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## **PRODUCTISATION: A LITERATURE REVIEW**

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### ABSTRACT

**Purpose:** *Productisation seems to be a managerial practice as the term is commonly used by practitioners. Industrial managers often comprehend productisation as combining and translating product, or service elements into a whole, that can be offered to customers. Dictionary defines productisation as “the act of modifying something to make it suitable as a commercial product”. However, the literature is not clear with productisation. Therefore, the purpose of this study is to combine and analyse all journal articles referring to productisation. The aim is to obtain a better understanding on how the literature understands productisation, and how the discussion is distributed.*

**Design/methodology/approach:** *This study is founded on a thorough literature search, the approach being content analysis, with two main steps: 1) defining sources and procedures for the searches, and 2) defining categories for classifying the found articles (e.g. Li and Cavusgil, 1995). Keyword searches were conducted through article databases, including; Google Scholar, Scopus, Emerald and Science Direct. The analysed literature contains 185 journal articles.*

**Findings:** *The analysed articles are divided into five content categories. Productisation of products seems to be the most discussed theme, with 37.3 % of the articles classified into this category. Productisation of services, productisation of software, and productisation of technology are the next most covered with 25.4 %, 17.8 %, and 16.2 % of the articles respectively. Noteworthy is that most articles referring to productisation are relatively new. This study also clarifies the characteristics of productisation as recognised by the articles, together with identifying relevant research interfaces.*

**Research limitations/implications:** *The limitations of this study include analysing articles found in certain databases, potentially ignoring some important work. The implications include synthesising, and making available the overall state of research surrounding productisation.*

**Originality/value:** *The authors have not identified similar studies conducted on productisation.*

**Keywords:** Productisation; Productization; Product management; Product development; Literature review; Categorisation; Content analysis.



## INTRODUCTION

Meeting the ever increasing customer demands and the resulting product proliferation are widely discussed in the literature (e.g. Forza and Salvador, 2002; Zhang et al., 2005; Bramham et al., 2005). Also, product development is widely discussed (e.g. Browning et al., 2002; Cooper and Kleinschmidt, 1995). Products are seen to constitute of tangible and intangible elements (Bitran and Pedrosa, 1998), to be a marketable mix of compatible hardware, firmware, and software (Mitola, 1999), or to be mainly software based, consisting of a set of computer programs, procedures, associated documentation, and data for delivery to users (Fricker, 2012). In addition, service industries are seen to have an increasingly important role in the global economy, while the basis of customer value is changing from manufacturing to a more product-service oriented systems (e.g. Wise and Baumgartner, 1999). Manufacturing companies increasingly provide product-service offerings rather than pure products; growth is often sought by increasing the sales of services (e.g. Baines et al., 2009). As a consequence, the scope of interaction with customers is being broadened from transactions to a relationship (Martinez et al., 2010).

Research on integration of products and services seems to use a variety of terminology, some discussing the same issues using different terms. Terminologies referring to the integration of products and services include system selling (e.g. Helander and Möller, 2006), bundling (e.g. Herrmann et al., 1997), system solution (e.g. Mont, 2002), integrated solutions (e.g. Davies et al., 2006), functional product (Alonso-Rasgado et al., 2004), functional sales (e.g. Sundin and Bras, 2005), product-service system (Morelli, 2002; Baxter et al., 2009), integrated product and service offering (Baines et al., 2007), and some others. The literature also uses terms of productisation and servitisation while discussing the integration of products and services (Geum et al., 2011). Nevertheless, the content and the level of discussion in the literature varies to a great degree, and is often very ambiguous, hence, this article focuses on clarifying one of the used terms, namely productisation.

This article presents a literature review on journal articles that refer to productisation to clarify the content of one part of the existing literature on the act of making something product-like, an offering that can be sold. An extensive literature search of academic journals was carried out through article databases, including; Google Scholar, Scopus, Emerald and Science Direct, yielding a total of 185 articles. Categories were defined and the found articles were classified.

This article attempts to answer the following research question:

RQ 1: How do the existing journal articles convey productisation?

RQ 2: What are the characteristics recognised for productisation and what are the relevant research interfaces?

Both research questions are answered based on literature findings.

## METHODOLOGY

The research process applied in this study is described in Figure 1. This study is founded on a thorough literature search. According to Fink (2004) literature review is a systematic, explicit, and reproducible method for identifying, evaluating, and synthesising the existing body of recorded work. More particularly, the approach used in this study, is content analysis, a research technique for systematic, qualitative and quantitative description of the content of literature in an analysed area (Li and Cavusgil, 1995).



Figure 1 Research process

When carrying out a study on the state of knowledge in a field or subject, three principal basic approaches have been used (Li and Cavusgil, 1995). One of these three approaches is the Delphi method through which experts familiar with the studied area are surveyed (Dalkey and Helmer, 1963). The second one is meta-analysis, an approach in which empirical studies on a studied subject are collected and analysed statistically. For example, Montoya-Weiss and Calantone (1994) used this approach for analysing the determinants of new product performance. The third approach, the one utilised in this study, is content analysis, a research method used for systematic, qualitative and quantitative description of the content of literature in a field or subject.

The procedure for conducting content analysis is seen to contain two main steps: (1) defining sources and procedures for the search of articles, and (2) defining categories for the classification of the collected articles (Li and Cavusgil, 1995; Seuring et al., 2005; Marasco, 2008). These two steps have been applied in the review of literature referring to productisation. In this study, only journal articles are included in analysing the research surrounding productisation. Any books, business periodicals, conference proceedings and other written material are left outside the scope of the study. Literature for inclusion contained published journal articles but was not limited to any particular journals. Key word searches were conducted through article databases including Google Scholar, Scopus, Emerald and Science Direct. The keywords utilised in this study contain the both transatlantic forms of productisation. The utilised keywords were expected to appear in the articles. Should the keywords appear only in the list of references, not in the actual discussion, the article was not analysed further. Once articles were identified, their references were reviewed to aid in locating additional papers, resulting in some beneficial findings. Journal articles were carefully read to understand their content and analyse their contribution to the research questions and aims. As the terminology surrounding the topic of interest is not cemented, some additional keyword searches were also made to reveal the surrounding discussions. This procedure yielded a total of 185 journal articles that were identified by the databases and search engines combined. Even though a number of other potentially relevant publications, aside journal articles, may be found using the keywords, they were not included in this study. The reference list to this article contains all the found articles. Although there is always the possibility that some



articles have been missed, the reviewed journals constitute a reasonably representative body of productisation-related research work that has been published.

