Technovation 55-56 (2016) 33–41

Contents lists available at ScienceDirect

Technovation

journal homepage: www.elsevier.com/locate/technovation

Contributions of design emphasis, design resources and design excellence to market performance in technology-based service innovation

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ARTICLE INFO

Article history:
Received 23 July 2015
Received in revised form
30 May 2016
Accepted 31 May 2016
Available online 6 June 2016

Keywords:
Service design
Design emphasis
Design resources
Design excellence
Market performance

ABSTRACT

The value of design in product innovation is widely acknowledged and supported by empirical research, although extant research tends to focus solely on the role of designers, or design excellence, or design emphasis. Design in the context of service innovation is less well understood. Technology-based firms are viewed as key loci of innovation and, indeed, this innovation is not limited to product innovation, even though many of the stereotypes that come to mind have to do with the development of ever more technologically advanced 'widgets'. In response to the gaps in current literature, this work takes a holistic approach to measuring design and examines how design resources (designers), design emphasis (emphasis on aesthetics and experience) and the outcomes of design (design excellence) jointly contribute to market performance in technology-based firms engaged in service innovation. Based on a survey conducted among managers of 176 technology-based service firms and evaluations of design excellence by design experts, the findings suggest that design emphasis and design resources both contribute to market performance. Surprisingly, design excellence is not found to contribute to market performance and possible reasons for this are discussed.

1. Introduction

A growing body of research has demonstrated that integrating design in the innovation process can contribute to enhanced business performance. The value of design as an element of product innovation is widely acknowledged (e.g., Gemser and Leenders, 2001; Hertenstein et al., 2005), while design in the context of service innovation is less well understood, although there is some work that suggests the value of design in this context (e.g., Candi, 2010a). The aim of this research is to examine *how design contributes to market performance in technology-based service innovation*. Design is a vague term, fraught with a wide range of interpretations, and therefore, this research takes a holistic view that entails including design resources, design emphasis and design excellence in one research model.

Technology-based firms are generally viewed as key sources of innovation (Autio, 1994; Dolfsma and van der Panne, 2008; Spencer and Kirchhoff, 2006; Bollinger et al., 1983) and, even if a common stereotype has to do with the development of ever more technologically advanced 'widgets', technology-based firms also develop new services. Furthermore, technology-based firms are often (albeit sometimes only stereotypically) seen as bastions of engineering and technological emphasis with little attention paid to design (Okudan and Zappe, 2006; Candi and Saemundsson, 2008). Thus, technology-based service firms are a particularly interesting context in which to study the value of design for service innovation.

Two trends are worth noting when examining innovation in technology-based firms and the role of design, namely *servitization* of products and *productization* of services (Baines et al., 2007). The trend towards servitization has been driven by the realization that services often account for a greater share of profits than products, even in manufacturing firms (Pawar et al., 2009). Servitization commonly requires new business models and new perspectives on ownership as well as new approaches to design, where the focus broadens to include not just the design of physical objects, but also to the design of service experiences. The productization trend is commonly seen in professional service firms, such as software development firms, and also calls for new business models. In these instances firms are faced with the limits to profitability imposed when selling their services based on a 'time and materials' model. These firms strive to find ways to standardize and package their services as products, which can be sold and resold with minimal customization. Here, whereas design might not have been at the forefront during service development, the recognition of the potential importance of design comes up when faced with

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http://dx.doi.org/10.1016/j.technovation.2016.05.004
0166-4972/

redefining a service as product, which might, for example spur efforts to counteract intangibility with design (Ma et al., 2002; Candi, 2007). Together, these trends of servitization and productization result in a seemingly seamless continuum between products and services, the middle of which is referred to as PSSs (Product-Service Systems), defined as *"systemic solutions including products and services"* (Morelli, 2003, p. 73). This continuum blurs the boundaries between product design and service design. Nevertheless, research on design as an element of service innovation has lagged behind, with the prevailing emphasis being on design in product innovation.

