Examining the influence of service additions on manufacturing firms' bankruptcy likelihood

Ornella Benedittini, Morgan Swink and Andy Neely

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Abstract

By evaluating secondary data from 74 bankrupt manufacturers and 199 matched non-bankrupt competitors, this study investigates the relationship of manufacturers' service offerings to their survival. While showing that the number of services offered is not significantly associated with bankruptcy likelihood, the results suggest that greater numbers of product-related and product-unrelated service offerings do reduce bankruptcy likelihood when properly complemented by firm-level contextual factors. Offering more product-related services causes bankruptcy likelihood to decrease for those companies that have a sufficiently diversified product business. In turn, companies with sufficient slack resources can expect bankruptcy likelihood to be reduced from the offering of more product-unrelated services. In contrast, companies should not expect that successful product sales performance will increase their chances of survival by focusing on product-dependent services. In light of these findings, this study challenges the notion from conceptual literature that additional services per se increase the chances of firm survival; it extends prior empirical studies in uncovering critical firm-level context effects; and it proposes portfolio theory as a theoretical foundation to examine manufacturers' service expansions.

Keywords: service strategy, service offering, manufacturing companies, bankruptcy, portfolio theory

1. INTRODUCTION

Faced with commoditisation and low cost competition, industrial companies are looking to services for survival (Ostrom et al., 2015). In particular, many manufacturing firms have upgraded their

commercial offerings with the inclusion of value-added services previously performed by customers and/or third parties (Reinartz and Ulaga, 2008; Shankar et al., 2009; Suarez et al., 2012; Steiner et al., 2016). Indeed, reconfiguring the total offering towards service provision is regarded as a sine qua non for surviving and prospering in contemporary product industries (e.g. Cohen et al., 2006; Bitner and Brown, 2008; Johnstone et al., 2008; Eggert et al., 2015). Researchers interpret this transformation of manufacturers' business strategies as a shift to service-dominant logic, service-based value propositions, service-oriented business models, and service-driven manufacturing (Kindström and Kowalkowski, 2009; Steiner et al., 2016; Windahl, 2015).

The service strategies of product companies can materialise in very different offerings, ranging from financial to professional services, including consultancy, R&D, technical support, and integration of multi-vendor products and services into customised solutions (Antioco et al., 2008; Kohtamäki et al., 2013a; Rabetino et al., 2015). Conceptual literature argues that adding such services to core product offerings improves firm performance. Yet, anecdotal accounts also reveal that companies are starting to withdraw, rather than extend, service offerings. For example, leading technology and industrial machinery providers that for a long time have been committed to continuously redefining their market offerings towards more extensive "life-cycle" (Rabetino et al., 2015) services are now seen to divest significant service activities. Examples include Johnson Controls disengaging from the provision of facility management services (Global Workplace Solutions), Voith divesting its Industrial Services (industrial maintenance for automotive and process industries) division, and ABB disposing of its Full Service (maintenance outsourcing) division. In a similar vein, some recent studies (cf. Eggert et al., 2011; Kohtamäki et al., 2013a) find empirical evidence that increasing services does not improve profit performance per se. Rather, these studies suggest that the effects of broader service offerings depend on other firm "contextual factors" (Josephson et al., 2016), and that this link is further influenced by the service category.

Against the backdrop of such research findings and cases, the present study posits that additional services fail to consistently exert a direct effect on company performance, in contrast to

the positive effect assumed so far by the mainstream conceptual literature (e.g. Mathieu, 2001; Oliva and Kallenberg, 2003; Gebauer et al., 2006; Mathyssens et al., 2006; Penttinen and Palmer, 2007). We propose that the performance impacts of service offerings should more realistically be conceptualised as a function of the firm context. Accordingly, we investigate specifically how the impacts of more extensive offering of different services on manufacturing companies' performance are moderated by other firm-level contextual factors.

Drawing on portfolio theory, our theoretical framework suggests that important interplays between service offerings and firm context encompass two primary dimensions: resource consistency and cash flow synergy. Resource consistency entails the congruence, alignment and coherence of the services offered with the existing resource endowments of the firm. Cash flow synergy reflects the ability of services to compensate for volatility of product demand, thereby stabilising total sales revenue. These interplays provide support to the fit of a service offering with an efficient and effective use of resources, and thus are likely to favourably affect its impact on company performance.

Previous empirical studies on the performance effects of service strategies have focused on accounting- or market-based measures of firm performance. Although the use of these well-understood performance indicators has provided valuable insights into the outcomes of service provision, this approach has certain limitations. While accounting- and market-based measures may serve as predictors of long term success, survival is arguably the ultimate measure of organisational performance (e.g. Drucker, 1954). Moreover, as previously outlined, many firms actually expand into services in order to survive shakeouts of their product industries. Given these accounts, our study proposes a survival analysis. It examines a sample of 74 bankrupt and 199 non-bankrupt service-oriented companies to determine bankruptcy likelihood in relation to service diversification and firm-level context, using secondary data and logistic regression analysis.

The study makes several contributions. Firstly, by viewing service offerings through the lens of portfolio theory, we propose a novel theoretical foundation for investigating the phenomenon of

manufacturers' expansion into services. Second, we assess how firm-level contextual effects can complement service additions to support firm survival, a critical but so far neglected topic. Thus, our findings contribute to advance the understanding of the impact of services on firm survival specifically and on performance in general. Third, we provide input to decisions concerning the configuration of service offering expansions, helping managers devise an effective service strategy. In sum, we challenge the notion that service additions make consistently positive contributions to manufacturing firm performance, and instead demonstrate the important role of several contextual factors as moderators of performance effects.

2. BACKGROUND

2.1 Services as part of the portfolio

Studies that conceptually discuss the adoption of services by manufacturing firms have proposed that a broader service offering brings benefits to the supplying firm. First, more services represent extra opportunities to generate sale revenues (Mathieu, 2001; Oliva and Kallenberg, 2003). Second, a broader service portfolio has the potential to improve the total offering's differentiation ability. An offering including more services tends to be more unique, difficult to imitate for competitors and valuable to customers (Malleret, 2006). More services enable greater flexibility of the offering as they can be combined into solutions to customer-specific needs (Cook et al., 2006; Gebauer et al., 2011). The positive experience of being offered something that they perceive as unique generates customer satisfaction, loyalty, and willingness to pay (Eggert et al., 2011). At the same time, a more extensive service portfolio has higher market visibility and encourages the perception of value among the customer base (Kohtamäki et al., 2013b), enhancing perceived firm quality, creating trustworthiness, and improving differentiation. Improved differentiation has consistently been shown to allow a firm to alter its competitive stance and remove itself from price-based competition, thereby achieving higher profit results and enhancing its chances of survival.

Third, with customers increasingly expecting suppliers to provide comprehensive bundled offerings that fully satisfy their needs (Kohtamäki et al., 2013a), a broader service portfolio can increase quality and longevity of customer relationships (Gebauer et al., 2008). In addition, comprehensive offerings are reported to lock-in customers via high switching costs (Reinartz and Ulaga, 2008), which increases repeated sales and reduces volatility of future cash flows. Finally, offering more services provides a basis for efficiency improvements. By including more services in the total offering, a manufacturing firm can spread some of the fixed costs of service production and boost organisational learning through repeated use of resources and capabilities (Eggert et al., 2011; Eggert et al., 2014a). Resource sharing and learning effects are well known to reduce the cost of resource accumulation and help firm survival (Garratt, 1987).

Despite these arguments, empirical research on manufacturers' service growth strategies fails to confirm a consistent direct impact of offering more services on company financial outcomes. Studies that identify positive performance effects from increased services measure the level of service provision through the share of total revenue generated by services (e.g. Fang et al., 2008; Suarez et al., 2013; Kohtamäki et al., 2013a), the amount of service sales (e.g. Visnjic and Van Loy, 2013), the quality (reliability, credibility and responsiveness) of service provision (He and Lai, 2012), or the activeness with which services are offered to customers (Kohtamäki et al., 2013b). Importantly, only the latter measure (activeness) constitutes an assessment of the *extent* of service offering; the other three measures are indicators of the *success* of service offerings (see, e.g., Antioco et al., 2008; Han et al., 2013), and so a relationship with company performance would be almost guaranteed. Using a more comprehensive measure of service strategy orientation that includes the number of services offered, Homburg et al. (2002) find that servitization has a positive impact on company performance. However, Antioco et al. (2008) find that only customer-oriented services, and not product-oriented services (cf. Mathieu, 2001) link significantly to increased product sales. Finally, both Eggert et al. (2011) and Eggert et al. (2014a) find that the extent to

which firms offer either product-oriented or customer-oriented services is not directly associated with profitability.