### *Classification categories*

Based on the database searches and the analysis during this study, articles referring to productisation can be divided into five categories. These categories are: *Productisation of Products*: Those articles that convey productisation to be linked to offering that constitutes of tangible and intangible elements, often provided with supporting services. *Productisation of services*: Those studies that convey productisation to be linked to offering that constitutes of services that are often abstract and intangible. *Productisation of software*: Those articles that convey productisation to be linked to offering that is software based, consisting of computer programs, procedures, associated documentation, and data for delivery to users. *Productisation of technology*: Those articles that convey productisation to be linked to future offering that constitutes of technology currently under development. The biggest difference to the category of productisation of products, or other categories, is the discussion being more at frontiers of technological knowledge in terms of products and manufacturing technologies, and/or discussion closely related to technology topics. The category *other*: Contains those articles that include miscellaneous discussion, one that cannot objectively be linked to any of the other categories, yet the articles refer to productisation. The first four categories of articles referring to productisation each have their own characteristics and clear commonalities to a degree.

## **CLASSIFICATION AND REVIEW OF PRODUCTISATION LITERATURE**

This chapter presents the classification of journal articles referring to productisation, based on a content analysis conducted during this study. Table 1 illustrates the distribution of the reviewed articles by the content categories. There are a total of five content categories, including; *productisation of products*; *productisation of services*; *productisation of software*; *productisation of technology*; and *other* context. The categories are based on the context of the discussion on productisation in the articles. Each article belongs to only one category.

It can be seen from Table 1 that the term productisation, in journal articles, is mostly linked to productisation of products with about 37 %, and to productisation of services with about 25 % of the total articles. Productisation is linked to productisation of software, third mostly with some 18 % of the articles. Roughly, 16 % of the total articles fall into the category productisation of technology. Finally, the category other, accounts for about 3 % of all the published journal articles.

**Table 1** Distribution of articles by content (productisation)

Content category	Number of articles	Percentage of articles
Productisation of products	69	37.3
Productisation of services	47	25.4
Productisation of software	33	17.8
Productisation of technology	30	16.2
Other	6	3.2
<b>Total</b>	<b>185</b>	<b>100</b>

Table 2 shows the details of the classification by content, providing a summary of all the reviewed articles that fall under each category. Should anyone be interested in searching for references under the category topics, this table may prove beneficial.

**Table 2** References by the content classification

Classification category	References
Productisation of products	Aksehirli (2000), Ayanoglu (1999), Belt et al., (2010), Beuren et al. (2013), Bowman and Swart, (2007); Cheng et al. (2009), Cummings and Haruyama (1999), Czuchry and Czuchry (2009), Danson et al. (2005), Eliezer et al. (2009), Eliezer and Staszewski (2011), Ferguson and Kline (1997), Fey (1985), Flamholtz (1995), Flamholtz and Aksehirli (2000), Flamholtz (2002), Flamholtz and Hua (2002), Flamholtz and Hua (2003), Flamholtz (2005), Flamholtz and Kurland (2005), Fujishiro (2011), Greco (2007), Hanninen et al. (2013b), Harkonen et al., (2009), Henton (2005), Hossain (2012), Huang et al. (2003), Iskanius et al. (2006), Karjalainen and Lappalainen (2011), Kasvi et al. (2003), Kettunen et al. (2009), Klein et al. (2010), Larsson et al., (2009), Leinonen et al. (2009), Leminen and Westerlund (2012), Leon et al. (2007), Lev. et al. (1995), Levänen and Hukkinen (2013), Ma and Fuh (2008), Maatta et al. (2009), Martin (1992), McDonald (1996), Meehan et al. (2010), Mitola (1999), Mort (2001), Murray (1999), Muzellec et al. (2012), Nakagawa et al. (2012), Nakazawa and Tokuda (2012), Nigussie et al. (2012), O'Mahoney et al. (2013), Parks and O'Hanlon (1993), Pratap and Arunkumar (2007), Pyron et al. (1998), Ruohonen et al (2006), Segarra (1999), Sharif (2012), Skervin (2010), Strand (2005), Tan (2003), Tanaka et al. (2012), Tatsumi (2011), Tikkanen and Jaakkola (2010), Tokumitsu (1999), Van der Loos (1995), Velamuri et al. (2011), Wiig (1997), Yamane et al. (2012), Yoshitake et at. (2011), Zhou et al. (2013)
Productisation of services	Aapaoja et al. (2012), Anupam et al. (2006), Artto et al. (2008), Aurich et al. (2009), Baines et al. (2007), Bask et al. (2010), Bask et al. (2011), Bruce et al. (2008), Chattopadhyay (2012), Crane (2005), Crane (2007), Daim et al. (2013), Geum et al. (2011a), Geum et al. (2011b), Gupta (2011), Hanninen et al. (2013a), Houlder and Williamson (2012), Jaakkola (2011), Kim (2009), Karmarkara and Apte (2007), Kim and Yoon (2012), Laperche and Picard, (2013), Leng et al. (2008), Maklan and Klaus (2011), Mattila et al. (2013), Meyer (1999), Morrison (2003), Nadim and Singh (2008), Nam et al. (2009), Nysten-Haarala et al. (2010), Ojala and Tyrväinen (2008), Park et al. (2012), Rajahonka (2013) Reitman (2001), Rekola and Haapio (2011), Rissanen et al. (2010), Salmi et al. (2008), Shin et al. (2009), Skalen and Hackley (2011), Stone (2010), Thomas (1994), Toivonen et al. (2008), Toivonen (2012), Ukko et al. (2011), Valminen and Wang et al. (2011), Vähätalo (2012), Wardlaw (2005)
Productisation of software	Alajoutsijärvi et al. (2000), Barzilay et al. (2009), Baumert et al. (1998), Carayannis (1998), Carayannis (1999), Davey et al. (1995), Emmerich and Sawyer (1998), Fay (2003), Feller et al. (2008), Helander and Kukko (2009), Helander and