Existing research on design tends to focus exclusively on engineering design or include a broad spectrum of activities such as architecture, interior design, industrial design, graphic design, styling and branding. To further confuse the issue, some authors use the term design as basically synonymous with product/service development (e.g., Bruce et al., 2007). Drawing on the theory of the experiential view of consumption (Holbrook and Hirschman, 1982), this research views design as distinct from engineering design (or functional design) and defines it to comprise aesthetic design and experiential design (Candi, 2010a). Thus, design is viewed as a distinct part of the innovation process – the part that focuses on aesthetic and experiential concerns. This is in line with Moody's (1984) proposal of a partitioning of product design into engineering design and industrial design. The industrial design concept – being generally associated with the creation of tangible products – is too narrow when considering innovation that can result in less tangible service offerings. Instead, aesthetic and experiential design in the context of services, are together viewed as analogous to industrial design in the product context. Aesthetic design, sometimes referred to as visceral or sensorial design, is design that appeals to the senses (Norman, 2005). Although aesthetic design is commonly thought of as intended to appeal to the visual sense, it also encompasses the design of sounds, textures, tastes and smells. Experiential design, referred to by Norman (2005) as reflective design, is concerned with engendering a reaction within persons through symbols, culture, meaning, and emotional and sociological aspects such as self-image and group membership (Beltagui et al., 2015).

Lado and Wilson (1994) propose a model of competitive advantage grounded in the resource-based view (RBV) that distinguishes four categories of firm resources and capabilities. The first category is managerial competencies, which include capabilities to articulate a strategic vision and empower people to realize this vision. The second category is input-based competencies that encompass physical resources, capital, human resources, knowledge, skills and expertise. The third category is transformational competencies that allow a firm to convert inputs into outputs and includes innovation capabilities. The fourth and final category is output-based competencies, which include tangible and intangible evidence of *"efficient and effective utilization or organizational resources"* (Lado and Wilson, 1994, p. 708). Applying Lado and Wilson's model, one can propose that design emphasis is a form of strategic vision that can be supported by managerial competencies, that design resources constitute a category of input-based competencies based on knowledge, skills and expertise, that the capability to transform inputs into outputs can be equated with an effective innovation process and finally, that design excellence – embodied in the outputs of design – is an output-based competency.

Building on Lado and Wilson's (1994) model, this work takes a holistic view of design and examines how design capacities/resources (input-based competencies), design emphasis (emphasis on the aesthetic and experiential aspects of services driven by managerial competencies) and outcomes of design (output-based competencies), all existing within the innovation process (transformational competencies), jointly contribute to market performance (another output-based competency) among technology-based firms engaged in service innovation. The holistic view of design taken in this research constitutes one of its key contributions.

Data collected from 176 technology-based firms at two points in time (one year apart) are used to test relationships using a structural model. The findings suggest that design emphasis contributes more to market performance than the involvement of designers (design resources) in technology-based firms engaged in service innovation. This lends credence to the notion that design in technology-based firms need not be executed or driven by designers – which resonates with the notion of *silent design* (Gorb and Dumas, 1987), defined as design performed by those who are not designers and whose formal role is not design. Design excellence, whether evaluated by design experts external to the firms or the firms' managers, is not found to contribute to performance. Thus, it seems that a technology-based firm's overall stance, or intention, with regard to design in service innovation is most influential when it comes to market performance. The relationships found in the structural model add to our understanding of how design can play a positive role in service innovation in technology-based firms as well as suggesting how these firms might best take advantage of this opportunity.

The rest of this paper is organized as follows. The theoretical background is discussed and hypotheses developed. This results in a research model tested using the methodology described. The findings are discussed followed by implications for theory and practice, and conclusions.

2. Background and hypotheses

Research on design as an element of innovation varies a great deal in the definitions of design used and in how design is measured. Design has largely been operationalized in one of three ways (Candi and Gemser, 2010). In the first place, some research uses *design emphasis*, measured in terms of the weight placed on design in the innovation process (e.g., Candi, 2010a). In the second place, some researchers use *design resources* as a measure of design, for example by measuring the time or human resources spent on design (e.g., Gemser and Leenders, 2001; Roy and Potter, 1993; Swan et al., 2005). Thirdly, there is research that focuses on the outcomes of design – or *design excellence* – either as evaluated by customers (e.g., Moody, 1984) or as evaluated by design experts or peers (e.g., Hertenstein, et al. 2005; Platt, et al. 2001). As discussed above, these three approaches correspond roughly to strategy driven by managerial competencies (design emphasis), input-based competencies (design resources), and output-based competencies (design excellence) in Lado and Wilson's (1994) model of competitive advantage. Extant research on design tends to test models that consider only one measure of design. However, it makes intuitive sense to recognize that design emphasis is likely to be driven, at least to some extent, by the presence of design resources, and vice versa. Likewise, design excellence is less likely to spring up of its own accord than to stem, at least in part, from an emphasis on design and the availability of design resources. Overall, with its focus on how design contributes to market performance, this research is aligned with the view that design is a mechanism for value creation (D'Ippolito, 2014).