Indeed, adding services can introduce several drawbacks for manufacturers. First, offering more services increases the need for resource commitments in service-specific assets, capabilities and infrastructure (Kowalkowski et al., 2011; Visnjic and Van Loy, 2013). High service sales and profit margins are often the outcome of essential investments by the firm (Gebauer and Fleisch, 2007). Extending the service offering may lead a firm to divert significant resources from other functional areas (e.g. the product business – cf. Fang et al., 2008; Kindström et al., 2012; Oliva et al., 2012) and, most importantly, to spread resources too thinly over the range of services that it offers. Insufficient resource support often results in an inability to ensure the efficiency of service operations (Grönos and Ojasalo, 2004) and may hinder learning about possible cost savings in service production. Insufficient resources may also result in ineffective services that do not satisfy customers' expectations (Zeithaml et al., 1988; Josephson et al., 2016). Unsatisfied customers are more likely to defect and switch service providers, ultimately increasing the company's exposure to price-based competition and market failure. Further, resource shortage due to supporting a wider service portfolio may increase financial risks (Nordin et al., 2011), making the company more exposed to failure during negative economic cycles and industry downturns.

Second, more extensive service offerings increase the input-output flows that a company needs to manage. The increased number, complexity and interdependence of input-output flows arising from a broader service offering may create ambiguity and confusion within the firm. This can cause poor coordination of activities, hindering the delivery of a seamless offering to customers and increasing the risk of service failures (Nordin et al., 2011). Such effects are likely to generate resource disruption and customer dissatisfaction, weakening the competitive position of the firm. Third, service breadth can increase financial and bankruptcy risks by disrupting the market's perceived stability of profit generating activities. A manufacturing company engaging in greater service diversification is likely to realise a more substantial departure from its core identity in terms

of focus, resources and capabilities (Fang et al., 2008). For example, it will require a more substantial capability upgrade, resulting in greater integration and implementation challenges (Baveja et al., 2004). The firm's ability to generate future returns may appear uncertain, creating market and investor apprehension (Josephson et al., 2016). This apprehension may adversely affect the investment attractiveness of the firm, causing problems in procuring external funds for financing the business and ensuring its survival.

Despite the benefits that a manufacturing firm can expect from offering more services, we argue that the associated loss of focus, complexity of coordination and potential increase in investors' uncertainty regarding future returns will make expanding the firm's service portfolio per se insufficient to achieve performance improvements and increase survival. As a consequence, we predict no significant direct relationship between breadth of services offered and firm bankruptcy likelihood. However, as the subsequent discussion will illustrate, we contend that offering more services can lower bankruptcy likelihood when complemented by key firm-level contextual factors.

2.2 Firm characteristics and performance

Several scholars contend that firm performance outcomes of service provisions are contingent on the firm's context (e.g. Neu and Brown, 2005; Tuli et al., 2007; Ulaga and Reinartz, 2011; Gebauer et al., 2012), and empirical studies are beginning to confirm the moderating effects of firm characteristics. For example, with regard to the quality of customer interaction, Kohtamäki et al. (2013a) explore how a firm's relational capital moderates the effect of offering R&D services on the firm's profit performance in a customer relationship. As further firm-level factors, situated managerial attention (Gebauer, 2009), network capabilities (Kohtamäki et al., 2013b), availability of slack resources (Fang et al., 2008), marketing intensity (Josephson et al., 2016) and firm's market share (Fang et al., 2008) have been explored. All but marketing intensity and market share are shown to positively interact with the service orientation of the business strategy to improve firm's financial performance. Level of R&D activity also positively moderates the impact of service

focus on level of company returns (Eggert et al., 2014b), while negatively moderating the increase in firm risk (Josephson et al., 2016). Other studies of service performance go on to investigate the differential interactions of firm-level variables with heterogeneous service categories. Eggert et al. (2011) provide empirical evidence that a firm's product innovation activity has different effects on the service-performance link for product-oriented and customer-oriented services. Similarly, Antioco et al. (2008) demonstrate that use of service technology and cross-functional communication positively moderate the performance outcome of some service offerings but not of others.

Against this background, we draw on portfolio theory (PT) (Markowitz, 1959; Cardozo and Smith, 1983; Rabino and Wright, 1984; Leong and Lim, 1991) to further explore the effects of broader service offerings on company performance when complemented by appropriate firm characteristics (as primary contextual factors). The PT conceptual lens is well suited to evaluate how and when service additions offer the prospect of an efficient and effective use of resources with attendant effects on a company's economic returns and financial viability.

Applied to the analysis of a firm's portfolio of products and services, PT identifies portfolio expansion as an opportunity to achieve scope economies in asset utilisation. If the capacities of a common set of organisational assets (tangible or intangible) can be pooled together and applied to multiple portfolio "items", i.e. shared, then increasing the commercial portfolio leads to improved utilisation of such organisational assets' capacity, more fully absorbing fixed costs (Jacobs and Swink, 2011; Byers et al., 2015). In addition, PT suggests that portfolio expansions can reduce sales volume volatilities, thereby decreasing uncertainty and lowering firm risk. As varied offerings are combined in a firm's portfolio, associated sales volume (or demand) volatilities can be pooled so that the total risk, as measured by variability of aggregated cash flows, is reduced (Gup, 1977; Amit and Livnat, 1988).

However, achieving the asset pooling and risk pooling benefits indicated by PT entails that varied offerings within the portfolio respectively: (1) share productive assets and (2) do not produce

highly correlated cash flows. Indeed, portfolio offerings that require specific assets yield a cost of joint production that is not less than producing each item separately. Similarly, if cash flows produced by portfolio offerings are affected by the same factors, variations in cash flows will not offset, and counterbalance. Using this logic, our model assesses the interplay between breadth of services offered and firm characteristics in terms of *resource consistency* and *cash flow synergy*.

We structure our investigation as a comparison between unsuccessful companies and successful competitors. Comparative studies of low- and high-performing service-oriented companies have been previously presented in Gebauer (2008) and Gebauer et al. (2010). While we build on these studies, our approach is more fine-grained because we match companies with their direct competitors (rather than comparing two generic groups of high- and low-performing companies).

Moreover, in prior studies, firm performance has been measured using financial indicators such as profit, revenue or market value (Gebauer et al., 2012; Eggert et al., 2014a), or through perceptual measures (e.g. He and Lai, 2012; Eggert et al., 2014b); we instead identify unsuccessful companies as companies that declared bankruptcy. Bankruptcy filing provides a clear and objective criterion to differentiate unsuccessful from more successful companies in the longer term (Benedettini et al., 2015), capturing poor performance in the most extreme sense (Singhal and Zhu, 2013). Lastly, bankruptcy is an especially relevant performance measure given many manufacturing companies are increasingly adding services to their portfolios in the belief that they will enhance their chances of survival.

3. HYPOTHESES DEVELOPMENT

Resource consistency

Our concept of resource consistency entails the congruence, alignment and coherence of a service offering with the existing resource endowment of the firm. We focus specifically on the resource endowment conferred by the product business, which we consider with regard to the range of the firm's product-based capabilities.

The logic of resource consistency suggests making a distinction between two types of services: product-related and product-unrelated services (Fang et al., 2008; Josephson et al., 2016). Product-related services draw on similar competences and resources as the product business. They include, for example, maintenance, certification, installation and product upgrade. To offer these services, suppliers can take advantage of the capabilities conferred by existing product-based assets and intangible input such as technological knowhow. As product and service operations are pooled together and resources can be leveraged from the product to the service domain, spillover effects reduce the need for service-specific resources (Fang et al., 2008). Conversely to product-related services, product-unrelated services consist of services that have little overlap or commonality of knowledge and resources with the core product business. They include, for example, financial or logistic services. If such product-unrelated services are offered, the potential scope benefits with product operations are only those that can be realised from sharing some generic factors of production (Rumelt, 1982), like sale channels, customer relationships, or brand name. As a result, additional service-specific assets must be developed, regardless of the existing product-based capabilities.