Classification category	References
	Ulkuniemi (2006), Helander and Ulkuniemi (2012), Hori et al. (2004), Iivari and Molin-Juustila (2009), Kiessling et al. (1994), Kuivalainen et al. (2007), Marjakoski (2009), Mathur (2006), Mohapatra and Roy (2012), Mont et al. (2006), Nguyen and Sohn (2003), Ojala and Tyrväinen (2006), Parry et al. (2012), Russell (1994), Sainio and McBride et al. (2003), Salo and Kakola (2005), Seager and Gorda (2009), Takafuji (2011), Tsou et al. (2005), Vlaanderen et al. (2012), Wallin et al. (2002), Ward et al. (2006), Youngdahl et al. (2010)
Productisation of technology	Autio et al. (2004), Ballato and Stern (1999), Chew et al. (2006), Cross and Montemorra (2012), Elkind et al. (1999), Fontes (2005), Hantos (2011), Hou and Lin (2006), Hytönen et al. (2012), Karbhari (1995), Mathur (2007), Myers et al. (2002), Oh et al. (2009), Peterson (1995), Quey (2004), Sahlman and Haapasalo (2011), Saultz (1997), Shah et al. (2008), Shapira et al. (2012), Smith et al. (2002), Sohn et al. (2012), Sparkman (2002), Sturgill et al. (2008), Thompson and Azvine (2004), Van Den Elst et al. (2006), West (2008), Wisely (2007), Xiuli (2011), Zayadi (2012), Zhu et al. (2012)
Other	Dobris (2005), Lysgard, (2013), Parjanen (2012), Pekkola, (2013), Prokkola (2007), Wu and Guo (1999)

Based on the publication years, the articles that refer to productisation seem to be mostly relatively new. In the category *productisation of products*, the first article found was published in 1985, yet the majority of articles have been published after year 2000. Most articles in the category *productisation of services* have been published since year 2000. In the category *productisation of software*, the earliest found article had been published in 1994 and over half since 2000. Out of the articles classified to belong to the category of *productisation of technology*, some had been published in the 1990s, yet most were published after year 2000.

Figure 2 illustrates the origins of journal articles referring to productisation, as given in the affiliations for the first author.

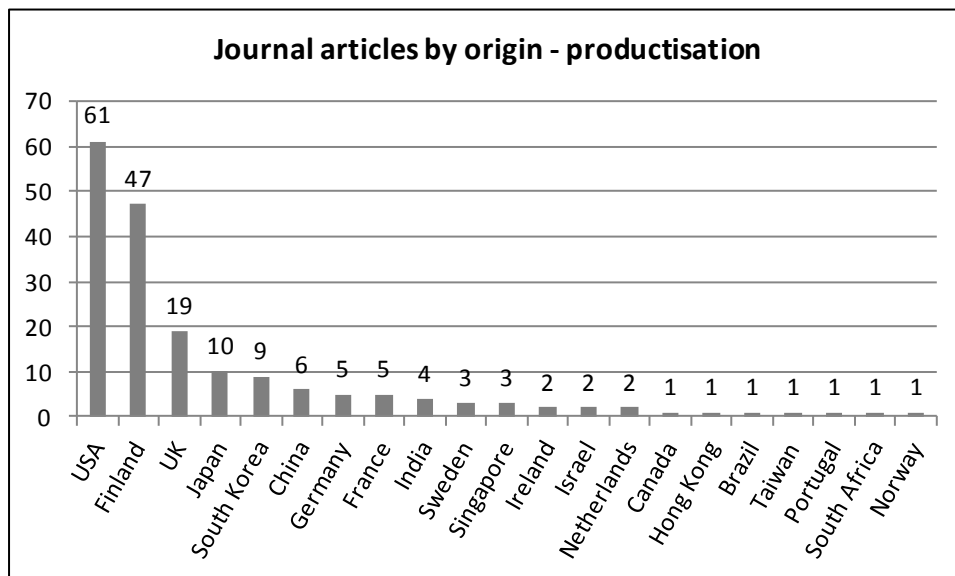


Figure 2 Journal articles by origin as given for the first author

The biggest proportion of journal articles that refer to productisation originate from the USA with 33.0 % of the articles, as given in the affiliations for the first author. Finland and UK are the next largest origins with 25.4 % and 10.3 % of the articles. Japan, South Korea, and China are the next biggest origins for journal articles referring to productisation with 5.4 %, 4.9 %, and 3.2 % of the articles, respectively. Should the European Union countries be seen as a single origin, the share of articles would be 84, or 45.4 % of the published journal articles.

Figure 3 presents the origins of the journal articles that refer to productisation, divided into the five classification categories. The origins of the articles are presented as given in the affiliations for the first author.