This research conceptualizes design as a combination of aesthetic design and experiential design. Aesthetic design is relatively easy to understand as it has to do with aspects that can be perceived with the human senses. Experiential design is somewhat more elusive, but no less important, as expressed by Crawford and Mathews (2001, p. 16): *"Historically, product features and functions were the primary determinants of value in business. Build a better mousetrap, and the world will beat a path to your door. Today,*

product quality is table stakes, the ante in a high-stakes game of poker….. Most cars run today, and do so consistently. Refrigerators keep food cold, stereos sound good, detergents get clothes clean, hotel rooms are clean and quiet. Consumers in mature economies expect products to perform at a given level of quality. Today, it is the human values that are displayed during the provision of goods and services that provide the opportunity for extreme differentiation, branding, and building loyalty."

Design efforts in innovation are generally driven by the motivation of gaining market appeal or acceptance (Verganti, 2008), which can ultimately lead to improved performance. Hence, market performance is chosen as the ultimate outcome variable of this research. In the following sections, hypotheses about the relationships between the three measures of design and market performance are developed. The research model is shown in Fig. 1.

Since research on design in the context of service innovation is scarce, a selection of extant work on design in the context of product innovation is included in the arguments for hypotheses. This is unfortunate, but also highlights the important contribution this research makes by examining design in the context of service innovation.

2.1. Design emphasis

Design emphasis reflects a firm's stance regarding whether or not, and if so, to what degree, to include design in its innovation activities. As such, it constitutes a tacit or implicit strategy and a managerial competency in Lado and Wilson's (1994) model of competitive advantage. Subjective measures have been used to measure design emphasis, for example senior management emphasis on design (Black and Baker, 1987), the degree of representation of design in the different phases of the innovation process (Black and Baker, 1987), or management assessments of the weight placed on design in the context of service innovation (Candi, 2010a). More objective measures of design emphasis include the number of specific design activities performed in the innovation process (Hise et al., 1989).

Research by Ravasi and Lojacono (2005) indicates that integration of design into the innovation process (or design emphasis) is related with design excellence. For the purposes of this research, design is conceptualized as consisting of both aesthetic design and experiential design. As outlined above, aesthetic design is design that appeals to the senses, and therefore design excellence of aesthetic design will be evidenced by strong and purposeful impact on the senses (Norman, 2005). Experiential design is concerned with creating reactions and memories by influencing a range of dimensions including emotions, community and self-image (Beltagui et al., 2015) and, thus, design excellence here will be evidenced by the creation of the desired reactions and lasting positive memories.

Intuitively, we can expect that there will be a positive relationship between design emphasis and design excellence in service innovation. The more emphasis a firm places on design, the more likely such a firm is to develop services that have a high level of design excellence.

H1. *Emphasis on design in service innovation contributes to design excellence.*

In research on design in technology-based service innovation, Candi (2010a) finds that emphasis on design is positively related with a number of performance outcomes including sales to new customers, repeat sales and firm image. The first two of these fall under the province of market performance, which can be classified as an outcome-based competency (or signal of effectiveness) in Lado and Wilson's (1994) model. These findings in the context of services resonate with findings in the context of product design presented by Black and Baker (1987), who find a positive relationship between design emphasis and sales growth. Thus, existing research findings lead to a hypothesis about a positive relationship between design emphasis in service innovation and market performance.

H2. *Emphasis on design in service innovation contributes to market performance.*

2.2. Design resources

A common approach to examining the relationship between design and performance is to focus on the design capabilities available and exploited when developing new products or services. This may, for example, be done by considering the number of designers involved in innovation projects (Gemser and Leenders, 2001; Roy and Potter, 1993), the time or effort spent on design in innovation projects (Swan et al., 2005), or by considering the proportion of total innovation expenditures that are spent on design (Gemser and Leenders, 2001; Swan et al., 2005).

As with design emphasis, we can intuitively expect that there will be a positive relationship between design resources and design outcomes in service innovation. The more design resources (designers) a firm has available for service innovation, the more likely the firm is to develop services that have a high level of design excellence.

H3. *Design resources available for service innovation contribute to design excellence.*

Roy and Potter (1993) report on a government program providing funding for small firms to hire design experts (design resources) to improve their design competencies. They found direct benefits to profitability and several indirect benefits, including improved company image.

