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# A business intelligence approach using web search tools and online data reduction techniques to examine the value of product-enabled services



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## ABSTRACT

This article summarizes the results of an empirical study focusing on the value of product-enabled services in intensive R&D spenders. The focus is on product-driven firms for which new service development is expected to be particularly promising but also quite challenging. Part of the motivation is based on the fact that existing studies on the value attributes of hybrid offerings are mostly conceptual and need to be further substantiated through more systematic empirical studies. The research includes two samples with a total of 83 product-driven firms selected among the top R&D spenders in Canada and Europe. It adopts an innovative methodology based on online textual data that could be implemented in advanced business intelligence tools aiming at the facilitation of innovation, marketing and business decision making. Combinations of keywords referring to different aspects of service value were designed and used in a web search resulting in the frequency of their use on companies' websites. Principal component analysis was applied to identify distinctive groups of keyword combinations that were interpreted in terms of specific service value attributes. Finally, the firms were classified by means of K-means cluster analysis in order to identify the firms with a high degree of articulation of their service value attributes. This work articulates a relatively simple and intuitive method for quantitative and qualitative semantic analysis of online textual data that is similar to latent semantic analysis but could be used as part of more user-friendly expert system solutions and business intelligence tools based on easily accessible business statistics packages. The results show that the main service value attributes of the Canadian firms are: better service effectiveness, higher market share, higher service quality, and customer satisfaction. The service value attributes for the European firms include, among others, product added-value, product modernization and optimization of customer time and efforts. Canadian firms focus on collaboration and co-creation with suppliers and customers for the sake of product-service innovation as a competitive advantage on the marketplace. On the other hand, the focus of EU firms on innovative hybrid offerings is not explicitly related to business differentiation and competitiveness.

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## 1. Introduction

The purpose of the present paper is to summarize the insights from an empirical study focusing on the value of product-enabled services in top R&D spenders from Canada and Europe. The focus is on product-driven firms for which new service

development is particularly challenging. The specific choice of top R&D spenders was justified by two specific reasons. *First*, such firms have a dominant focus on the development of tangible products. *Second*, the services they develop are focusing on product-added value and not just on issues related to product maintenance and operation. Dynamic, high-tech growth industries (e.g., pharmaceuticals and biotech, IT hardware and equipment, automobiles and parts, software and computer services and electronic and electrical equipment) implemented the highest R&D investments over the last 10 years (Gerybadze, 2010). While the most active corporations were based in the US and Asia, European companies (with a few exceptions) did not perform at

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the same level and mostly allocated their R&D spending to traditional manufacturing sectors such as automobiles and parts, chemicals, industrial engineering and general industrials (Gerybadze, 2010). On average, many product-focused firms in the western world are currently experiencing a challenging situation. Disruptive forces are changing the workings of the global economy, and it is becoming increasingly difficult for product-focused firms to maintain their competitive position (Gebauer, Gustafsson, & Witell, 2011; Vladimirova, Evans, Martinez, & Kingston, 2011). Shrinking product lifecycles, widely available production know-how and inexpensive production in developing countries are all factors contributing to the emergence of increasingly volatile conditions for product-focused firms (Chesbrough, 2011, p. 9). To cope with these challenges, firms are looking into new approaches to innovation and sustainable growth. Many firms have explored various approaches to hybrid value creation through the development of product enabled services or product–service systems (PSS) as a way to innovativeness, business differentiation and sustainability (Tukker, 2004; Tukker & Tischner, 2006; Vladimirova et al., 2011). Combinations of products and services are driving practices and business models of companies integrating upstream asset complementarities (e.g., German machinery companies in the solar energy sector) or downstream activities (e.g., in machinery industry, transportation and medical equipment by relying on service strategies, customer solutions and integrated lifecycle management) (Gerybadze, 2010). Many scholars consider the development of value-adding services on top of existing products as a process of servitization of manufacturing (Baines & Lightfoot, 2014; Cavalieri & Pezzotta, 2012; Lightfoot, Baines, & Smart, 2013).

PSS, in particular, are usually associated with a specific type of value proposition consisting of a mix of tangible products and intangible services designed and combined in a way that they jointly are capable of fulfilling final customer needs (Tukker & Tischner, 2006). In this article the term product-enabled service will be used as an inclusive way of addressing the different ways of adding value by combining products and services within a specific business context.