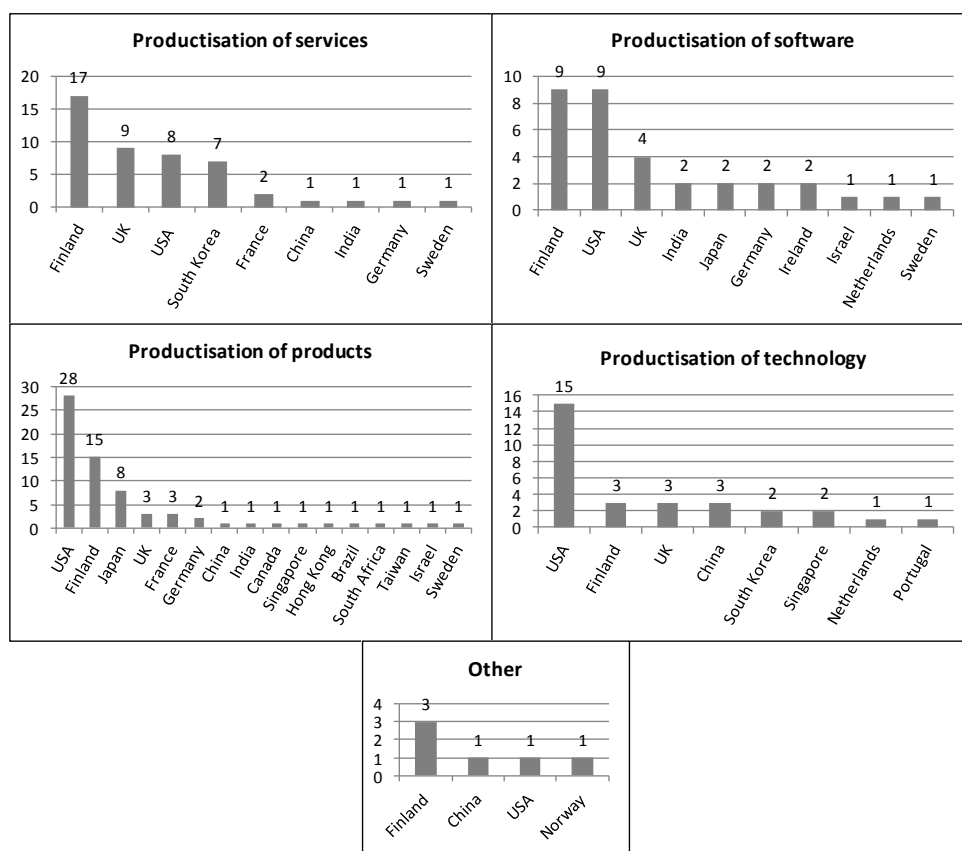


Figure 3 Journal articles by origin by the classification categories

The biggest proportion of journal articles that refer to productisation, in the category *productisation of services*, originate from Finland with 36.2 % of the articles. UK and USA are the next largest origins with 19.1 % and 17.0 % of the articles. South Korea is the origin for 14.9 % of the articles in this category. Should the EU countries be seen as a single origin, the share of articles would be 30, or 63.8 % of the articles in the category *productisation of services*. In the category, *productisation of software*, the biggest proportion of articles originate from Finland and USA with 27.3 % both. UK is the origin for 12.1 % of articles in this category. India, Japan, Germany, and Ireland are the next biggest origins with 6.1 % of articles each. If EU countries would be seen as a single origin, the share of articles for EU would be 19, or 57.6 % of the articles in the productisation of software category. The biggest proportion of journal articles that refer to productisation, in the category *productisation of*





*products* originate from USA with 40.6 %. Finland and Japan are the next biggest origins with 21.7 % and 11.6 % of the articles. UK and France come next with 4.3 % of the articles each. Germany is the origin for 2.9 % of articles in this category. Should the European Union countries be seen as a single origin, the share of articles would be 24, or 33.8 % of the published journal articles in the category *productisation of products*. In the category, *productisation of technology*, USA is the biggest origin of journal articles, with 50 % of the published articles. Finland, UK, and China are the next biggest ones with 10 % each. South Korea and Singapore are both the origin for 6.7 % of the articles. If EU countries were seen as a single origin, the share of published articles would be 8, or 26.7 % of the articles in the category of *productisation of technology*. The category *other* contains few miscellaneous articles that refer to productisation, ones that cannot be categorised into any of the other categories. Finland is the biggest origin in this category with 50 % of the published articles. The share for EU would be the same 3 articles, or 50 % of articles in the category *other*.

## CONTENT ANALYSIS

The following chapters by the content categories present discussion supporting each category together with the content analysis of all the analysed articles. These chapters further reveal the type of discussion found in the articles of each category. Relevant research interfaces are also attempted to identify.

### Productisation of products

Products often have tangible and intangible elements, tangible referring to physical elements and intangible to non-physical elements. The product development literature is seen to mostly deal with tangible characteristics of both elements (Bitran and Pedrosa, 1998). Products can range from fairly simple ones to complex systems, often provided with supporting services, sometimes also referred to product-service systems (e.g. Tukker, 2004). Typically, products are developed and produced to satisfy a need. However, understanding the needs of potential customers can be tricky, especially when considering intangible elements. For example, marketing literature often discusses value proposition and value creation in relation to understanding customer wishes. Customer wishes are seen to be met via processes of new product development and customer order fulfilment. (e.g. Slater, 1997). Value experienced by a customer is seen to be driven by product and process attributes, i.e. a process producing right deliverables and a product meeting the expectations (Browning, 2003). Marketing literature also discusses product differentiation in terms of attaining higher desirability and promoting sales (e.g. Sharp and Dawes, 2001). The literature also discusses commercialising products in conjunction with meeting customer expectations. Rapid commercialisation of new products is seen as one of the current top priorities in many organisations. (Harmancioglu et al., 2007). Producing a product recipe that satisfies requirements is emphasised as the goal of a product development process (Browning et al., 2002).