In research that examines differences between the use of designers and silent design (Gorb and Dumas, 1987) (design conducted by persons who are not designers) in service innovation,

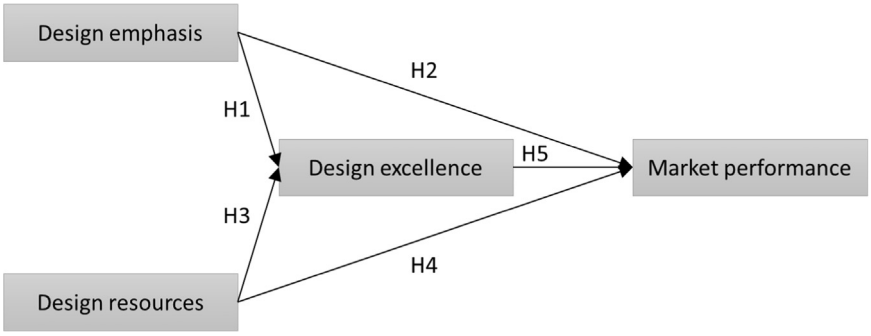

Fig. 1. Research model depicting the relationships expected in technology-based firms engaged in service innovation.

Candi (2010b) finds that firms that use designers tend to perform better at attracting new customers than firms that use silent design. Furthermore, existing research in the product domain suggests that designers can contribute to performance outcomes, both objective financial outcomes and more subjective outcomes such as market performance (Swan et al., 2005; Bruce and Bessant, 2002). This leads to a hypothesis about a positive relationship between design resources available for service innovation and market performance.

H4. *Design resources available for service innovation contribute to market performance.*

2.3. Design excellence

A number of researchers have examined relationships between design and performance by using measures of design outcomes, or design excellence, as the antecedent variable. Here, design excellence is defined as the quality or goodness of observable design characteristics. To assess design excellence, primarily two approaches have been used: customer evaluations (e.g., Veryzer and Hutchinson, 1998; Veryzer, 1993; Creusen and Schoormans, 2005; Yamamoto and Lambert, 1994; Berkowitz, 1987; Meyers-Levy and Tybout, 1989; Bruce and Whitehead, 1988) or evaluations by design experts or peers (e.g., Goodrich, 1994; Hertenstein et al., 2005; Platt et al., 2001; Talke et al., 2009).

Micheli and Gemser (2016) find that novel product designs enjoy better market acceptance if they receive attention from design experts, which can be viewed as a signal of design excellence. Services tend to be intangible, which makes it more difficult to notice and assess their design excellence than might be the case for tangible products. However, when we take into account that design excellence encompasses not only aesthetic design but also experiential design, the severity of the apparent obstacle of intangibility is decreased. For example, Brakus et al. (2009) find a relationship between experiential design and customer loyalty, and Jones et al. (2006) argue that effectively designed service experiences can influence customers' decision making by establishing an emotional connection. In fact, research by Shobeiri et al. (2015) compares the contributions of design outcomes between products and services, and finds that although effective for both products and services, the impact is considerably stronger for services. Thus, existing research leads to the hypothesis that design excellence is related with market performance.

H5. *Design excellence of new services contributes to market performance.*

3. Methodology

3.1. Data

A list of firms classified as technology-based service firms according to the European Nace 1 coding system was obtained from public records in Northern Europe. Background information was checked for all potential participant firms to eliminate firms not likely to be engaged in technology-based service development despite their Nace classifications. The result was that 251 firms were identified as potential participants. Managers of these firms were contacted by phone and 212 agreed to participate (84%) and were sent a link to an online survey. The survey consisted entirely of structured questions covering the variables of interest. Before data collection the survey was pre-tested by several managers. A few changes in wording were made based on pre-testing to improve question clarity. Survey respondents were managers, including CEOs, innovation managers, marketing managers and project managers. A year later, 176 (83%) of the original managers agreed to be surveyed again. These 176 matched pairs of responses from as many firms, measured one year apart, were used to test the hypotheses.

On average, the firms included in analysis based 77% of their revenues on the sales of services and the rest on the sales of products. The participating firms ranged in size from 1 employee to 550 employees with an average size of 26. The firms belonged to a broad range of industry sectors, including engineering, software development, telecommunications, information technology services, online games, laboratories, etc.

3.2. Variables

Norman (2005), Wickham (2006) and Candi (2006) all suggest similar three-dimensional taxonomies of design. The dimensions are referred to as the functional/behavioral, the aesthetic/visceral, and the experiential/reflective dimensions. Items adapted from this work were included in the survey to obtain a measure of design emphasis, made up of emphasis on aesthetics and emphasis on experience. The composition of the reflective variables in the research model is reported in the Appendix.

Design resources are generally thought of as being the designers available to a firm. As argued by Dell'Era and Verganti (2010), this should take into account both internal designers (employees) and external designers. Thus, the number of employees having formal education in design or related fields, plus the number of external designers (full-time equivalencies) employed by each firm, was taken as a measure of design resources. Since the firms included in the research were all technology-based firms, they employed a large proportion of engineers and persons with similar technological backgrounds. Therefore, it was deemed safe to assume that designers, as defined above, would be primarily engaged in aesthetic and experiential design, while functional/engineering design was likely to be in the hands of engineers or similar.