Our first hypothesis postulates that there is a significant interaction between the breadth of product-related services offered by a company and the unrelated diversification of its product business. Specifically, we expect that the impact of a broader offering of product-related services on reducing bankruptcy likelihood is a function of the company's unrelated product diversification.

Strategic management researchers identify low and high levels of diversification as being "related" and "unrelated" diversification, respectively (e.g. Rumelt, 1974; Teece, 1982; Amit and Livnat, 1988; Robins and Wiersema, 2003). Related product diversification indicates the extent to which a firm's offering includes product businesses that share or draw on the same common core skills, strengths, or resources; it results from the involvement of the firm in a set of product industries that are similar and closely linked to each other. In contrast, unrelated product diversification occurs when a company expands its operations beyond existing resources and

capabilities in order to pursue market opportunities in product industries that have little commonality with the firm's existing businesses. The level of diversification a firm pursues determines the extent to which its resources are mainly shared or specialised (Teece, 1980). In particular, firms that pursue many unrelated product businesses require many different kinds of assets and resources.

Product-based resources possessed by the firm constrain the extent to which a firm's service offering can leverage existing resources. Thus, we assert that unrelated (high) product business diversification presents greater opportunity to generate scope economies by expanding the offering of product-related services. In such an environment, adding product-related services to the total offering should enable not only higher revenues but also lower incidence of fixed costs; hence, it should reduce the risk of financial distress. In contrast, if a firm's diversification is mostly of related product businesses (low diversification) then it is expected that the offering of product-related services will have significantly less opportunities to act as a source of resource synergy and knowledge spillovers so as to reduce the company's exposure to failure.

The case of Tetra Laval provides a useful example. The company operates in the unrelated industries of manufacturing of packaging for liquid food and manufacturing of packaging machinery. Package manufacturing is complemented by the product-related service of package design and development. Compared to a company that manufactures only packages, Tetra Laval can also leverage on its expertise in the manufacturing of packaging machinery to develop packaging that is optimised for both production and use. Similarly, the company can rely on its experience in package manufacturing to offer services related to the provision of packaging machinery, for example solutions including customised equipment, line optimisation, line audit, training, and maintenance.

Using this logic of complementarities among product-related service offerings and unrelated product diversification, we offer the following hypothesis:

H1a. Unrelated diversification of the product business moderates the effect of breadth of product-related services on a firm's bankruptcy likelihood; under high unrelated diversification of the product businesses, increased breadth of product-related services reduces a firm's bankruptcy likelihood.

Our second hypothesis concentrates on product-unrelated services. Since they have little consistency of knowledge and resources with product activities, these services cannot easily take advantage of spillovers and economies of scope from the product business. Because such initiatives are likely to be expensive, requiring idiosyncratic investments, organisational slack provides a unique complement to the offering of a wide number of product-unrelated services. Organisational slack indicates a cushion of excess resources in an organisation that can be used in a discretionary manner (Burgeois, 1981). It provides the means for innovation and change and, as such, it can enable flexibility in the development of strategy options and improvements in company performance (George, 2005). In particular, organisational slack can enable firms to implement the service-specific resources required to offer product-unrelated services, without constraining or affecting other projects and goals. As a consequence, we envisage that the availability of slack resources reduces the risk that an extended offering of product-unrelated services leads a firm to spread its resources too thinly over its various product and service activities, leading to ineffective products and services that do not meet customer expectations. By reducing such potential negative effects, slack resources facilitate the creation of healthy revenue and profit streams from product-unrelated services, thereby aiding in firm survival. Thus, the following hypothesis:

H1b. Slack resources moderate the effect of breadth of product-unrelated services on a firm's bankruptcy likelihood; under high levels of slack resources, increased breadth of product-unrelated services reduces a firm's bankruptcy likelihood.

Cash flow synergy

Cash flow synergy involves the ability of service offerings to act jointly with product sales in a way that produces a benefit for total sale revenues. Based on the notion of cash flow synergy, we draw a distinction between product-independent services and product-dependent services, where *dependency* refers to associations between product and service sales. Product-independent services deliver a source of revenue that is imperfectly or negatively correlated with product sales. As a consequence, product-independent service offerings can offset and compensate for shifts in product demand, so as to stabilise total sales revenues through complementary demand patterns and variations. For instance, maintenance services provided for industrial equipment deliver prospective returns that tend to be counter-cyclical to product sales (Wise and Baumgatner, 1999; Gebauer et al., 2011); in particular, higher service sales can balance the effects of declining product demand in times of economic downturn (Oliva and Kallenberg, 2003; Brax, 2005), when customers tend to keep their equipment in operation for longer. In contrast, product-dependent services are closely connected to sales of new product units, and therefore product-dependent service sales exhibit high positive correlation with revenues from product sales. Examples of these services are financing, distribution, installation and implementation. Though these services are not necessarily *related* to products (e.g., financing requires product-unrelated technology and resources – see Appendix for examples of product-dependent services that are product-related or product-unrelated), sales of product-dependent services are strongly triggered by product sales. Consequently, product-dependent service offerings can create cash flow synergies by amplifying the effects of healthy product sales. For example, the provision of installation and implementation services by a manufacturer of air conditioning systems provides a parallel stream of revenues that builds upon and multiplies high levels of product sales. However, product-dependent service offerings are unlikely to compensate for downward shifts in product sales. If product sales are not successful, then offerings of product-independent services would be more valuable in stabilizing the overall revenues for the firm.

Our third hypothesis is concerned with the relative focus on product-dependent versus product-independent services in the firm's service offering. We assert that a service offering portfolio that focuses mainly on product-dependent services has greater chances to help firm survival when product sales are high, while a focus on product-independent services will aid survival when product sales are low. Because product sales generate demand for product-dependent services, a successful product business with high product sales magnifies the effect of a focus on product-dependent services on financial performance and ultimate firm survival. If product sales are poor, then the impact of product-dependent services on firm survival is insignificant or detrimental, as the firm will be struggling also with scarce service sales. On the other hand, a greater focus on product-independent services is likely to be more valuable for firm survival when product sales are low, as these service offer alternative sources of revenue. Accordingly, we propose the following hypothesis:

H2. Past product sales performance moderates the effect of service offering focus (product-dependent versus product-independent services) on a firm's bankruptcy likelihood; under high past product sales performance, product-dependent services focus reduces a firm's bankruptcy likelihood.

Figure 1 summarises our theoretical model and hypotheses.

--- Insert Figure 1 here ---

4. METHODOLOGY

4.1 Sample selection

We first gathered a sample of failed service-oriented manufacturing firms from the 'Public and major company' database of bankruptcydata.com. This database includes bankruptcy filings by all firms with at least one public security and $50 million in assets since 1986. We considered the over

2800 firms in this database that filed for Chapter 7 or 11[1] or otherwise declared bankruptcy until December 31, 2013. A preliminary screening was conducted by examining the company synopsis reports compiled by the bankruptcydata.com service, as these indicate the core industry of the firm and often include a brief description of its business. We dropped the firms that the synopsis information identified as service (i.e. non-manufacturing) firms. Consistent with the findings of previous research on organisational survival (Yang and Aldrich, 2012 - p.479), we also eliminated the firms that declared bankruptcy less than five years after foundation so as to avoid the well-known effects of liabilities of newness and smallness (Sheppard, 1994). For all other companies, we examined the relevant narratives in their 10-K form[2] (or 10-K405 or 10-KSB or 20-F, as appropriate) in order to determine if they had adopted a service strategy. 10-K narratives provide a comprehensive overview of a company business, and they reflect the focus of organisational strategy because they outline what upper management believes is important to stakeholders (Ditlevsen, 2012). Of relevance to the use of 10-Ks in this study is the work of Bowman (1984), who demonstrated the validity of annual report discussion as a source of information regarding firm activities[3]. Service proactive firms will typically provide evidence of service activities in their 10-K forms. Accordingly, if services are explicitly mentioned in 10-K forms, then they are likely to be relevant to corporate strategy. The use of 10-K forms also avoids retrospective biases inherent, for example, in interviews that attempt to elicit information from the past (Harris, 2001; Barr and Huff, 1997). Lastly, 10-Ks are produced by many companies and are relatively easy to obtain (Barr and Huff, 1997).