The literature referring to productisation of products mostly convey productisation as a phase in developing products (e.g. Eliezer et al., 2009; Karjalainen and Lappalainen, 2011; Meehan et al., 2010; Ayanoglu, 1999, Eliezer and Staszewski, 2011; Nigussie et al., 2012; Czuchry and Czuchry, 2009; Klein et al., 2010; Mort, 2001; Fujishiro et al., 2011; Nakazawa and Tokuda, 2012; Yamane et al., 2012; Tanaka et al., 2012; Yoshitake et



al., 2011; Tokumitsu, 1999; Ferguson and Kline, 1997; Kettunen et al., 2009; Lev. et al., 1995; Iskanius et al., 2006; Strand, 2005; Zhou et al., 2013; Pratap and Arunkumar, 2007; Leminen and Westerlund, 2012; Tan, 2003; Leon et al., 2007; Fey, 1985; Huang et al., 2003; Martin, 1992; Parks and O'Hanlon, 1993, McDonald, 1996). Nevertheless, in many cases productisation is presented self-evidently as a part of the discussion, leaving room for interpretations. Some authors present productisation as an activity that follows a research and development (R&D) phase (e.g. Murray, 1999; Van der Loos, 1995). Ma and Fuh (2008) name and organise different development phases as: industrial design, conceptual design, detailed design, *productisation*, process planning, manufacturing, assembly, sales, maintenance, and recycle or destroy. Productisation is also presented as a late product development phase (e.g. Belt et al., 2010; Harkonen et al., 2009), and as a part of innovation cycle including R&D, new product development, productisation, after-sales, and disposal. (Maatta et al., 2009). Many articles present the development of products simply as productisation, including analysing the needs of customers, designing the product and developing the ability to produce it. They view productisation to involve, in the case of a production company, the design and manufacturing phases, and in the case of a service company, forming a system for providing services to customers. (Flamholtz and Hua, 2002; Flamholtz, 2002; Flamholtz, 2005; Flamholtz and Kurland, 2005; Flamholtz 1995; Flamholtz and Aksehirli, 2000). In many cases, R&D projects are seen to result in exploitation that includes productisation, i.e. making commercial products from R&D prototypes (Segarra, 1999). Productisation is also seen as an activity of making something tangible in the real physical world (Muzellec et al., 2012). Tikkanen and Jaakkola (2010) view productisation to allow understanding product content to enable better quality. In addition, total time to market is suggested to include productisation efforts, while productisation simply means all activities required before a product is ready commercially (Pyron et al., 1998).

Other authors emphasise the marketability aspects in conjunction with productisation while viewing productisation as a phase in developing products. (Tatsumi, 2011; Cummings and Haruyama, 1999; O'Mahoney et al., 2013). Some authors discuss productisation purely as activities related to making something marketable (Leinonen et al., 2009; Henton, 2005; Cheng et al., 2009). For example, Mitola (1999) indicates a product being productised as a marketable mix of compatible hardware, firmware, and software modules. Skervin (2010) emphasise the value-adding aspects of productisation in developing products, while Greco (2007) view productisation as a part of value creation pipeline, a phase where validated concepts are converted into commercially ready products. Velamuri et al. (2011) associate productisation of products with hybrid value creation, i.e. the process of generating additional value by innovatively combining products (tangible component) and services (intangible component). Also, Bowman and Swart, (2007) associate productisation with value creation. Velamuri et al. (2011) also differentiate designing for hybrid value creation from traditional product offerings by hybrid value creation requiring the involvement of more stakeholders. Nakagawa et al. (2012) point out how, in collaborative product development, product requirements are often negotiated and how different actors may have their own interests during productisation. Productisation is also viewed to have two outputs, a product that is delivered to an internal or external customer, and knowledge related to the product, its production and use (Kasvi et al., 2003). Also, Wiig (1997) discusses the knowledge content.



The following aspects are also brought up by the journal articles referring to productisation of products. Sharif (2012) view productisation as an essential follow-up measure for commercialising R&D, linked to new goods and services, aside capitalising intellectual property (monetisation). Also, Hossain (2012) discusses productisation as a commercialisation activity. Van der Loos (1995) highlights the importance of involving the prototype developer and the importance of technical documentation for productisation. Levänen and Hukkinen (2013) see productisation as one of the critical points of industrial activities as the productisation process still contains significant risks. For example, productisation risks include products under productisation being potentially viewed differently in the eyes of the legislator. Hanninen et al. (2013b) present a concept of rapid productisation that covers versatile activities before the actual productisation.

Productisation of products is also associated with the concepts of complex product systems, customer solutions, extended products, functional products, hybrid products, hybrid solutions, integrated solutions, product based services, product related services, product services, product service systems, and servitisation. (e.g. Velamuri et al., 2011). Productisation is in some cases discussed as a part of product integration process, the product constituting of software, service components and a subset of application components. These parts are seen to be combined into more complex ones and eventually into a product or system that will be delivered to a customer. (Larsson et al., 2009). Productisation is also viewed as a process of defining products based on customer needs (Danson et al., 2005). Some authors view Product-Service System as the convergence of productisation and servitisation, trends that consider a product and a service as a single offering (e.g. Beuren et al., 2013). Ruohonen et al (2006) view productisation as standardisation - an opposite to cooperative customisation that is conducted when it is difficult for customer to express product preferences or the product involves complicated specifications.

As a summary on *productisation of products*, ignoring any terminology-related inconsistencies, the published journal articles recognise the following characteristics:

- seen as a process phase
- making something marketable
- activities before a product is ready commercially
- defining products based on customer needs
- hybrid value creation
- standardisation
- potentially three outputs, product, service and related knowledge
- a follow-up measure for R&D commercialisation
- making tangible

### **Productisation of Services**

In the service industry, the object of exchange is abstract and intangible, a clear distinction between services and tangible products, (e.g. Shostack, 1977, Gummesson, 1991). Services are also characterised by heterogeneity, customer participation, and perishability (e.g. Chai et al., 2005). Services can be customised for individual customers' unique needs, and produced



and delivered as a result of an interactive process. However, in many cases services are only partially customised rather than bespoke solutions (e.g. Hipp, 2000; Aapaaja et al., 2012). High degree of customisation and the resulting heterogeneity are seen to cause challenges in communicating, promoting, and pricing service products (e.g. Clemes et al., 2000).