As discussed above, existing research has mostly used evaluations of design excellence by customers – commonly in experimental settings – or evaluations by experts or peers. Since the focal outcome variable of this research is market performance, there was a risk that asking customers to evaluate service design excellence would provide more of a measure of customer satisfaction or acceptance than the actual variable of interest, namely design excellence. Thus, to obtain a measure of design excellence, five design experts were asked to evaluate the quality of each of the firms' service design based on an examination of the firms' web sites. The designers evaluated each service by filling in a short online survey consisting of questions (see the Appendix) about excellence in terms of aesthetics and experience. The design experts each had at least 5 years of experience as designers, including service design, they were not associated with any of the firms in the sample, and their evaluations of the firms' services were generally highly consistent.

The independent variables for design emphasis, design resources and design excellence were measured in the first year of data collection. In the second year, managers answered questions about their firms' market performance. Market performance was deemed to be a relevant performance variable since existing research leads us to expect that design will lead to improved market performance. The variable for market performance was made up of four items adapted from Griffin and Page (1996).

Fig. 2 shows the sources of data for the variables in the research model. Collecting data for the dependent and independent variables at different points in time and including two sets of independent informants (managers and design experts) greatly reduces the risk of common method bias.

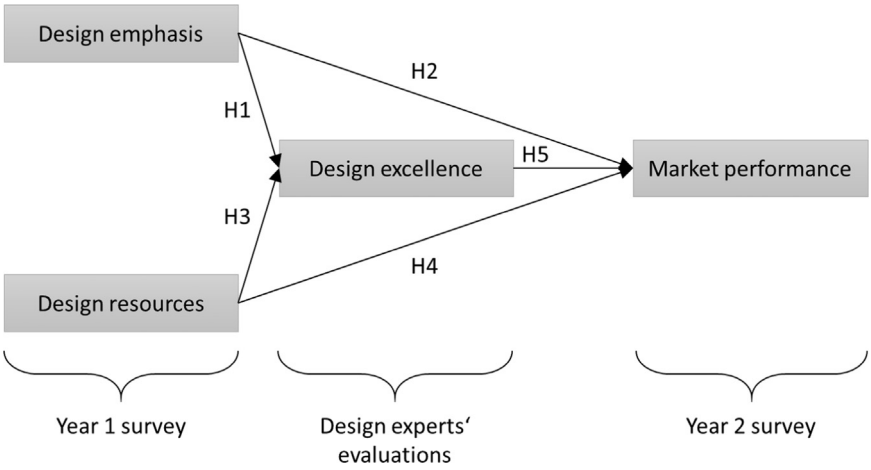

Fig. 2. Research model showing information about data collection using two surveys and design experts' evaluations.

3.3. Control variables

Lado and Wilson's (1994) model of competitive advantage includes transformational competencies, which refer to the capability to transform inputs into outputs. The innovation process is one such competency; the one that is critical for innovation that results in the launch of new services. R&D intensity is a commonly used measure of the strength of the innovation process. Low R&D intensity is taken as a signal of a weak under-funded innovation process, and high R&D intensity is taken as a signal of strong commitment to innovation. Firm size also constitutes a measure of the firm's overall capacity to do things, including innovation.

Therefore, R&D intensity and firm size were included as control variables. To measure R&D intensity, managers were asked to indicate what percentage of their annual turnover was spent on innovation/R&D. This question was posed in the first year's survey. Secondly, firm size (number of employees) was included as a control variable. Both these variables can be expected to be related with the availability of design resources, design emphasis and the realization of design excellence and market performance.

Pairwise correlations between variables and summary statistics are shown in Table 1.

3.4. Measurement model validation

One of the strengths of this research is that data were collected from managers at two points in time separated by one year, and a third set of data was provided by design experts (see Fig. 2). Collecting data from multiple sources mitigates the risk of common method bias. Nevertheless, the method proposed by Podsakoff and Organ (1986) was used as a formal test of common method bias. All the items making up the independent variables were included in a factor analysis, which resulted in the expected factors without cross-loadings. This provides a basis for assuming that common method bias was not a problem in the data.

The pairwise correlations between the items making up the variables were examined and correlations between items belonging to each variable were higher than correlations with items belonging to other variables, which indicates discriminant validity of the variables (Fornell, 1992).

