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Title: Measuring new product and service portfolio advantage

Year: 2018

Version: Publisher's PDF

Please cite the original version:

Heimonen, J., & Kohtamäki, M., (2018). Measuring new product and service portfolio advantage. *International entrepreneurship and management journal* 15, 163–174. https://doi.org/10.1007/s11365-018-0548-x

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Measuring new product and service portfolio advantage

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Abstract

The current study introduces the concept of new product and service portfolio (NPSP) advantage by creating and validating a three-dimensional measurement method that reflects novelty, meaningfulness and superiority – the three characteristics of NPSP advantage. Based on industry-wide homogeneous generalizable quantitative data from 108 manufacturing companies, the results indicate that these three characteristics of NPSP – novelty, meaningfulness and superiority – are distinct characteristics that together constitute NPSP advantage. This paper contributes to the literature on new product development, as its findings suggest that when measuring the concept of NPSP advantage, the three-dimensional construct that includes the three aforementioned characteristics has a better fit to the data than the unidimensional structure. Because it considers both new products and services, the current study offers an integrated approach to measure the desired innovation process outcome (NPSP advantage). In this way, this paper bridges the research on new product development with that on new service development.

Keywords New product development (NPD) · New service development (NSD) · New product success · New product and service portfolio advantage · Measurement development · Servitization

Introduction

In the prior new product development (NPD) literature on new product success, the success-driving characteristics of new products and the performance-mediating role of new product advantage have received considerable attention (Cooper and Kleinschmidt 1987; Hong et al. 2013; Im and Workman 2004; McNally et al. 2010; Nakata et al.

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2006; Rijsdijk et al. 2011). Recent scholarly discussions on the characteristics driving new product success have raised the issue of measuring different advantageous characteristics, such as novelty, meaningfulness and superiority, through a unidimensional advantage construct, as the different characteristics are likely to be consequences of dissimilar actions and may have different performance implications (Rijsdijk et al. 2011; Szymanski et al. 2007). For example, prior studies have shown that new product novelty and meaningfulness represent separate characteristics (Hong et al. 2013; Im and Workman 2004) and argued that superior products are not necessarily meaningful in fulfilling customer needs (Rijsdijk et al. 2011; Szymanski et al. 2007), indicating the need for a more transparent distinction between novelty, meaningfulness and superiority and improved measures.

Given that manufacturing firms have also begun to add services to their offering portfolios to better match customer preferences and to differentiate themselves from competitors (Gebauer et al. 2011; Oliva and Kallenberg 2003), instead of relying solely on value delivered through a singular product, new services and novel combinations of new products and services can provide an additional source of competitive advantage (Nordin and Kowalkowski 2010; Rabetino et al. 2015). In their recent review, Rabetino et al. (2018) structured the field of servitization-related research, where studies conceptualize the interplay between product and services (See also Baines et al. 2017; Kowalkowski et al. 2017; Reim et al. 2015). Thus, innovation no longer solely involves products or processes but also increasingly incorporates services and product-service combinations, requiring a more holistic approach to innovation efforts that considers both new product and service development simultaneously (Biemans et al. 2016; Papastathopoulou and Hultink 2012; Parida et al. 2014). Despite the growing body of knowledge on new service development (NSD), compared to NPD research, the field is fragmented; in addition, no generally accepted guidelines for new service success have been presented (Biemans et al. 2016). For example, the prior NSD research has not conceptualized new service advantage as a measurable concept and has not identified the characteristics (such as novelty, meaningfulness, and superiority) that constitute this advantage. However, it has been suggested that the same advantageous characteristics that apply to new products apply to new services as well (Cooper and de Brentani 1991). Where new product advantage is defined as "the extent to which a new product offers unique benefits and to which it is superior to competing products" (Rijsdijk et al. 2011, p. 35), similarly, an advantage may be achieved through new services or new product-service combinations that provide unique benefits enabling a firm to outperform competing alternatives (Rabetino et al. 2015). Thus, the existing NSD research would benefit from incorporating the advantage-constituting characteristics and the performance-mediating concept of new product advantage and from taking a more holistic approach to new product and service development by measuring the advantage at the portfolio level.