The relevance of the research topic has both practical and scholarly aspects. Although many firms have become fully aware of the potential value of product-enabled services and have seriously tried to develop the necessary resources and capabilities, many of them failed since the nature of new service development is very different as compared to new product development (Ettlie & Rosenthal, 2012; Shankar, Berry, & Dotzel, 2009). Also, although there is a visible emergence of a product–service research domain (Mont & Tukker, 2006; Tukker & Tischner, 2006), there is a need for more empirical studies focusing on the specific types of add-on value associated with product related services. There are interesting open questions concerning the impact of servitization on the overall performance of manufacturing firms. While some studies demonstrate the benefits of servicing for both the performance of the product itself and in terms of customer value, its impact on the performance of the product service provider is little studied. For example, mobile value-added services are expected to form mobile operators' strategy to make up for the declining revenue obtained from users (Kuo & Chen, 2006). There is some evidence that suggests the strategic and economic potential of product-enabled services, however empirical studies seem to yield mixed results (Kastalli & Van Looy, 2013). For example, limitations in the service engineering approaches of manufacturing companies have been observed with no impact on the optimization of the hybrid offerings (Cavalieri & Pezzotta, 2012). In fact, the value-in-use and co-creation concepts related to servitization should be refined and further developed (Lightfoot et al., 2013).

In this paper we apply a methodologically innovative way to examine the value attributes of services in product-driven firms with heavy investment in R&D activities by using a combination of quantitative and qualitative content analysis of online textual data. Data mining techniques focusing on textual data are becoming increasingly popular (Chung, 2014; Kaklauskas, 2015; Nassirtoussi, Aghabozorgi, & Ngo, 2014, 2015; Ngai, Xiu, & Chau, 2009). The analytical approach that was adopted here could be categorized as a modified and more intuitive version of latent semantic analysis (LSA) – a method for extracting the meaning from passages of text, based on a series of linear algebraic operations and statistical computations over a collection of documents or other textual sources such as e-mail messages, web pages, etc. (Evangelopoulos, 2013; Evangelopoulos, Zhang, & Prybutok, 2012; Kundu, Jain, Kumar, & Chandra, 2015; Landauer, Foltz, & Laham, 1998). Even though the adoption of the LSA technique has visibly increased in the last 20 years, it still remains to be a relatively complex approach with high barriers to adoption by the majority of scholars and practitioners. The analytical method suggested here aims at further developing and validating a more intuitive version of quantitative content analysis that could become more easily accessible through the use of open source software web search and computational tools as well as standard business statistics software packages such as SPSS, SAS, Microsoft Excel, etc. We were first inspired by its application to the development of a taxonomy of business models of small technology-driven firms on the basis of exploratory factor analysis of specific keyword occurrences on firms' websites (Libaers, Hicks, & Porter, 2010). We have then extended it and further developed it within the context of studies focusing on the value co-creation practices of technology driven firms (di Tollo, Tanev, De March, & Ma, 2012; Tanev et al., 2011) and product-enabled services product driven firms (Ansevics, Iversen, Tanev, & Liotta, 2013). The present research study enhances the methodology by demonstrating its ability to discern the difference between the insights emerging from two different research samples including top R&D spenders in Canada and Europe.

The focus on more intuitive and easily accessible expert tools and decision making solutions positions the paper within the context of the growing interest in expert and intelligent systems that make use of text mining and analytics in order to gain insights on, e.g., financial and market trends (Nassirtoussi et al., 2014, 2015) or business intelligence factors, value chain and customer relationship aspects which are of high relevance for firms decision making processes (Chung, 2014; Coussement & Van den Poel, 2008; Kaklauskas, 2015; Kundu et al., 2015; Ngai et al., 2009). Unfortunately, user-friendly intelligent systems for business intelligence purposes are not widely available yet, thus entailing labour intensive and time consuming tasks for business analysts (Chung, 2014). This work addresses this issue by using in a novel way several techniques that have already been applied in the field of expert and intelligent systems such as principal component analysis (PCA), K-means clustering and semantic analysis to discover competitive differentiation factors and value proposition patterns in the online articulation of firms' hybrid offerings. Starting with a data collection from the text on the websites of a sample of firms, on the basis of a set of keywords that was pre-selected and combined by domain experts, the combination of the above techniques allows the user to: (i) identify specific competitive factors (components) grouping the keywords appearing in a similar semantic context; (ii) classify the firms in terms of the degree of articulation of any specific component on their websites; (iii) apply an additional qualitative semantic analysis of selected company websites aiming at enhancing and refining the interpretation of the different components. The current implementation of the methodology is

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