The measurement model was tested using Stata version 14. The results were very good compared with the recommendations made by Diamantopolous and Siguaw (2009), with $\chi^2=56$ (30 degrees of freedom), root mean squared error of approximation (RMSEA)=0.063 and comparative fit index (CFI)=0.97. The Appendix shows the item loadings, composite reliabilities, average variances extracted and Cronbach's alphas for the independent and dependent variables. All item loadings were equal to or larger than 0.60, which is acceptable according to Hair et al. (2006) and indicates unidimensionality of the variables. All composite reliabilities and average variances extracted were over the generally accepted cut-offs of 0.7 and 0.5, respectively (Dillon and Goldstein, 1984) and all Cronbach's alphas were well over the 0.7 cut-off. A comparison of the average variances extracted and the correlations between variables confirmed that the condition for convergent validity proposed by Fornell and Larcker (1981) was met.

To summarize, the reliability and validity of the measurement model were confirmed by the tests and metrics examined, which provided confidence for testing the hypotheses using the structural model.

4. Findings

The research model was tested using structural equation modelling (SEM) in Stata version 14 and the findings are shown in

Table 1
Pairwise correlations and summary statistics for the variables included in the research model.

		Average	Std. dev.	Range	1	2	3	4	5
1	Market performance	3.2	0.8	1–5					
2	Design emphasis	3.4	1.0	1–5	0.29*				
3	Design resources	3.1	9.1	0–70	0.21*	0.00			
4	Design excellence	3.2	1.0	1–5	0.11	0.30*	0.19*		
5	Firm size	26.0	71.3	1–550	0.28*	−0.20*	0.62*	0.22*	
6	R&D Intensity	0.2	0.3	0–1	−0.02	0.18	0.03	0.07	−0.13

* $p < 0.01$.

Table 2. Turning first to the control variables, we see that R&D intensity is positively related with design emphasis, which means that the more a firm invests in innovation, the more likely it is to emphasize design. This potentially resonates with the notion of design-driven innovation (Verganti, 2008), meaning innovation that is based on design novelty. Firm size is positively related with design resources, meaning that the larger a firm is, the more design resources (internal or external designers) it is likely to have at its disposal. This is an intuitive result. R&D intensity is also positively related with design resources, which means that the more a firm invests in innovation, the more likely it is to hire internal or external designers. Again, this might be an indicator of innovation being not only technology-driven but also design-driven in firms that invest a lot in innovation.

From Table 2 we see that hypothesis 1 about the positive relationship between design emphasis and design excellence is supported by the data. Thus, greater design emphasis is likely to coincide with greater design excellence, although because both variables are measured at the same time, we cannot speculate about the direction of causality; design emphasis may lead to design excellence, or vice versa. Likewise, hypothesis 2 about the positive relationship between design emphasis and market performance is supported. Here, since the two variables are measured one year apart, we can cautiously speculate that design emphasis contributes to market performance. The more emphasis a technology-based firm places on design in service innovation, the more likely it is to enjoy improved market performance.

Hypothesis 3 about the positive relationship between design resources (designers available for service innovation) and design excellence is supported. Thus, a greater number of designers coincides with greater design excellence, but as with design emphasis, the direction of causality is not known. Hypothesis 4 about the positive relationship between design resources and market performance is also supported. Again, we can cautiously speculate that, because the two variables are measured one year apart, having more design resources contributes to market performance.

Contrary to expectations, hypothesis 5 about the relationship between design excellence and market performance is not supported by the data. This unexpected finding indicates that while design emphasis and design resources are found to contribute to market performance, this is not necessarily because they are related with design excellence. In fact, examination of indirect effects in the model confirms that design excellence does not act as a statistically significant mediator between design resources and design emphasis, respectively, and market performance.

As a robustness test, the structural equation model was re-evaluated, this time using managers' evaluations of the design excellence of their firms' services, instead of evaluations by external design experts. This was done to ascertain whether the external designers' evaluations might be inaccurate, which might explain the fact that hypothesis 5 was not supported. However, the results were consistent with those shown in Table 2, which confirms the lack of support for hypothesis 5.

Since the coefficients in Table 2 are standardized, they can be compared. We note that both coefficients for design emphasis are larger than other coefficients in the model. This indicates that for market performance, a firm's stance regarding design (design emphasis) is more important than whether or not the firm has design resources at its disposal. Hence, the possible influence of silent design (Gorb and Dumas, 1987) is raised, which in the empirical context of this research might translate to engineers engaged in aesthetic and experiential design of services.

Table 2
Results of structural equation modelling. Coefficients are standardized.

