actual level of design emphasis, respondents were also asked to indicate how much more they thought their current or future customers would be willing to pay for products or services due to each design aspect.

Respondents were also asked to indicate how their firms' revenues are divided between revenues for the sale of tangible products, on one hand, and revenues for the sale of services, on the other.

The question texts are shown in the Appendix.

Results

Figure 3 shows the results for the firms studied. Interestingly, only 5 of the firms included in the study reported that all their revenues are due to sales of tangible products, while a little over half of the firms indicated that their revenues are based on a mix of sales of tangible products and services. Keeping in mind that the firms in question are less than 5 years old, this may be an indication that new technology-based firms tend to define themselves as service providers rather than manufacturers. This is in harmony with the trends observed by previous research (Von Stamm 2003; Pine and Gilmore 1998 and 1999; Gallouj and Weinstein 1997; Coombs and Miles 2000; Bryson et al 1997).

The largest concentration of firms, 70%, were found to have their primary design focus on the behavioural (functional) dimension. This is not surprising in view of the fact that the firms under study are technology-based firms and as such can be expected to have a foundation in engineering with a corresponding emphasis on functionality.

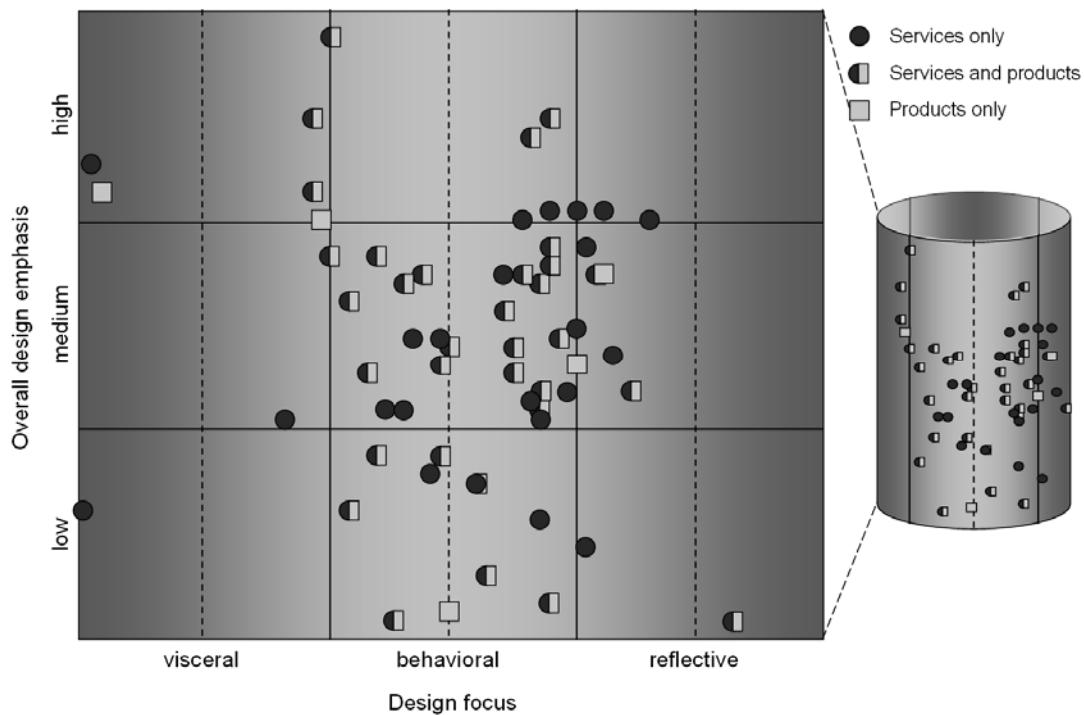


Figure 3: Classification of firms surveyed based on design focus (x-axis) and overall design emphasis (y-axis).

Figure 4 shows the average emphasis along each dimension for three groups of firms, grouped according to their overall design emphasis.