The literature referring to productisation of services points out how service productisation is acknowledged among practitioners, discussed commonly in managerial magazines and seminars, but not discussed explicitly in the academic literature. (e.g. Jaakkola 2011). Productisation of services is seen to be conducted due to various challenges, including inefficient production of services, services being tailored from scratch for each client, difficulties by customers and company employees perceiving the service offering (Valminen and Toivonen, 2012; Jaakkola 2011).

A need to make services more product-like, repeatable, and tangible are seen as the motivations for productisation of services, hence productisation contributing to competitiveness and overall efficiency (e.g. Valminen and Toivonen, 2012; Bask et al., 2010; Chattopadhyay, 2012; Karmarkara and Apte, 2007; Skalen and Hackley, 2011; Morrison, 2003; Nadim and Singh, 2008; Rissanen et al., 2010; Mattila et al., 2013; Ojala and Tyrväinen, 2008; Gupta, 2011). Productisation is also seen as a tool for packaging services (Ukko et al., 2011; Bruce et al., 2008).

Most of the literature on productising of services view productisation as means for enhancing customer understanding, an activity by which a company gives a service more tangible features, and makes buying easier (e.g. Salmi et al., 2008; Valminen and Toivonen, 2012). Hence, productisation is seen to help customers to understand where they get value and what they spend money on, potentially influencing a company's revenues positively (e.g. Stone, 2010; Chattopadhyay, 2012). Shin et al. (2009) view service productisation as a way to stabilise revenue stream through the resulting continuity. In addition, Arto et al., (2008) view pricing of services and service productisation to be closely related activities. Chattopadhyay (2012) emphasises how productisation makes pricing of the service easier. On the other hand, Rekola and Haapio (2011) emphasise the importance of justifying expenses on productisation activities for ensuring continuity.

In productisation of Services customers are seen to have a role in producing the services (e.g. Jaakkola 2011). Nysten-Haarala et al. (2010) highlight productisation as a pre-sale activity. Productisation is also seen beneficial for cooperation with clients (e.g. Toivonen et al. 2008), for example, Anupam et al. (2006) point out how productisation can be favourable in learning customer preferences. Also, Hanninen et al. (2013a) discuss the customer interface.

Productisation of services is also discussed in conjunction with standardisation (e.g. Meyer, 1999), and service productisation is seen to be particularly essential for implementing modular products (Vähätalo, 2012). Rajahonka (2013) views productisation as a characteristic of modularity in services. Productisation of services includes standardisation and modularisation of service processes (Kim, 2009). Productisation of services is also presented as a part of a value creation mechanism (Nam et al., 2009), and seen as a managerial practice (Jaakkola 2011). Productisation is also



seen as one of the stages of service content lifecycle (e.g. Crane, 2005; Crane, 2007; Daim et al., 2013; Wardlaw, 2005; Reitman, 2001). Geum et al. (2011a) view productisation as a relationship between technology and a service, one on which eventually evolves towards productisation, i.e. development of a product that combines technology and service.

In general, the discussion on productisation of services in the published journal articles seems to be somewhat limited and lacking depth. Also, the terminology utilised is not unambiguous. Neither are the discussed issues new, for example, already Levitt (1976) referred to standardisation of services when discussing industrialisation of services.

*Productisation* of services and *servitisation* of products are seen as overlapping concepts (e.g. Bask et al., 2011). The borderline between products and services is seen to be disappearing while products are servitised and services are productised (Thomas, 1994). Servitisation is seen as a concept related to productisation, yet the relationship between service and product elements are somewhat different in these two. According to Chattopadhyay (2012) productisation of services is accomplished largely by associating tangible features with intangible service offerings. Geum et al. (2011a; 2011b) view servitisation to mean converting an existing manufacturing offering to a service that includes elements such as planning, consultation, realisation and evaluation. McAloone and Andreasen (2002) present an example of servitisation on Xerox, changing its competitive offering from manufacturing copying machines to offering an integrated document management service. Park et al. (2012) see servitisation as companies offering fuller market packages, or bundles of customer-focused combinations of goods, services, support, self-service, and knowledge. In simple terms, servitisation could be understood as a shift from selling products to selling integrated product and service offerings that deliver value in use (e.g. Martinez et al., 2010). Companies are increasingly adopting a service oriented model on manufacturing (e.g. Wang et al., 2011). Delivering value in use is also discussed using the concept of *product-service system* (e.g. Baines et al., 2007), the difference to other concepts is in the existing approaches starting from the perspective of a physical product (Aurich et al., 2009). Also, Kim and Yoon (2012), Laperche and Picard, (2013), and Baines et al. (2007) see a strong link between productisation, servitisation and product-service systems.

As a summary on *productisation of services*, aside any terminology-related inconsistencies, the published journal articles recognise the following characteristics:

- making services more product-like
- defining services better
- systemising and creating repeatability
- making more tangible
- enhancing and improving services
- standardisation and modularisation of services
- making service production more efficient and profitable
- combining a tangible product and service offerings



## Productisation of software

Many of today's products are increasingly software-based, rather than electro-mechanical. A software product is seen to consist of a set of computer programs, procedures, associated documentation, and data for delivery to users. (e.g. Fricker, 2012). Software products are seen flexible and soft, allowing relatively easy changes in a technical sense (Kilpi, 1997). A software product can also be seen as modular, consisting of one or more software modules (Ajila and Dumitrescu, 2007). Hence, a software product consists of many artefacts that are linked (Beuche et al., 2004).

The discussion on productisation of software in journal articles seems to be somewhat limited and lacking depth. Nevertheless, the literature does refer to productisation, even if the term is occasionally taken for granted. Productisation of software is seen to relate to characteristics and concerns that software systems should adopt as soon as they become products, i.e. deployment, security, configuration, and usability among any others (Barzilay et al., 2009).