[1] Chapter 7 (liquidation) and Chapter 11 (reorganisation) are the two types of bankruptcy filing available to distressed companies. The Bankruptcy Code sets forth specific rules under which companies may use either Chapter 7 or Chapter 11.

[2] The 10-K form is a report that must be filed annually by all companies whose stock is publicly-traded on a US stock exchange. The report contains the company's financial statements and a significant amount of other financial and non-financial information. Prior to 2003, a substantial portion of 10-Ks were categorised as 10-K405. Small businesses and foreign companies whose securities and traded in the US file the 10-K form as 10-KSB and 20-F form, respectively.

[3] Business descriptions in 10-Ks are at least as complete as those in annual reports to shareholders (Glueck and Willis, 1979).

To determine if the companies had ventured into services from 10-K reports, we used qualitative content analysis. Content analysis is a methodological technique that enables researchers to systematically and scientifically evaluate descriptive content in textual documents (Tangpong, 2011; Krippendorff, 2013). Although rarely used in marketing and operations management, this is a firmly established method in various fields of research and is probably the most prevalent approach to the analysis of communication material (Bryman, 2004). Especially in social and environmental accounting research, it has also been extensively used on annual reports (see, for example, Deegan and Gordon, 1996). *Tangpong* (2011) states that 'researchers interested in macro-level topics, such as operations strategy and strategy-operations alignment, can use content analysis to examine relevant data available in companies' 10-K reports'. The provision of services by a manufacturing firm would certainly fit that concept of macro-level topic.

In content analysis, text is coded according to a predefined set of themes or categories that illustrate the range of meanings of the topic of interest. For the purpose of this study, we developed a list of the services that manufacturing firms have integrated into their offerings. We based the list on the servitization literature (e.g. Antioco et al., 2008; Neely, 2008; Kohtamäki et al., 2013b; Rabetino et al., 2015) and accounts from industry managers. We then converted the list into 13 mutually exclusive service categories (see the Appendix) for use in content analysis. The conversion process followed an emergent approach involving a preliminary examination of the latest 10-K form of 30 leading service-oriented manufacturers from different industries (Semler, 2001). The service categories were developed with the specific intent of ensuring that they were broad enough to consider that different firms might describe service activities with different levels of detail in 10-K reports. As can be seen in the Appendix, the definition of the coding categories also comprised examples of specific services that fall in each category and that might be found in firms' reports. Notably, our coding categories confirm and extend the topology of manufacturers' services developed by Neely (2008) for use on database business descriptions. Qualitative content analysis pays attention to existence vs. not existence of information that relates to the selected

content categories, rather than the frequency of occurrence of such information (Zhang and Wildenmuth, 2009). Accordingly, we identified a company to be active in services if it reported the offering of one or more of the 13 service categories in its business description or segment description (Item1 and 'Operating Segments' note to Item 8, respectively) in the relevant 10-K form. To be included in the study sample, the bankruptcies must have also reported the offering of manufactured products.

The analysis was performed on the 10-K form (or 10-K405 or 10-KSB or 20-F) that the companies filed three years prior to bankruptcy (i.e. in year t-3[4]). The forms were gathered from 'Capital IQ' and 'Edgar' databases. The three-year lag was introduced to mitigate the effect of the potential 'endogeneity' of the diversification decision, as outlined by Singhal and Zhu (2013 - p.1481). In essence, distressed companies may choose to diversify into services in an attempt to escape bankruptcy failure or, on the contrary, they may decide to shut down the service business so that to concentrate on their traditional manufacturing core. Considering firm activities before, rather than at the time of, the bankruptcy filing helps control for this possibility. After excluding firms that did not meet sampling criteria or for which relevant reports were unavailable, a sample of 164 bankruptcies of service-oriented manufacturers remained.

In the next step of the research design, we developed a set of matched survivors for each bankrupt firm. A comprehensive list of potential matches was obtained by scanning the competitors that the bankrupt firm mentioned in its year t-3 report[5] and the list of competitors suggested by Capital IQ[6]. Matched survivors had to meet two criteria: 1) it competed with the bankrupt firm (offered competing products), and 2) it offered at least one of the 13 categories of services in the Appendix. Again, we drew information for matched survivors for the year t-3 from 10-K forms (or

[4] For example, if a company declared bankruptcy in 2010, we looked at the 10-K form that the company filed in 2007.

[5] Although there is no legal requirement, point c.x of Item 101 of S-K regulation suggests that firms disclose the names of their main competitors in their narrative description of business.

[6] We examined various other databases offering competitor information, including Mergent Online, Hoovers, Factiva, Thomson One Banker and Bloomberg. However, these databases either do not include firms that are currently inactive (which is often the case of firms that declared bankruptcy) or identify competitors based on only industry membership and location (returning a very high number of hits). On the contrary, because it uses SEC filings, press releases and other public documents to identify competitors, Capital IQ indicates fewer and more likely relevant competitors.

equivalents) accessed from Capital IQ or Edgar. Matching competitors must not have filed for bankruptcy either before or after year t-3, as we sought to ensure that survivors were not in danger of failure. Lastly, we limited the survivor sample to a maximum of five matched competitors for each bankrupt firm. This upper limit was consistent with Hosmer et al. (2013, p. 243) reporting that the most common matched sample designs include one to five matches for each case. Moreover, as will become clear in section 5, the technique used to analyse the data treated each bankrupt firm and its matching competitors as a separate stratum. In such a circumstance, the number of matches need not to be constant across strata (Hosmer et al., p. 243).

We conducted the matching process by first examining the competitors mentioned in the year t-3 report of each firm. Then, we examined the competitors suggested by Capital IQ, which names competitors identified by the company, by a competitor company, or by third parties in public documents such as SEC filings or press releases. Using these two sources, we reviewed competitor data starting at year t-3 and going backward until five companies that met the selection criteria were identified, or until the list of potential competitors was exhausted. Although each list of potential matches usually consisted of from several tens to over one hundred competing firms, the search yielded no suitable matching survivors for 84 bankrupt firms. For the remaining 80 bankruptcies, we found a total of 223 matching survivors. As a result of the sampling approach (use of 10-K forms in particular), most of the sample companies (275 of 303) were based in the US. The sample companies covered a wide range of manufacturing industries, with electronic and electrical equipment (58 companies), industrial machinery (43 companies), and transportation equipment (28 companies) being the most common ones.

Table 1 provides the distribution of bankruptcies by year, along with numbers of matched survivors. Panel A shows that the bankruptcies were spread over 18 years from 1996 to 2013. The distribution of the bankruptcies has peaks corresponding to the recession periods of the early and late 2000s, and is relatively uniform elsewhere. Panel B presents the survivor sample. Twenty-seven point five percent (22 firms) of the bankrupt firms had one matching survivor, and the

remaining 72.5 % (58 firms) had more than one match. We were able to identify five matching competitors for twenty-five percent (20) of the bankrupts. In cases where more than five matches were available, our matching procedure selected competitors of the bankrupt firm in year t-3 or in the closest subsequent year.

The objective of this sampling approach was to reduce the effects of differences in firms' business and environmental conditions. Matched sample design is suggested as a practical and effective way to control for potential confounding factors in observational studies (Rubin, 2006). A long history of employing research designs that involve matched samples in failure research, accounting research, political science, medicine and even epidemiology research (e.g. Sheppard, 1994; Morgan and Harding, 2006; Stuart, 2010) also supports the use of such sampling technique. While we matched firms by product portfolio, we also employed statistical control variables directly in the model (Rubin, 2006; Sheppard, 1994) to account for other potentially confounding factors (further discussion follows).