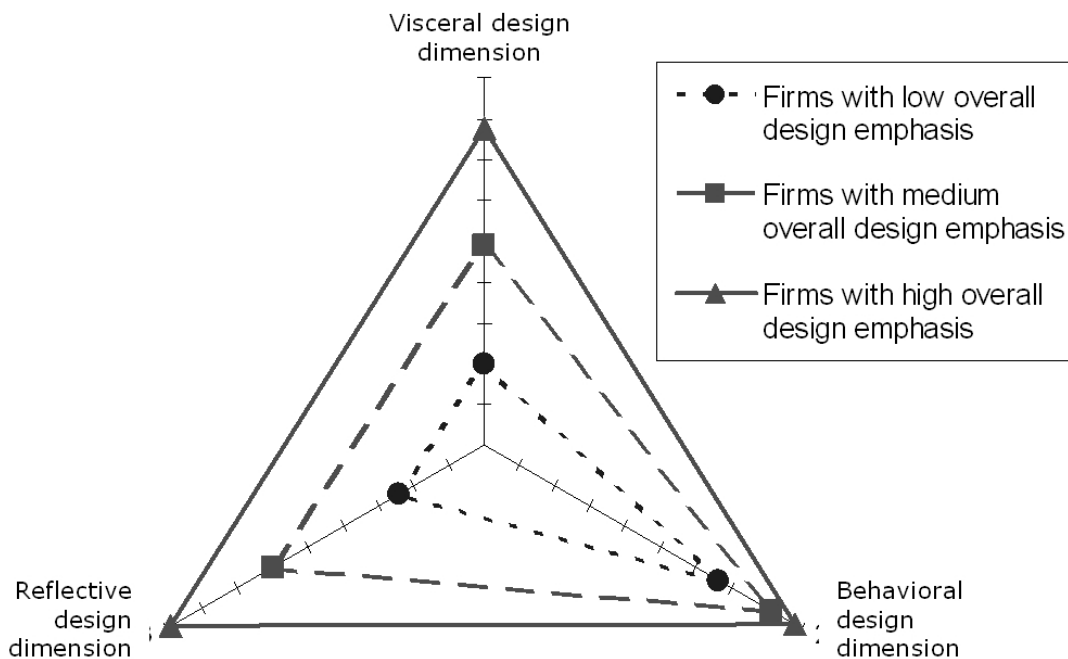


Figure 4: Average strength of focus along the three design dimensions for 3 groups of firms having varying overall design emphases.

As shown in figure 4, the group of firms with a high overall design emphasis (16% of the firms) show a consistently high emphasis along all three dimensions, albeit a somewhat lower emphasis along the visceral dimension. The group of firms with low overall design emphasis (23% of the firms) show the greatest skewing with relatively greatest emphasis along the behavioural dimension. The group of firms with a medium overall design emphasis (the

remaining 61% of the firms) show some skewing with relatively greatest emphasis along the behavioural dimension.

To test the validity of the synthesis approach to innovation in manufacturing and services, the design emphases of the three groups represented by the firms surveyed, namely firms basing all of their revenues on the sale of services, firms basing part of their revenues on the sale of services and firms basing all their revenues on the sale of products, were plotted and compared. The results are shown in figure 5.

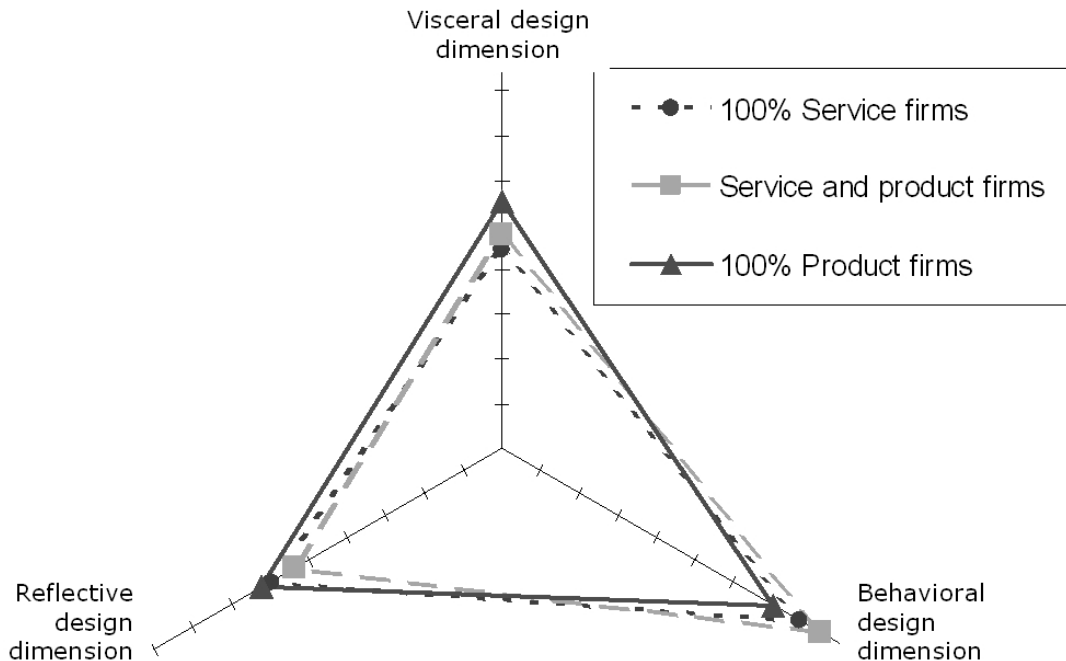


Figure 5: Average emphases along the three design dimensions for 3 groups of firms classified according to the makeup of their revenues.