Productisation of software is viewed as a managerial area related to marketing challenges, indicating that customer understanding of software products could be one of the driving forces (Helander and Ulkuniemi, 2006; Helander and Ulkuniemi, 2012; Baumert et al., 1998; Mohapatra and Roy, 2012). Productisation of software is also seen as means to demonstrate value (e.g. Feller et al., 2008), and make a product more tangible so that a buyer is able to test its functionality before the purchase decisions (Alajoutsijärvi et al., 2000). Productisation of software is also seen as means for standardisation and reproducibility. (Sainio and Marjakoski, 2009; McBride et al. 2003; Ward et al., 2006).

The discussion in Mont et al. (2006) indicates that productisation of software relates to packaging software to a form that can be offered to customers. Hence, productisation can be seen as an activity that relates to marketability (e.g. Kiessling et al., 1994; Emmerich and Sawyer, 1998). A process of converting routine software functions into modules that can act as building blocks for different applications (Youngdahl et al., 2010).

On the other hand, productisation is also seen as a process phase after creating an initial prototype, created to prove a concept (Davey et al.; 1995; Tsou et al., 2005; Seager and Gorda, 2009; Carayannis, 1999; Hori et al., 2004; Takafuji, 2011; Fay, 2003; Nguyen and Sohn, 2003; Mont et al., 2006). Wallin et al. (2002) present productisation as a phase of a software development life-cycle model, one that precedes production. Productisation is seen as a process involved in software effort (e.g. Russell, 1994), but not discussed thoroughly in journals.

From the perspective of software industry, productisation is seen to include a shift from unique service-intensive customer projects towards tangible standardised products aimed for international markets. (Alajoutsijärvi et al. , 2000; Helander and Kukko, 2009; Kuivalainen et al., 2007). In other words, productisation of software is seen as a transformation process from customer specific software to a standard product (Vlaanderen et al., 2012), meaning that productisation relates to delivering standardised software products (e.g. Parry et al., 2012; Salo and Kakola, 2005).



Ojala and Tyrväinen (2006) view the degree of a software productisation to be connected to the amount of required installation and after-sales services, where a low level of productisation means that a product requires intensive consulting, support, and maintenance, while a highly productised software product can be installed and used by customers without additional support. Nevertheless, according to Iivari and Molin-Juustila (2009), the extent to which users are listened during product based software product development is not dependent on the degree of productisation.

In addition, productisation of software is seen as an emerging trend, (Mathur, 2006), discussed in conjunction with final quality and packaging of a product, and also, incremental innovation is seen to be prevalent in productisation (Carayannis, 1998). Productisation is also seen as one of the central capabilities of software product business. (Alajoutsijärvi et al., 2000; Helander and Ulkuniemi, 2006).

Discussion, similar to productisation can be found in articles on *software product management* (e.g. Ebert, 2009; Fricker, 2012; Helferich et al., 2006). Software product management is seen as a discipline and a business process that governs a product from inception to the market to generate the largest possible value to a business (Ebert, 2009). Nevertheless, also the discussion on software product management is seen to lack in some aspects, as for example, Ebert (2007) calls for clarifying the roles of product manager, project manager, and marketing manager to successfully define, engineer, produce, and deliver a product.

As a summary on *productisation of software*, ignoring any terminology-related inconsistencies, the published journal articles recognise the following characteristics:

- improving customer understanding
- demonstrating value
- tangibilising
- standardising
- reproducibility
- relates to required amount of support
- packaging to a form suitable for customers
- seen as a process phase

### **Productisation of technology**

The literature on productisation of technology contains discussion that is more at the frontiers of technological knowledge in terms of products and manufacturing technologies (Thompson and Azvine, 2004; Shah et al., 2008; Sparkman, 2002; Elkind et al. 1999; Cross and Montemorra, 2012; Sturgill et al., 2008; Chew et al., 2006; Saultz, 1997, Wisely, 2007). In many cases the literature refers to productisation, but does not discuss it thoroughly. Productisation is seen as converting research findings, or technology into marketable products or services (Fontes, 2005). Myers et al. (2002) link productisation to three stages of technology development; i.e. *proof of concept*, *limited application*, and *widespread application*, particularly to the second and third ones.



Productisation of new technology is also linked to product development and technological innovation, while the discussion seems to refer a bit further into the unknown than in the category for productisation of products. (e.g. Mathur, 2007; Karbhari, 1995; Smith et al., 2002). Productisation is also conveyed as a development phase, aside sufficient supporting infrastructures of scientific understanding of a technology, engineering design, process and product development, manufacturing, reliability, and such. (Myers et al., 2002). Hantos (2011) emphasises the technology readiness in relation to productisation of technology.

Few authors also imply commercialisation in conjunction with productisation of technology, productisation being a relevant activity (West, 2008; Autio et al., 2004; Xiuli, 2011). Productisation is also discussed together with technological innovation, and technology transfer (Oh et al., 2009; Autio et al., 2004; Van Den Elst et al., 2006; Peterson, 1995; Ballato and Stern, 1999). Oh et al. (2009) point out the importance of timely productisation when developing and planning to introduce disruptive technologies to the market. Sohn et al. (2012) discuss productisation in terms of technology evaluation; productisation is seen as a R&D variable among laboratories, patents, utility patents, and types of funding applications.

Another line of literature discusses productisation together with intellectual property, patenting and licensing technologies (Hytönen et al., 2012; Hou and Lin, 2006; Zayadi, 2012; Quey and Malhotra, 2004; Shapira et al., 2012). Hou and Lin (2006) discuss productisation in conjunction with patent/technology appraisal. Hytönen et al. (2012) point out how the royalty levels should be predictable enough to support the planning of technology development and productisation investments. Zayadi (2012) emphasises how one ought to consider whether they have adequate enough ideas for using, or productising a patent, and if not, consider licencing to someone who has the required depth to realise productisation of the technology. Quey and Malhotra (2004) mention productisation, referring to technology transformation; companies using their own intellectual property to others' platform technologies. Shapira et al. (2012) present productisation of technology as a part of a "double-boom phenomenon" where corporate patenting activity first concentrates on technological improvements, then followed by a period of technology productisation. The first cycle is seen to be propelled by technological prospects and the second by marketing prospects.