By applying the generalizable quantitative data from 108 manufacturing companies and developing and validating measures for new product and service portfolio (NPSP) novelty, meaningfulness, superiority and NPSP advantage, the purpose of this study is to develop a measurement method for new product and service portfolio advantage. Specifically, as the first main contribution, the findings suggest that novelty, meaningfulness and superiority represent distinct characteristics that can be measured separately; however, together, they constitute a three-dimensional NPSP advantage construct demonstrating a better fit than the unidimensional approach to measuring new product

and service advantage. As the second contribution, this study introduces an approach to measuring the advantage-constituting characteristics of both new products and services simultaneously by incorporating the characteristics into the portfolio level and conceptualizing the NPSP advantage construct. Thus, the findings contribute to the existing literature on NPD and NSD, providing an integrated approach to measuring the advantageous characteristics of new products and services at the portfolio level and suggesting interesting future research opportunities.

New product and service portfolio advantage

Although modern economies are service-driven, innovation knowledge produced and consumed by scholars remains mainly product-driven (Biemans et al. 2016). In accordance with the suggestion by Papastathopoulou and Hultink (2012) that NSD literature would benefit from a synthesis of the existing NPD and NSD knowledge to build an integrative innovation model, the present study builds on prior NPD literature to develop the concept of new product and service portfolio advantage, which is considered the desired outcome of a new product and service development process. Whereas most prior studies do not distinguish advantage-constituting characteristics when measuring new product advantage (Atuahene-Gima and Li 2004; Cooper 1979; Cooper and Kleinschmidt 1987; Slotegraaf and Atuahene-Gima 2011), recent studies have argued that different characteristics may have different antecedents and performance outcomes and thus should be measured separately ((Im and Workman 2004; McNally et al. 2010; Rijsdijk et al. 2011). As prior research on NPD defines new product advantage as "the extent to which a new product offers unique benefits and to which it is superior to competing products" (Rijsdijk et al. 2011, p. 35), the definition may be considered to address three advantage-constituting characteristics: novelty (unique), meaningfulness (beneficial) and superiority (superior). As the characteristics of singular products and services constitute the characteristics of the new product and service portfolio, the same advantage-constituting characteristics may be considered to apply at the portfolio level. In addition, at the portfolio level, new products and services can provide novel value combinations, together enabling a firm to better match the target customer preferences and thus produce superior value. Therefore, NPSP advantage is here conceptualized to indicate a firm's ability to produce products and services with unique features, original product and service concepts or novel product and service combinations that are perceived useful and appropriate in fulfilling the needs of the target customers and the ability to outperform the competing offerings.

Novelty refers to the uniqueness of the new products and services or to a novel combination of new products and services in comparison to those currently on the market. Uniqueness is suggested to contribute to new product advantage by differentiating the offering from competing offerings (Cooper 1983). Unique features are also linked to the product competitive advantage and product success through their ability to assist the customer in performing unique tasks (Song and Parry 1997). Similarly, a singular new service can enable a firm to differentiate itself from other companies in the market or to assist in performing a customer-specific job (Gebauer et al. 2011). Furthermore, although some singular products or services may not be novel, these can complement other products and services, enabling a firm to offer novel value through a novel combination of new products and services. Thus, unique products or

services or novel combinations of products and services may enable a firm to differentiate the offering and better match the preferences of the target customer and enjoy an advantage over competitors.

Regardless of how new products may differ from other existing offerings in the market, they should also produce value to the target customer. As Sethi et al. (2001, p. 74) stated, "a primary determinant of new product success is the extent to which the product is different from competing alternatives in a way that is valued by customers." Meaningfulness refers to attributes or functionalities that target customers perceive as valuable and beneficial. A product or service that addresses certain needs can create value by providing gains or relieving pains by being useful, assisting the customer in achieving his or her goals or generating value by other means. For example, quality and reliability, which are often considered traditional measures for new product advantage (Li and Calantone 1998), are advantageous only if they are meaningful to the target customers. Furthermore, at the portfolio level, with the introduction of additional meaningful products or services, a firm may be able to increase the level of delivered value, reducing the customer pain of seeking complementary products or services elsewhere. Thus, a high level of NPSP meaningfulness may provide an advantage over competitors.

Additionally, customers tend to prefer offerings with superior characteristics (Carpenter and Nakamoto 1989). Superiority refers to the extent to which the new product provides superior value over competing products (Rijsdijk et al. 2011). Hence, superiority can be achieved through cost efficiency and a low price (Kim et al. 2016), through superior performance, or through superior quality. At the portfolio level, new products and services may deliver superior value alone or in combination with other products and services. Therefore, NPSP superiority can provide a competitive edge against competitors.