--- Insert Table 1 here ---

4.2 Measures

4.2.1 Unrelated diversification of the product business

We employed the unrelated component of the Entropy index (Jacquemin and Berry, 1979) as measure of unrelated diversification (BUSDIV). This measure is comparable to the widely used Herfindahl index (Jacquemin and Berry, 1979), but it better reflects the degree of diversity among various firm's businesses (Martin and Sayrak, 2003). Unrelated entropy is given by the weighted average of the shares of the firm's sales in each industry group (industry groups defined by two-digits SIC codes), the weights being the natural logarithms of the inverse of the industry groups' sale shares. Because our measure was focused on the product business, we only included SIC codes in the range 10-39 (Neely, 2008). Weighted average formulas using SIC codes and sales/assets data are common in financial research (see, e.g., Robins and Wiersema, 1995), and often preferred to

'strategic' measures of diversification (Wrigley/Rumelt's topology and similar schemes) (Martin and Sayrak, 2003). Treating t as the year of a firm's bankruptcy, we calculated the unrelated entropy for the firm and its matched survivors at year t-3.

4.2.2 Resource slack

We used retained earnings divided by total sales as an indicator of resource slack (SLACK). Retained earnings reflect cash reserves that are maintained by the company to be invested into areas where they can create growth opportunities. Therefore, the higher the level of retained earnings, the more flexibility the firm has in developing strategy options to pursue business opportunities. This high-discretion form of slack (George, 2005) captures the concept of 'available slack' (Cheng and Kesner, 1997), i.e. excess of uncommitted, immediately available resources. Several previous empirical studies have measured lagged slack, under the view that if organisational outcomes are to be affected by slack, then the time of that effect is not immediate but lagged (e.g. Greenley and Oktemgil, 1998). Although other lag structures may be reasonable, we computed the average retained earnings/sales between years t-7 and t-3. Average measures for multiple years increase measurement stability (Kohtamäki et al., 2013b) and have been used for slack by Miller and Leiblein (1996), Cheng and Kesner (1997), and Palmer and Wiseman (1999).

4.2.3 Past product sales performance

Given that manufacturing firms typically derive the majority of their profits from product sales, the market success of a company's product offering is strongly reflected by its past profit performance. Indeed, profitability measures are prominent firm financial performance indicators of long-term survival (Ramachandran and Kakani, 2005). Accordingly, we measured past product sales performance (PASTPERF) via a firm's return on assets (ROA) at year t-3. ROA is also highly correlated with other profitability measures (Hambrick and D'Aveni, 1988) and is a common

financial performance indicator in studies of bankruptcy (e.g. Hambrick and D'Aveni, 1988; Daily, 1996).

4.2.4 Breadth of product-related and product-unrelated services

To measure the breadth of product-related (BRRELSERV) and product-unrelated (BRUNRELSERV) service offerings, we counted the numbers of service categories offered, of two different types; this approach is consistent with foregoing research (e.g. Homburg et al., 2003; Antioco et al., 2008; Gebauer et al., 2010; Eggert et al., 2011; Oliva et al., 2012; Eggert et al., 2014a). Services in seven categories were coded as being product-related (see Appendix); examples include maintenance and support, design and development, and system integration services. The remaining six service categories were coded as product-unrelated services, including categories such as 'logistic', 'procurement' and 'financial' services (see Appendix).

4.2.5 Focus on product-dependent services

The coding of service offerings at year t-3 was again employed to assess the importance of product-dependent services in the firms' portfolio strategies (DEPSERVFOC). We identified six categories of product-dependent services, encompassing 'financial' and 'installation and implementation' services (see the Appendix for the complete list), and examined whether a firm offered services within these categories. We calculated the share (number) of product-dependent services over total services and dichotomised the resulting continuous variable into a dummy variable. In particular, we considered a firm's service strategy to be focused on product-dependent services when the share (number) of product-dependent services over total services was 0.5 or greater. In contrast, we assumed that values of the share of product-dependent over total services below 0.5 were reflective of a firm's focus on product-independent services.

4.2.6 Control variables

We included control variables related to both the firm and the industry. Although the sampling procedure avoided potential effects of liabilities of newness and smallness, we controlled directly for firm size (SIZE) (natural logarithm of sales) and age (AGE) (years since foundation). Based on Flagg et al. (1991) and Hambrick and D'Aveni (1988), we introduced further controls for firm liquidity (LIQ) (measured by the current ratio) and leverage (LEV) (measured by the total assets to total liabilities ratio). All firm-level control variables were computed at year t-3. At industry level, we controlled for industry profitability, munificence, turbulence and power. We used the average ROA of the firms in the industry at year t-3 to assess industry profitability (INDPROF) and followed the operationalisation of the remaining three constructs proposed by Boyd (1990). Munificence (INDMUN) was the slope of the regression of industry sales for years from t-5 to t-1, divided by the mean value of industry sales for those years. For turbulence (INDTURB), we measured the standard error of the regression used to calculate munificence and divided it by the mean of industry sales. Finally, industry power (INDPOW) was measured through the three-firm concentration ratio at year t-3. Categorisation of industry was based on the four-digit primary SIC code.

4.2.7 Data collection

We used multiple data sources. The data for the calculation of product business diversification were gathered from the Compustat Historical Segments and Capital IQ databases. The Compustat Fundamental Annuals and Capital IQ databases were used to estimate resource slack, product sales performance and the control variables for firm size, age, liquidity and leverage. We also examined 10-K reports (or equivalent) for firm-level data that was not captured by Compustat or Capital IQ. Finally, the data for industry-level controls were obtained from Compustat.

Table 2 reports descriptive statistics for the bankrupt firms and the matched survivors. Group t-Tests indicate that the bankrupts were significantly smaller ($t=6.9705$; $p<0.01$) and younger ($t=2.9311$; $p<0.01$) than the survivors. They also had less leverage ($t=2.1213$; $p<0.05$), less

diversified product businesses (t=4.4916; p<0.01), lower slack resources (t=4.0513; p<0.01) and worse past performance (t=6.2773; p<0.01). Finally, on average they offered less product-unrelated services (t=2.5511; p<0.05).

--- Insert Table 2 here ---

5. DATA ANALYSIS AND RESULTS

5.1 Model Development

To test our research hypotheses, we estimated a conditional multivariable logistic regression (LOGIT) model (Hosmer et al., 2013; Kleinbaum and Klein, 2010), and employed the STATA 12 software programme to perform statistical computations. The regression modelled the probability that a firm will declare bankruptcy (coded "1") or not (coded "0"). LOGIT analysis fits well with the use of non-random samples (Balcaen and Ooghe, 2006) and does not require strict adherence to the assumptions (multivariate normality, homoscedasticity) of other statistical methods for modelling a dichotomous outcome in a regression context (e.g. discriminant analysis) (Hair et al., 2007; Tinsey and Brown, 2000). In addition, in matched case-controls designs, conditional LOGIT allows specifying matched sets and avoids biased parameter estimates that would arise from choosing other (unconditional) candidate methods (Kleinbaum and Klein, 2010). Recent research indicates logistic regression as a superior statistical method for predicting bankruptcy (Balcaen and Ooghe, 2006).

The estimation of logistic regression models has proved to be extremely sensitive to outlier observations (Bianco and Martinez, 2009). In line with the protocol suggested by Hutcheson and Sofroniou (1999), we searched for cases (sample firms) with z scores in excess of ± 4.00 on at least one independent variable. These firms (6 bankrupts and 6 non-bankrupts) were deemed outliers and were accordingly removed from the sample. The elimination of the 6 bankrupts required us to also remove the corresponding non-bankrupt matches, which were a further 18 firms. As a consequence, our final sample included 74 bankrupt manufacturers and 199 non-bankrupt matched competitors.