In addition to the above presented, Zhu et al. (2012) discuss productisation of technology and marketisation of products in terms of imitating technology, i.e. analysing existing technology and productising the core without infringing the relevant rights. Sahlman and Haapasalo (2011) refer to productisation relating to product offering relevant to technology management objectives, technology acquisition and development lead time for productisation in particular.

As a summary on *productisation of technology*, ignoring any terminology-related inconsistencies, the published journal articles recognise the following characteristics:

- at the frontiers of technological knowledge
- making something marketable
- a development phase
- relevant to product offering





### Productisation – category other

Productisation, category *other*, contains all those journal articles that refer to productisation, but could not be objectively placed into any of the other categories. It was not possible to judge based on the discussion in these articles, whether they should be placed elsewhere. In some cases, it was clear that the article would not belong to any of the other categories. For example, Wu and Guo (1999) utilise the term productisation in the context of cybernetics and pansystems theory. Dobris (2005) discusses productisation of trusts and trustification. Prokkola (2007) uses the term productisation in the context of tourist destination packaging and commercialising a destination in a manner that the article could not be placed to the categories of products, or services. Neither could (Lysgard, 2013) be placed into any of the other categories, even if the article discusses productisation and culturalisation of products in conjunction with culture-based development strategies where experiences, services and products are seen to have a large role in peoples' lives. Parjanen (2012) uses the term productisation in the context of open innovation, innovation sessions, and exchange of ideas. In addition, Pekkola (2013) discusses productisation of academic work, i.e. work done by academics in universities or other higher education institutions. Some of the articles in this category have weak indications to packaging something and commercialising in reference to productisation activities. Other articles are merely impossible to judge.

## CONCLUSIONS

The act of making something suitable as a commercial product is an important topic. Productisation is one of the relevant terms used when discussing these matters. Nevertheless, the previous literature is somewhat ambiguous when discussing productisation. This article aims to clarify the content of one part of the existing literature on the act of making something into a product-like offering. An extensive literature review is presented on journal articles that refer to productisation. A total of 185 relevant journal articles identified through article databases, including; Google Scholar, Scopus, Emerald and Science Direct, are analysed. Suitable categories are defined and the found articles are classified into these categories. The content of discussion on productisation is analysed carefully, together with identifying relevant research interfaces.

The literature that refers to productisation can be divided into five categories of *Productisation of: Products; Services; Software; Technology; and Other*. Respectively, the frequency of these categories is roughly 37 %, 25 %, 18 %, 16 %, and 3 % of the published journal articles. The four first categories have their own distinct characteristics. Articles in the category *Productisation of products* convey productisation to be linked to offering that constitutes of tangible and intangible elements, often provided with supporting services. Many of the articles in this category also view productisation as a process phase, or phase in new product development. Productisation of *services* conveys productisation to be linked to an offering that constitutes of services that are often abstract and intangible. The literature on productisation of *software* presents productisation to be linked to offering that is software based, consisting of computer programs, procedures, associated documentation, and data for delivery to users. Articles on productisation of *technology* convey productisation to be linked to future offering that constitutes of technology currently under development, more at the frontiers of technological knowledge.



The analysed journal articles are all relatively new; the majority of the articles have been published after year 2000, some during the 1990s, and even the earliest found article during the eighties. Hence, it seems that the streams of journal literature that refer to productisation are relatively new. Interestingly, large proportions, some 25 %, of all the articles originate from Finland, a small country of just over five million people. USA is the origin of one third of all the articles and the UK just over 10 %. The distribution of origins in different categories also varies somewhat. Although there is always the possibility that some articles have been missed, this review provides some reasonable insights into how the literature conveys productisation.

The literature on the first four identified categories of productisation of: *Products*; *Services*; *Software*; and *Technology* present some commonalities in terms of characteristics. Nevertheless, none of the identified characteristics are simultaneously common to all four categories, yet three characteristics could be identified that are common to three of the categories. Two of the characteristics are common for two categories. The literature on the categories of product, software, and technology indicate productisation as a process, or a development phase. The literature on categories product, service, and software see productisation as an activity that has a goal of standardisation, systematisation, better defining the offering, and reproducibility. The literature on product, service, and software also see productisation as an activity of making the offering more tangible, to translate something abstract into an exchangeable offer and make value more visible. In addition, product and technology categories present productisation as an activity of making something marketable, while only the articles in product and service categories refer to hybrid value creation through combining tangible and service offerings.

There seem to be many relevant research interfaces for productisation as productisation seems to have linkages to activities such as sales, new product development, product management and product data management. Linked or similar issues are also discussed in the literature in conjunction with the following concepts: product-service systems, product-service integration, servitisation, complex product systems, customer solutions, extended products, functional products, hybrid products, hybrid solutions, product service, software product management, marketising of products, commercialisation, and probably many others.

The implications of this study include any potential benefits of the review combining journal articles that refer to productisation and bringing together different streams of literature on an issue that is relevant to many companies. Clarifying the used terminologies, recognising the characteristics of productisation conveyed by the literature, and recognising relevant research interfaces may also be beneficial for those interested in the topic.

The limitations of this article includes the analysis only including those journal articles that refer to productisation, available, at the time of search, through the article databases of Google Scholar, Scopus, Emerald and Science Direct. Also, only journals were included in the review, as they are generally considered to be the highest level of research for acquiring information and disseminating new findings. Hence, this article



potentially ignores other relevant knowledge published in other forms of literature. Including knowledge from other sources might influence the results and the made conclusions. Also, the choice of terms utilised during the literature searches may have influenced the results.

Future analysis could include, a review of research approaches used in the literature referring to productisation, as well as the distribution of approaches by articles, and content categories. Future analysis could also include the level of journals that have published articles that refer to productisation. Aside addressing the limitations of this study, future studies could include, extending the literature search to cover potential other terminologies on the act of modifying something to make it suitable as a commercial product.

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