Hypothesis 1: Novelty, meaningfulness and superiority represent distinct characteristics of NPSP

Finally, novelty, meaningfulness or superiority should provide an edge against competitors' offerings and should provide a source of advantage. Offerings that are clearly different from other offerings on the market and that provide high customer value through meaningful characteristics that precisely match customer needs and that do this better than any other offering may be expected to enjoy an advantage over competitors. Therefore, novelty, meaningfulness and superiority are herein suggested to represent distinct characteristics that together constitute the NPSP advantage concept.

Hypothesis 2: Novelty, meaningfulness and superiority together constitute NPSP advantage

Scale development

Data collection, response pattern and respondents

To test and validate the measures, primary quantitative survey data were collected from the Finnish food manufacturing industry. The sample for the study was outlined by

utilizing the ORBIS database, through which 343 food manufacturing companies employing five or more people were identified. Thereafter, through calls to all identified companies, 293 were successfully contacted; finally, 255 agreed to provide their emails to receive the research form. After two email reminders, 108 fully completed responses from CEOs and managers of companies employing an average of 38 people were registered.

Development of measurements

To develop the portfolio-level measures, a three-step process was employed: 1) item identification, selection and new item generation; 2) content validity evaluation; and 3) data collection and analysis. In the first phase, prior research was explored to identify relevant items for novelty, meaningfulness and superiority of new products and services. In addition to developing items introduced and deployed in prior studies ((Atuahene-Gima 1995; Chen et al. 2012; Cooper and Kleinschmidt 1987; Im and Workman 2004; McNally et al. 2010; Rijsdijk et al. 2011), complementary questions were generated. In the second phase, the content validity index (CVI) approach was deployed to ensure the content validity of each item. In the CVI assessments, eight academic professionals rated each question based on a 4-point scale: 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant and 4 = highly relevant in measuring the phenomenon at hand (Polit et al. 2007). The first evaluation round indicated a need for minor rephrasing. After the second evaluation round, all items achieved the suggested (>.8) average I-CVI threshold value. In the third phase, respondents were contacted and questionnaires were sent; eventually, the answers were analyzed. For all the items, a 7-point scale stating "To what extent do the following statements reflect the new products and services sold in 2010, 2011 and 2012? (1 = strongly disagree, 7 = strongly agree)" was employed. Common method bias and tests for complex construct structures were executed in two phases. First, exploratory factor analysis (EFA) for all 15 items was run, and second, the optimal structure for the constructs with confirmatory factor analysis (CFA) was tested.

Results

To analyze the factor structure of all 15 items, maximum likelihood and Oblimin with Kraiser normalization rotation were used for the factor analysis. The results of the exploratory factor analysis (presented in Table 1) suggested a three-factor solution. One item that failed to exhibit satisfactory loading (>.5) to any common factor was removed. The remaining 14 items loaded onto their common factors, suggesting the first factor represented novelty, the second factor represented meaningfulness, and the third represented superiority. Eigenvalues greater than one explained 76.4% of the variance, where the strongest factor explained 53.9%. Cronbach's alpha tests indicating the threshold value (.70) for each factor (.91; .89; .94) were deployed to ensure the reliability of the constructs. Furthermore, the factor analysis demonstrated an excellent KMO-value (.90) that was highly significant in Bartlett's test of sphericity (<.001). In addition, the results of the exploratory factor analysis indicated that the data were free of common method bias and that the measures were reliable; the results support the first

hypothesis that novelty, meaningfulness and superiority are distinct characteristics of new products and services.

To confirm the results of exploratory factor analysis and to test the optimal construct structure, confirmatory factor analysis was executed by using SPSS AMOS version 23.0.0. First, a unidimensional structure with all 14 items for new product and service advantage was tested. The results demonstrated poor model fit: $\chi2 = 444.76$, degrees of freedom (d.f.) = 77, $p = .000$, $\chi2/d.f. = 5.776$, RMSEA = .211, GFI = .550, CFI = .687, and IFI = .691 (Bollen 1989; Hu and Bentler 1999). The loadings for the factors ranged from .467 to .851. Testing any number of released error variance relationships between items did not lead to an acceptable model fit, supporting the EFA results of a multidimensional structure for the construct.