	Coef.	Std. err.	Z	p	
Firm size -> Design emphasis	−0.14	0.08	−1.79	0.07	
R&D intensity -> Design emphasis	0.19	0.07	2.64	0.01	*
Firm size -> Design resources	0.66	0.04	18.21	0.00	*
R&D intensity -> Design resources	0.15	0.05	2.88	0.00	*
H1: Design emphasis -> Design excellence	0.31	0.07	4.20	0.00	*
H3: Design resources -> Design excellence	0.21	0.07	3.22	0.00	*
H2: Design emphasis -> Market performance	0.33	0.08	4.18	0.00	*
H4: Design resources -> Market performance	0.24	0.08	3.12	0.00	*
H5: Design excellence -> Market performance	−0.03	0.08	−0.36	0.72	

* $p < 0.01$.

5. Discussion

5.1. Implications for theory

This research examines relationships between design and market performance in the context of technology-based firms engaged in service innovation. As such, this research is positioned at an important intersection between technology and design. A considerable body of existing research has explored the performance implications of product design, but the present research distinguishes itself particularly by focusing on service innovation rather than product innovation.

This research draws from the theory of the experiential view of consumption (Holbrook and Hirschman, 1982) and makes a distinction between engineering design, on one hand, and visceral and experiential design, on the other. This distinction is important because there is a lack of consensus in the literature about what exactly is meant by design and there is a body of work that essentially views design as synonymous with product/service development. Taking a holistic view of design, this research considers relationships between and among design emphasis, design resources, design excellence and market performance. Indeed, one of the key contributions of this research rests on its inclusion of these three design variables.

Much of the existing work on the benefits of design for innovation focuses on the issue of designers (design resources) and the importance of including designers in innovation projects (e.g., Gemser and Leenders, 2001). The findings of the present research suggest that, at least for service innovation, it is not so much having many designers as having a strong emphasis on design that leads to success. This resonates with the findings of research on design in service innovation that focuses on design emphasis (Candi, 2010a). Furthermore, the findings suggest that service design excellence is not a contributor to market performance. These findings are unexpected; the expectation was that design excellence would be positively related with market performance. Since the findings based on design experts' assessments were replicated with a robustness test using managers' assessment of design excellence, the unexpected findings cannot be explained based on how design excellence was assessed by the design experts. Nevertheless, these findings seem to contradict a substantial body of existing research (e.g., Hertenstein et al., 2005; Creusen and Schoormans, 2005; Yamamoto and Lambert, 1994; Goodrich, 1994). A possible explanation may be assessments of design excellence that take a narrow styling-oriented approach and fail to take into account other dimensions (Roy and Riedel, 1997). Another potentially plausible explanation may be that existing research has focused on product design but that design excellence of services is not comparable. Because of the intangibility of services, assessing service design excellence requires a focus on the experience created rather than preoccupation with the design of

physical artefacts (Beltagui et al., 2015). Although both aesthetic design quality and experiential design quality were included in the assessment instrument used by design experts, we could possibly speculate that assessing the quality of experiential design might have been too challenging for them.

The lack of support for the hypothesis about the relationship between design excellence and market performance suggests that other variables need to be taken into account. One such variable could be customer involvement in the service innovation process. However, Verganti (2008) advocates against involving customers in the design of new meanings (a concept analogous to our aesthetic and experiential design), so the benefits of involving customers are not unequivocally proven.

Perhaps it is necessary to confront the idea that design excellence might not in fact have a tendency to please service markets. This might be due to lack of familiarity, which existing research has shown can hinder market acceptance (e.g., Veryzer, 1998). According to Mandler's (1982) schema congruity theory, moderately incongruent stimuli are preferred to drastically incongruent stimuli. Indeed, Meyers-Levy and Tybout (1989) found that products differing slightly from a baseline are likely to be perceived more positively than those that differ greatly from the baseline.

5.2. Implications for practice

The research findings yield three important implications for firms engaged in service innovation; they should emphasize design, they should include designers in service innovation, and they should seek evaluations of their design outcomes (design excellence) from outside the firm. Each of these implications will now be discussed in turn.

First, firms engaged in service innovation should place emphasis on design, meaning that they should emphasize aesthetic design and creating experiences with their services. When thinking about the design of services, a potentially useful perspective is that of the *experience economy* espoused by Pine and Gilmore (1998). In more recent work, Beltagui et al. (2012) argue that services can benefit from a design approach that results in compelling experiences. Designing for experience requires thinking beyond the design of tangible objects to the design of conditions that make the enactment of a memorable experience possible. Beltagui et al. (2015) develop a model of service experience that includes what they refer to as deliverable dimensions, or the dimensions that a firm can control – namely employees and environments – and impressible dimensions, which are unique to each individual and for which a firm can set the stage, but which it cannot fully control.