Although eventually the companies eliminated represented almost 10% (30 over 303) of the total companies in the sample, eliminating outliers is a highly recommended procedure to avoid that extreme data points can distort the results of the analysis and lead to incorrect inferences (see, e.g. Kleinbaum and Klein, 2010; Sarkar et al., 2011). Moreover, 1-10% outliers is a typical figure for routine datasets (Hampel et al., 1986). Because logistic models are also very sensitive to multicollinearity, we decided to mean-centre the variables used in interaction terms before the analysis. Moreover, best practices in the use of logistic regression analysis prescribe seeking the most parsimonious model that still accurately reflects the patterns existing in the data (e.g. Hosmer et al., 2013). The rationale for minimising the number of variables in the model is to avoid that the model produces numerically unstable estimates because it is "overfit" (Harrell et al., 1996). Hosmer et al. (1999) propose a method to purposefully select variables for a logistic model. The purposeful selection method starts with applying a univariable analysis of each independent variable to identify variables that should be included in an initial multivariable model. Variables are then eliminated in a stepwise manner from the multivariable model based on significance or on the change-in-estimate criterion (Miettenen and Cook, 1981). Subsequently, variables that were excluded by the univariate analyses are one by one re-entered in the model and evaluated for significance. Once the direct effects model is obtained in this way, interaction terms are introduced separately to the direct effects model. Finally, the interactions that were not excluded at the previous step are added together to the direct effects model. Their statistical significance indicates moderation and defines the final model. Based on Bursac et al. (2008), the purposeful selection method provides more stable and generalizable estimates than traditional stepwise selection. Therefore, we followed this method to develop our own model.

The initial multivariable model should contain all independent variables (including controls) having a significant univariable test at the 0.20 or 0.25 level, along with any other variables judged to be of critical importance. Table 3 shows the results of fitting a univariable conditional logistic regression model for each independent variable. Three variables, INDMUN, INDTURB, INDPOW,

were not significant at the required level with p = 0.870, 0.836, 0.941 respectively. Given that they were not critical to test our hypotheses (they were introduced as potential controls), these variables were deselected from the initial multivariable conditional logistic regression model (Model 0). We next used p-values from the Wald test of the individual coefficients to identify variables that might be deleted from Model 0. Six variables did not contribute at traditional level of significance (0.05): AGE, LIQUIDITY, INDPROF, BRRELSERV, BRUNRELSERV, DEPSERVFOC (Table 4). While the three service-related variables ought to be in the model because they were involved with the interactions proposed in our hypotheses (i.e. they were critical to test the hypotheses), AGE, LIQUIDITY and INDPROF were control variables and hence could be removed (Model 1). Following the fitting of the reduced model (Model 1), we assessed whether the removal of the variables produced an important change (>20%) in the coefficient of the variables remaining in the model (change in estimate criterion). Table 4 shows that the coefficient of BRRELSERV changed by 45% (from -0.1073 to -0.0582) from Model 0 to Model 1. Therefore we re-entered INDPROF (the excluded variable with smallest p-value) as suspected confounder (Model 2). Model 2 indeed satisfies the change-in-estimate criterion (Miettenen and Cook, 1981). To double check that no important variables were excluded during the initial univariable analyses, we added back each deselected variable (INDMUN, INDTURB, INDPOW) in turn to Model 2. None of the coefficients became significant by Wald statistic p-value (results not shown). Model 2 is therefore the direct effects model, including the relevant first-order paths linking independent variables with the dependent variable. As such, Model 2 includes the influential controls and the variables that account for the direct effects in our hypotheses. In Models 3 to 5, we individually added to Model 2 the interactions proposed in our hypotheses: between BRRELSERV and BUSDIV (Model 3) (H1), between BRUNRELSERV and SLACK (Model 4) (H2), and between DEPSERVFOC and PASTPERF (Model 5) (H3). Two of the three interactions were significant at the recommended 0.1 level: BRRELSERV x BUSDIV and BRUNRELSERV x SLACK (see table 4). Both interactions remained significant ($p<0.05$) when added together to the direct effects (Model 6). The two degrees

of freedom L-R test of Model 6 versus the direct effects model (Model 2) further demonstrates that the two interactions add significant explanatory power over the direct effects (G^7=11.6828, p=0.0029) (Hosmer et al., 2013). Finally, we tested the model with all three hypothesised interactions included simultaneously (Model 7). The BRRELSERV x BUSDIV and BRUNRELSERV x SLACK interactions remained significant ($p<0.05$); the DEPSERVFOC x PASTPERF remained non-significant ($p>0.1$). The same L-R test performed above was used to compare Model 7 with a model in which the two significant interaction terms were dropped, that is Model 5. The results (G=10.9070, p=0.0042) reaffirm that the BRRELSERV x BUSDIV and BRUNRELSERV x SLACK interaction effects make a statistically significantly contribution to the model fit.

--- Insert Table 3 here ---

--- Insert Table 4 here ---

With 273 observations (74 bankrupts and 199 non-bankrupts) and 12 covariates, Model 7 meets the sample size requirement of at least five observations for the rarer outcome per covariate included in the model (Stoke et al., 2000; p.213). As reported in table 4, all the models have statistically significant chi-square coefficients (p=0.0000). Table 4 also presents values for the Nagelkerke Pseudo R-square fit statistics, which reaffirm that lack of fit is not a concern with any of the models. As expectable, the Pseudo R-square value improves with the inclusion of interaction terms. Based on Dixon and Verma (2013) and Rao et al. (2014), we used an F-test (Cohen, 1968) to assess if this R-square increase was statistically significant. In particular, the F-Test results (table 5) regarding the difference in the Pseudo R-square values between Model 6 and Model 2 (F=34.99, $p<0.001$) and between Model 7 and Model 5 (F=32.87, $p<0.001$) demonstrate a statistically significant improvement by the addition of the two significant interaction terms in explaining our dependent variable variance, providing additional support to the L-R Test performed above.

--- Insert Table 5 here ---

[7] G = (-2 Log-Likelihood of the model without the variable(s)) - (-2 Log-Likelihood of the model with the variable(s))

In addition to goodness-of-fit, we evaluated the predictive ability of the models (please refer to Table 4). An examination of the observations correctly classified by Model 7 indicates an overall hit ratio of 89.74% under the typical cut-off value of 0.5. We followed Wooldridge (2009)'s recommendation and also computed this percentage for each outcome. 75.67% of the bankrupted and 94.97% of the non-bankrupted firms were correctly classified, indicating that the model is well capable of detecting both outcomes. We also recomputed the model reintroducing the 12 cases of outliers and the 18 corresponding non-bankrupt matches. The overall hit ratio dropped by 5.26% to 84.48%, confirming (recommended minimum difference is 2% – see, e.g., Dida et al., 2014) that the removal of outliers was appropriate in our model. We also conducted several tests (not reported) to ascertain that the model results were robust against the potential selection of different non-bankrupt matches.

Finally, we tested the data for multicollinearity. The highest correlation between independent variables in Models 2 to 7 is -0.6121 (table 4), between DEPSERVFOC and BRRELSERV. Despite this relatively high correlation, the values of the Variance Inflation Factor (VIF), also shown in table 6, exclude multicollinearity problems. Indeed, the VIF value remains below 2.10 for all independent variables (threshold: 4). Table 6 also presents the mean and standard deviation of the independent variables in Models 2 to 7.

--- Insert Table 6 here ---

5.2 Hypotheses testing

The estimation of Model 7 (Table 4) provides the empirical evidence to test our hypotheses. In support of our overall premise, we find that the direct effects of more extensive offerings of either product-related services (BRRELSERV) or product-unrelated services (BRUNRELSERV) are not significant ($p>0.1$). Although not specifically relevant to our hypotheses, it is worth mentioning that our data reveal a significant direct effect of product business diversification (BUSDIV) on bankruptcy likelihood ($b=-2.6483$, $p<0.01$); thus our results support bankruptcy research, arguing

that bankruptcy becomes less likely when firms operate in multiple industries, even when these are unrelated. This is usually referred to as 'coinsurance effect' (e.g. Singhal and Zhu, 2013). Although there is little operational synergy to be gained, diversification into unrelated industries is argued to reduce the variance of returns, yielding an increase in the firm's debt capacity and thus a lower risk of bankruptcy (Lewellen, 1971). Similarly, we find that the availability of slack resources (SLACK) tends to lessen a firm's bankruptcy likelihood ($b=-2.8238$, $p<0.01$), in line with the studies by Hambrick and D'Aveni (1988), Sheppard (1994) and Azadegan et al. (2013). According to theory and research on demise (bankruptcy prediction models in particular) (e.g. Altman, 1968), we also find that past performance (PASTPERF) is a significant attribute in categorising failed from non-failed companies ($b=-0.0503$, $p<0.05$).