The structural model for the three-dimensional advantage construct consisting of novelty, meaningfulness and superiority was tested (Fig. 1). The results demonstrated a good model fit: $\chi2 = 79.34$, degrees of freedom (d.f.) = 67, $p = .144$, $\chi2/d.f. = 1.184$, RMSEA = .041, GFI = .909, CFI = .990, and IFI = .990. The loadings for the first-order factors ranged from .598 to .901, and those of the second-order factors ranged from .751 to .970. Composite reliability and average extracted variance values for both the first- (CR = .95;.95;.96, AVE = .80;.80;.86) and the second-order factors (CR = .98, AVE = .82) were suitable compared to the suggested threshold values (CR > .80, AVE > .50). Eight error variance relationships were released inside the main factors. The results suggest that each dimension (novelty, meaningfulness and superiority) represents an individual construct alone (hypothesis 1); Moreover, these three dimensions together constitute a second-order construct measuring NPSP advantage, hence supporting hypothesis 2.

Discussion and implications

By conceptualizing and validating a three-dimensional construct to measure NPSP advantage, the present study contributes to prior discussions on the characteristics of new product advantage (Kim et al. 2013; McNally et al. 2010; Nakata et al. 2006; Rijsdijk et al. 2011) and answers the call to approach the innovation process more holistically by considering both new products and services simultaneously (Biemans et al. 2016; Papastathopoulou and Hultink 2012), which is important because often, the success of products and that of services are inter-dependent (Gebauer et al. 2010; Oliva and Kallenberg 2003; Rabetino et al. 2015). However, previous studies often measure the characteristics of products (Hong et al. 2013; O'Cass et al. 2014) and services (Coreynen et al. 2018; Partanen et al. 2017) separate. Thus, this study has two particular contributions. As the main contribution, the study confirms the distinction between different new product and service characteristics commonly perceived to constitute the unidimensional advantage construct (Li and Calantone 1998; McNally et al. 2010; Slotegraaf and Atuahene-gima 2011). Recent studies have reported with confidence the difference between superiority and meaningfulness (Rijsdijk et al. 2011) and the distinction between meaningfulness and novelty (Hong et al. 2013; Im and Workman 2004) but have not tested or reported these three distinct characteristics simultaneously. Aligned with prior studies suggesting that product advantages consist of unique, beneficial and superior characteristics (Atuahene-Gima 1995; Li and Calantone 1998; Rijsdijk et al. 2011), the present results suggest that novelty, meaningfulness and superiority represent distinct

Table 1 The results of the exploratory factor analyses (EFA)

Construct and items	Mean	Std. Dev.	Factor 1	Factor 2	Factor 3
Novelty (α = 0.91)					
1 The new products and services are very unusual in comparison to the competing products and services	3.16	1.68	−.726		
2 The new products and services are more revolutionary than the competing products and services	2.58	1.56	−.875		
3 The new products and services are very unexpected in comparison to the competing products and services	3.06	1.62	−.946		
4 The new products and services offer a new kind of solution to the customer's problems versus the competing products and services	3.51	1.81	−.651		
5 The new products and services are unique in terms of their features versus the competitive products and services	3.52	1.76	−.709		
Meaningfulness (α = 0.89)					
6 The new products and services are useful when considering the targeted customer group	5.20	1.30		.648	
7 The new products and services produce high value when considering the targeted customer group	4.94	1.40		.587	
8 The new products and services meet the customer expectations when considering the targeted customer group	5.32	1.22		.811	
9 The new products and services help the customers in achieving their goals when considering the targeted customer group	5.25	1.42		.828	
10 The new products and services reflect customer needs well when considering the targeted customer group	5.50	1.16		.785	
Superiority (α = 0.94)					
11 The new products and services are superior to the competing products and services	deleted				
12	4.79	1.75			.901

Table 1 (continued)

Construct and items	Mean	Std. Dev.	Factor 1	Factor 2	Factor 3
The new products and services are the best of their kind in the market in comparison to the competing products and services					
13 The new products and services are the best in the market in their category in comparison to the competing products and services	4.42	1.70			.974
14 The new products and services are superior to the competing products and services in satisfying the customer needs	4.13	1.62			.676
15 The new products and services are superior in quality to the competing products and services	4.52	1.66			.783

Extraction Method: Maximum Likelihood. Rotation Method: Oblimin with Kaiser Normalization.

characteristics. In addition, the three-dimensional construct structure fits with the empirical data significantly better than the unidimensional construct. Thus, the findings add to the existing knowledge on the concept of new product advantage.