Second, firms engaged in service innovation would be well advised to include designers on staff or engage external designers, since this research suggests that designers' involvement in service innovation is related with improved market performance. Designers are widely believed to have the ability to interpret consumer needs (for a review, see D'Ippolito (2014)) and are therefore likely to be well equipped to design memorable service experiences for consumers. However, when taking into account how services differ from products and the key importance of the service experience, firms might do well to involve not only those who are commonly thought of as designers – e.g. industrial designers and graphic designers – but also consider engaging designers from the performing arts, such as stage and lighting designers, etc.

Finally, firms can be advised to seek evaluations of their design outcomes (design excellence) from outside the firm, since their own evaluations and even design experts' evaluations appear to have a weak relationship with market performance. Better evaluations might be obtained by polling customers about service experiences or observing them covertly to understand the experiences delivered and impressed upon them.

6. Conclusions

This work takes a holistic view of design and examines how design resources, design emphasis and design excellence jointly contribute to market performance in technology-based firms engaged in service innovation. This holistic view of design represents an important contribution of the research along with the focus on design in service innovation, which is an under-researched context. The research findings suggest that design emphasis – which can be viewed as an element of a firm's strategy – contributes more to market performance than the involvement of designers in technology-based firms engaged in service innovation. Design excellence, whether evaluated by design experts external to the firms studied or the firms' managers, is not found to contribute to performance.

An important limitation of this research is that it examines the phenomena under study, namely design and performance, at the firm level rather than at the level of individual innovation projects. Firms can have multiple innovation projects under way simultaneously and design emphasis, design resources and design excellence can vary among these projects. Thus, the research model tested here should be replicated at the innovation project level.

The measure of design resources used in this research is essentially based on counting designers and does not include consideration of what these designers actually do. Examples of activities that might be worth studying are the use of sketches, storytelling, or prototypes as well as interaction with customers (Steen et al., 2014). Furthermore, the research model does not take into account the nature of design(er) roles within the service innovation process (Perks et al., 2005) or the potential effects of design management capabilities. Research by Chiva and Alegre (2009) indicates that these capabilities mediate the relationship between design investment and performance and so a more complete model would include this variable.

While this research takes important steps to view the issue of design in service innovation holistically and uses data collected at two different points in time in an attempt to be able to say something about causality, the model tested is nevertheless incomplete since it neglects the potential influence of feedback effects. How might design excellence at a particular point in time influence design emphasis at a later time? How might market performance at a particular time influence the hiring or firing of designers in the future? These are just examples of the types of questions that might be answered with a model including feedback effects tested using multi-year panel data.

Acknowledgements

Part of the funding for this work has been provided from the European Union's Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement no. 324448, and by the Icelandic Research Fund, grant agreement no. 100668022.

Appendix A

see: Table A1

Table A1
Variables.

Variables and references	Items	Item loadings (λ)	CR	AVE	Alpha
Market performance *Manager survey, year 2.* *Possible answers from 1 (disagree) to 5 (agree).* *Adapted from* Griffin and Page (1996).	We increase our market share more than our competitors We gain more new customers than our competitors We increase sales to existing customers more than our competitors Our revenue growth is greater than our competitors' revenue growth	0.97 0.90 0.71 0.82	0.92	0.73	0.92
Design emphasis *Manager survey, year 1.* *Possible answers from 1 (disagree) to 5 (agree).* *Adapted from* Candi (2006).	When we develop new services we emphasize design When we develop new services we emphasize creating an experience When we develop new services we emphasize aesthetics When we develop new services we emphasize meeting needs for self-expression	0.76 0.73 0.87 0.60	0.83	0.55	0.82
Design resources *Manager survey, year 1.* *The number of employees and the number of external designers were summed.* *Based on* Dell'Era and Verganti (2010).	How many people having formal education in design or related fields are employed by the firm? How many external designers are employed by the firm? Please indicate full-time equivalencies.	N.A.	N.A.	N.A.	N.A.
Design excellence *Design expert survey.* *Possible answers from 1 (poor) to 5 (excellent).* *Adapted from* Candi (2006).	As a designer, how would you rate the aesthetic qualities of [the service]? As a designer, how would you rate [the service]'s effectiveness in creating an experience?	0.94 0.87	0.90	0.82	0.91

CR = Composite reliability
AVE = Average variance extracted
Alpha = Cronbach's alpha
N.A. = Not applicable for objective measure.

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