In terms of our hypotheses, the interaction between product business diversification and breadth of product-related services (BRRELSERV) is negative and significant ($b=-1.6566$, $p<0.05$); product business diversification negatively moderates the relationship between breadth of product-related services and bankruptcy likelihood, in support of H1a. In figure 2, panel A, we illustrate exemplar relationships between breadth of product-related services and bankruptcy likelihood for firms with low (mean – 1.5 SD) and high (mean + 1.5 SD) product business diversification.
The results in table 4 further reveal that resource slack (SLACK) negatively moderates the relationship between breadth of product-unrelated services (BRUNRELSERV) and bankruptcy likelihood ($b=-1.7238$, $p<0.05$). Thus, H1b is supported. The relationship between resource slack and bankruptcy likelihood for firms with low and high (mean ± 1.5 SD) breadth of product-unrelated services appears in figure 2, panel B.

However, we do not find support for H2. Although our findings indicate a non-significant direct effect of focus on product-dependent services (DEPSERVFOC) on bankruptcy likelihood ($p>0.1$), the moderation test (Model 5 and Model 7) reveals that also the interaction between past product sales performance (PASTPERF) and focus on product-dependent services fails to achieve statistical significance.

Previous research indicates that, in order to fully analyse interactions, it is important to test the significance of their marginal effects (Brambor et al., 2006). The preceding L-R Test and F-Test comparing Model 6 to Model 2 and Model 7 to Model 5 demonstrate that the added contribution of the interaction terms proposed in H1 and H2 provides an improvement in model fit and makes as well a significant contribution in explaining the dependent variable variance.

--- Insert Figure 2 here ---

6. DISCUSSION

Many manufacturing companies are extending their service offerings to protect and enhance their chances of survival (Neely, 2008; Fang et al., 2008; Cusumano et al., 2015), with conceptual research in both marketing and operations management suggesting this as a wise strategy. Offering more services yields several advantages, but also entails a business expansion that can weaken the financial and market position of the firm, affecting its performance and survival. Hence, this study set out to investigate the effect of more extensive service offerings on company bankruptcy likelihood.

Results support our expectation that offering more services does not consistently increase a firm's chances of survival. Extensive offerings of neither product-related or product-unrelated services are consistently associated with bankruptcy likelihood. We conclude that, despite many potential benefits can accrue from an extended service offering, the company also needs to deal with the attendant risk of resource shortage, loss of focus, complexity of coordination and investor uncertainty in potential future earnings.

However, according to our results, additional services can lead to increased survival chances when properly complemented by firm-level contextual factors. Using portfolio theory as our conceptual lens, we investigate how *resource consistency* and *cash flow synergy* between service extensions and firm context affect bankruptcy likelihood.

Regarding resource consistency, we find that product business diversification moderates the impact of offering more product-related services on bankruptcy likelihood, reducing bankruptcy likelihood. We ascribe this effect to the broader range of resources that must be maintained by a firm that offers a diversified product business; such resources offer a broader range of knowledge and competence that can be applied (leveraged) in making service line extensions. A diversified product business complements the offering of product-related services, enabling greater resource spillovers and scope economies, thus helping firm survival. One might argue that because resources needed for product-related services are similar to resources needed for product businesses, we should also observe a direct effect of these service offerings on bankruptcy likelihood. Our results do not provide support for this effect. It may be that product-related service offerings alone are not differentiated enough to enable scope economies (resource absorption and knowledge spillovers), especially with the firm competes in a narrow range of product offerings. We also find that the relationship between product-unrelated services and bankruptcy likelihood benefits from greater resource slack. This demonstrates that advantages from an extended offering of product-unrelated services are available to those companies that can rely on sufficient slack resources to support required resource investments in service specific assets without increasing the firm's financial exposure, or affecting other projects and goals. In particular, firms lacking slack resources might expand their service offerings at the expense of their product investments. Importantly, recent research demonstrates that such strategies do not pay-off (e.g. Eggert et al., 2015).

Regarding cash flow synergy, the hypothesised interaction between focus on product-dependent services and past performance did not achieve significance in our model. A potential explanation for this finding concerns the measurement of the service offering variable. In order to reduce multicollinearity with other service offering variables, we constructed a dichotomous variable as an indicator of focus on product-dependent services. This approach reduces the information provided by the measure, thus potentially lessening the ability to detect significant associations. As a post hoc examination of this effect, we ran a separate analysis using a continuous proportion-based

measure of product-dependent service offerings, while dropping the other service offering variables to limit multicollinearity. The interaction of product-dependent service offerings and past product sales performance remained non-significant. Another possible explanation involves the measurement of past product sales performance. Given the unavailability of actual product unit sales data, we chose ROA as a proxy indicator of product sales performance. In another post hoc analysis, we substituted asset turnover (sales / assets) as the proxy measure of product sales performance, with the same non-significant result. Setting aside measurement issues, another possible explanation for the non-significant effect of product sales performance on the relationship between focus on product-related services and bankruptcy likelihood is that the sale of products is a necessary but insufficient condition to sell product-dependent services. Firms may run very successful product businesses, yet still struggle to sell product-dependent services because, for example, they lack adequate service marketing abilities or infrastructure. Further research could investigate this issue and clarify whether product sales can complement focus on product-dependent services to reduce bankruptcy likelihood. Visnjic and Van Loy (2013) showed that, in the case of a compressor manufacturer, greater product sales generated greater service sales, yet the nature of the services offered was not explicitly considered in that study.

6.1 Theoretical contribution

Previous empirical research on the performance consequences of service provision has focused on a small set of accounting- or market-based measures of business performance (Gebauer et al., 2012; Eggert et al., 2014a). By examining the impacts of different types of service offerings on firm survival, we contribute to a more holistic understanding of the role of services to manufacturing companies' results, responding to the call of Gebauer et al. (2011, p.1278) for use of a more comprehensive perspective on business performance in this research field. Although financial indicators will reflect if a company survives or fails, no previous research has addressed bankruptcy likelihood as a direct outcome variable. Importantly, we show how a key strategic dimension, the

breadth the offering of various services, affects bankruptcy likelihood. In doing so, we challenge the notion from conceptual literature that additional services are always good for manufacturing companies, and extend prior empirical studies that highlight the important roles of contextual contingencies. We show that the breadth of the service offering differs from other measures of service provision, such as the share of service revenue to total revenue, the amount of service sales, or the activeness with which services are offered to customers, as it does not exert a direct impact on firm performance. This notion contributes to theory by underscoring that service provision involves multiple dimensions, which differ in their meaning and consequences and thus should not be conceptually unified.

In addition, we propose a novel theoretical lens for investigating manufacturers' service offerings. Viewing service offerings through portfolio theory improves our ability to conceptualise key mechanisms underlying service extensions as well as expand the theoretical understanding of their performance consequences via effects on resource compatibilities and cash flow synergies. Furthermore, we contribute to a systematic and comprehensive understanding of service extensions by unveiling key firm contextual effects. We demonstrate the role of additional services to reducing bankruptcy factors when properly complemented by firm-level contextual factors.

Finally, from a methodological perspective, we propose conditional LOGIT for studies contrasting low- and high-performing service-oriented companies. As noted, conditional LOGIT provides advantages over other (unmatched) regression methods for binary outcomes, including unbiased parameter estimates in case-controls designs.

6.2 Managerial implications

Across industries, manufacturing companies strive to survive the pressure of difficult economic times by increasing their portfolio of ancillary services (Neely, 2008; Fang et al., 2008; Cusumano et al., 2015). Our study provides empirical evidence that this is not always an effective strategy. The finding that broader offerings of product-related or product-unrelated services fail to consistently

reduce bankruptcy likelihood warns managers that additional services are not a self-enforcing path to firm survival. Managers should not overestimate the value-creation potential of services and assume that additional services increase chances of firm survival under all circumstances.

Findings further suggest that managers should carefully consider their firm context, as this might provide the conditions for service additions to reduce bankruptcy exposure. Specifically, we demonstrate that a diversified product business provides an important complement to product-related services, enabling companies to increase their chances of survival by expanding their offering of such services. In turn, in conjunction with sufficient slack resources, additional product-unrelated services can lead to lower bankruptcy likelihood. Therefore, managers must strive for consistency between their service offering expansions (product-related or -unrelated) and their firms' existing product business diversification and resource slack.