Figure 5 shows that there is negligible difference between the design emphases of firms deriving all their revenue from the sale of services, all their revenue from the sale of products, and those selling both products and services.

Conclusions

This paper develops a methodology for evaluating design emphasis and design focus in innovation and illustrates the use of the methodology empirically by classifying and evaluating new technology-based firms according to the model developed. The results of the empirical study consist of a potentially useful classification and evaluation of new technology-based firms with respect to their design emphasis and focus, as well as a confirmation of the validity of a synthesis approach to innovation in services and manufacturing.

The selection of new and technology-based firms for the empirical study is deliberate. New technology-based firms can be expected to be innovative as well as to operate under resource constraints. Whereas these firms could use design to achieve differentiation and thus potentially improve performance, they have limited resources and may employ these resources for measures other than design or opt, consciously or unconsciously, for a narrow design focus or limited design emphasis.

Only negligible differences were found between the design emphasis and design focus of firms basing all their revenues on sales of services, firms basing all their revenues on sales of tangible products, and firms basing their revenues on a mix of sales of services and products. Hence, a synthesis approach to

innovation within all firms, whether they are classified as service, manufacturing or hybrid firms, is supported for further research.

The model developed in this paper can be viewed as a definition of design as an element of innovation as well as a dimensioning and bounding of the concept. An important prerequisite for research on design as an element of innovation is a method for operationalisation within which firm activities, emphases and efforts can be evaluated.

The model developed is of potential use to both researchers and practitioners. The model is useful for classifying firms according to design emphasis and design focus and could be used as a tool to select firms from a large set, such as the one used as a basis for the study reported in this paper, for in-depth research. The evaluation model provides a straightforward way to evaluate single firms or groups of firms with respect to their emphasis along the dimensions of visceral, behavioural and reflective design.

This evaluation model could be useful for managers and practitioners for first-party or third-party evaluation of current design emphases and foci, and identification the gap between the current situation and a desirable state.

Ultimately, for design to be beneficial, it must have a positive influence on performance. The methodology developed in this paper provides a basis for isolating and evaluating design along three dimensions. Future research could examine the effects of overall design emphasis and various combinations of design foci on performance. Comparing design focus and design emphasis with firms' level of innovation could also be useful.

Further research is needed on the role of design as an element of innovation in new technology-based firms. Manifestation of design in the form of actual design activities practiced and how design activities are organized should be studied. Classifying firms according to the nature of their design emphasis could provide a basis for identifying differences in the innovation processes, with respect to design manifestation, for the different groups of firms.

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APPENDIX: Survey Questions

Question text	Answer coding	Design dimension measured
When new products or services are defined and developed in your firm, how much emphasis do you place on visual design?	Emphasis on a scale from 1 to 5	Visceral
Do you think your customers are prepared to pay a lot more or a little more for products or services because of their visual design?	How much more on a scale from 1 to 5	Visceral
When new products or services are defined and developed in your firm, how much emphasis do you place on the characteristics of the environment where the product is sold or the service is provided?	Emphasis on a scale from 1 to 5	Visceral
Do you think your customers are prepared to pay a lot more or a little more for products or services because of the characteristics of the environment where the product is sold or the service is provided?	How much more on a scale from 1 to 5	Visceral
When new products or services are defined and developed in your firm, how much emphasis do you place on utility characteristics?	Emphasis on a scale from 1 to 5	Behavioural
Do you think your customers are prepared to pay a lot more or a little more for products or services because of their utility characteristics?	How much more on a scale from 1 to 5	Behavioural
When new products or services are defined and developed in your firm, how much emphasis do you place on the customer's self-image?	Emphasis on a scale from 1 to 5	Reflective
Do you think your customers are prepared to pay a lot more or a little more for products or services because they fulfill their self-image?	How much more on a scale from 1 to 5	Reflective
When new products or services are defined and developed in your firm, how much emphasis do you place on creating a positive experience, emotional value or positive memories for your customers?	Emphasis on a scale from 1 to 5	Reflective
Do you think your customers are prepared to pay a lot more or a little more for products or services because of the positive experience, emotional value or positive memories which the product or service creates for them?	How much more on a scale from 1 to 5	Reflective
How was your firm's income in the year 2004 divided between income based on the sales of services and the sales of products, respectively?	Percentage split	N/A