As the second contribution, this study builds a bridge between the new product development literature and the new service development literature by introducing an approach to measure new product and service advantage at the portfolio level. Where the prior NPD research has discussed the advantageous characteristics of new products (Hong et al. 2013; Im and Workman 2004; Rijsdijk et al. 2011; Szymanski et al. 2007), the driving characteristics of new service success have received less attention (Biemans et al. 2016). At the same time, it has been suggested that taking a more integrated approach to studying innovation processes that considers both new products and services simultaneously provides interesting future research opportunities (Papastathopoulou and Hultink 2012). By considering not only a singular product or a service but also combinations of products and services, the concept of NPSP advantage captures the total value a firm can deliver, which is an increasingly important criterion affecting the success of a firm (Oliva and Kallenberg 2003; Gebauer et al. 2011). By developing a measure to capture the advantage at the new product and service portfolio level, this study provides an integrated approach to measure a desired innovation process outcome, the advantage over competitors that is available through the total possible value a firm can deliver. Thus, by bridging the research streams of new product and service development and by incorporating the concept of advantage into the portfolio level, the results provide interesting opportunities for future studies.

Limitations and suggestions for further research

Like all studies, this one has its limitations. The main limitation of the results derives from its contextual setting. The data were collected from industrially and culturally homogeneous companies. Future studies should validate the measures in other than
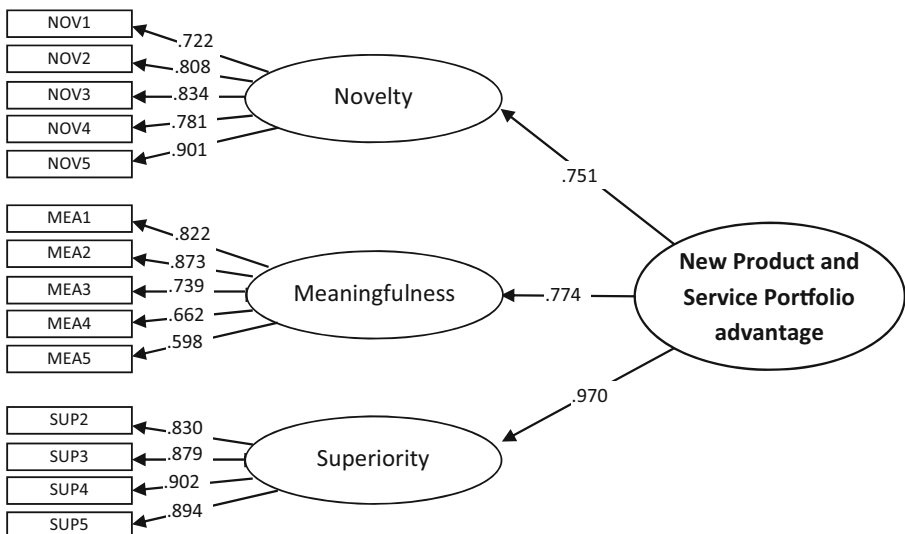

Fig. 1 Three-dimensional NPSP advantage construct structure (CFA)

low- and medium-technology industries and in different cultural environments to confirm the reliability of the construct. Furthermore, conceptualizing NPSP advantage provides numerous new research opportunities such as investigations of antecedents and outcomes of NPSP advantage. Interesting opportunities for future research include the relationship between NPSP advantage and strategic orientations such as entrepreneurial orientation and market orientation; an integrated new product and service development process; and new product and service portfolio success. Moreover, the created measurement method could be utilized in technology industries, where researchers study the servitization of manufacturing companies (Baines et al. 2017; Lenka et al. 2018; Rabetino et al. 2018), product-service bundling (Coreynen et al. 2018; Partanen et al. 2017), and the role of integrated products and services for company success (Fang 2008; Kohtamäki et al. 2013). However, because combining products and services is far from easy and shadowed by paradoxical challenges (Kohtamäki et al. 2018; Visnjic Kastalli and Van Looy 2013), further research could tap into product-service bundling.

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