Finally, we suggest that industrial companies carefully consider the purpose of their service offering expansions. This study focused on bankruptcy likelihood as performance outcome. If a company is willing to take the risk of default, also service offerings that do not meet our recommendations could pay-off.

7. LIMITATIONS

We conducted our study among public companies for which we could find the 10-K, 10-K405, 10-KSB or 20-F form, and thus most of the companies were US-based. In this way, we could ensure that our dataset contained no missing values (LOGIT requires complete case analysis) and we could also reliably use the Compustat database for industry-level data (Ali et al., 2009). We assume that our findings would transfer to Western European manufacturers, yet further validation in other national contexts would be valuable. Further research might also explore evidence from private equities, although recent statistics indicate that, at present, failure risk is significantly higher for large public companies than for small private ones (Danner, 2008). Moreover, limiting the sample to companies with 10-K, 10-K405, 10-KSB or 20-F forms led us to exclude 84 of 164 bankrupt

companies for which we could not find competitors with one of the above forms. We leave it to future research to examine broader samples.

We operationalized companies' breadth of product-related, product-unrelated and product-dependent services by counting the number of services they offered within each category. Although using the number of services is in line with our focus on the configuration of the service offering portfolio, including other measures of the *importance* of different services would provide a finer-grained assessment. Therefore, a natural extension of our work would be to investigate different dimensions of service offering strategy, including the emphasis placed by the firms on specific services (Homburg et al., 2003). For example, it could be interesting to investigate the effect on bankruptcy likelihood of the number of customers to which specific services are offered, or the role of the activeness with which they are offered, as both these dimensions have shown a link to firm financial performance in previous empirical research (e.g. Gebauer et al., 2010; Kohtamäki et al., 2013b). To the best of our knowledge, there is no public information or secondary source providing such data, so such an investigation would require primary data collection, an extremely difficult task for bankrupted companies.

We linked the service offering to bankruptcy likelihood, but we did not isolate the causal mechanisms (i.e. debt capacity, cash flows, sales, profits) through which this effect ensues. Therefore, additional research should try to capture the causal mechanisms embedded in the services-bankruptcy relationship and identify the relevant mediating variables.

The consistency of the results concerning our first two hypotheses with the theoretical underpinnings of our model corroborates the asset relatedness argument of portfolio theory in the case of service extensions. Yet future studies are needed to shed more light on the emergence of demand correlation effects. We focused on cash flow synergies generated by the ability of product-related service offerings to capitalise on high product sales, and product-independent service offerings to compensate for low product sales. While we investigate overall product sales as a moderator, our measurement model does not directly address product demand volatility. Future

researchers should investigate the role of product-independent services in compensating for volatility in product sales over time, especially in cases where such services, while independent of demand, nevertheless depend on the presence of an installed base of products (e.g. maintenance, renewal and upgrade, end-of-life services). Finally, we encourage additional research adopting the portfolio perspective. Portfolio research can still contribute a great deal to understanding the characteristics of different service expansions, and how product companies can better articulate their service offerings to support organisational success and survival.

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Figure 1 – Overview of the theoretical model

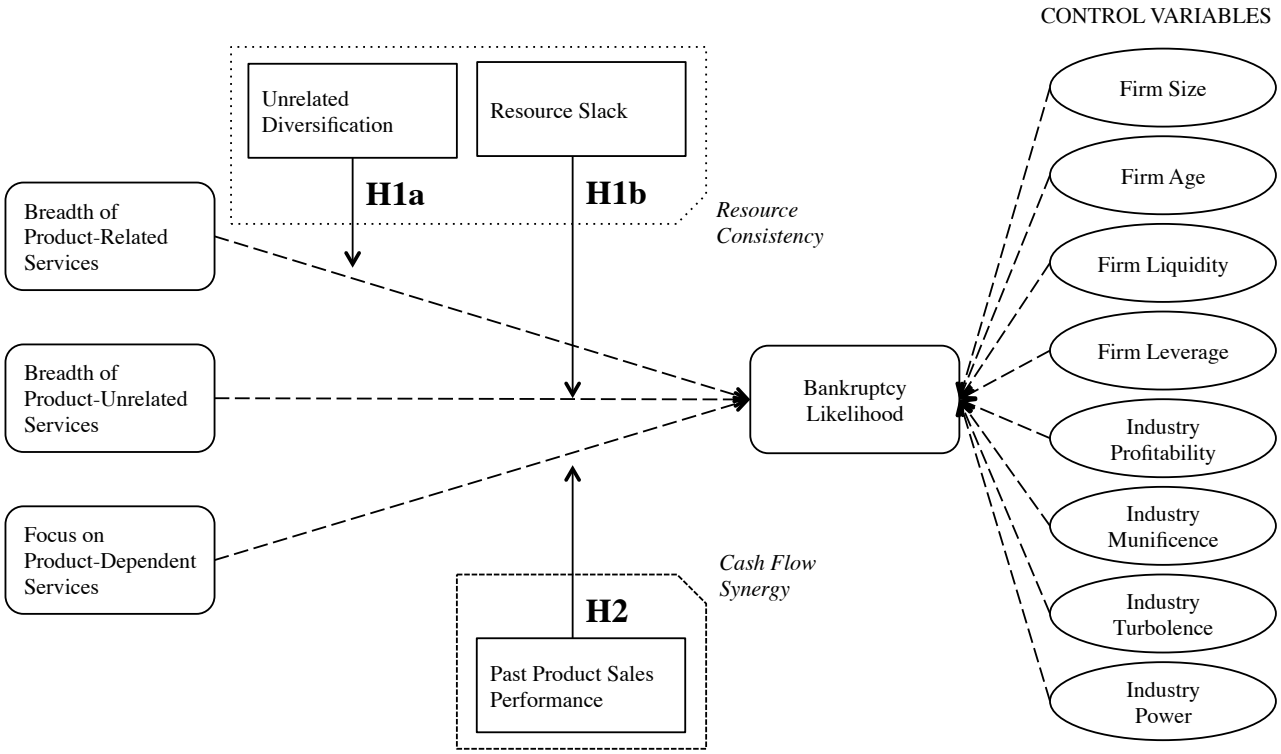


Table 1 – Distribution of bankrupt firms by bankruptcy year and number of matched survivors

Panel A: Bankruptcy year																			
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
N	1	0	3	5	5	13	7	10	5	4	3	2	6	10	2	1	1	2	80
%	1.25	0	3.75	6.25	6.25	16.25	8.75	12.5	6.25	5	3.75	2.5	7.5	12.5	2.5	1.25	1.25	2.5	100.00

Panel B: Number of matched survivors						
	1	2	3	4	5	Total
N	22	18	15	5	20	80
%	27.5	22.5	18.75	6.25	25.00	100.00

Table 2 – Descriptive statistics of the study variables

	Total Sample		Bankrupts		Matched Survivors		t-Test Value
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
SIZE	7.1185	0.1377	5.6285	0.2189	7.6530	0.1551	6.9705***
AGE	51.8910	2.3335	40.6125	4.6365	55.9372	2.6535	2.9311***
LIQ	2.2623	0.1115	1.9713	1.1847	2.3667	1.1359	1.5655
LEV	2.2343	0.1075	1.8557	0.2150	2.3702	0.1231	2.1213**
INDPROF	0.9835	0.0313	0.0451	0.0113	0.1174	0.0423	1.0156
INDMUN	0.0781	0.0068	0.0747	0.0124	0.0793	0.0081	0.2953
INDTURB	0.1867	0.0092	0.1845	0.0161	0.1876	0.0112	0.1458
INDPOW	67.7678	1.1949	69.4237	2.2286	67.1738	1.4139	0.8296
BUSDIV	0.2341	0.0202	0.0868	0.0240	0.2869	0.0252	4.4916***
SLACK	-0.1053	0.0792	-0.6283	0.2351	0.0822	0.0628	4.0513***
PASTPERF	-0.7393	1.0405	-11.0108	2.9500	2.9454	0.8115	6.2773***
BRRELSERV	1.7524	0.1030	1.5625	0.1855	1.8206	0.1231	1.1042
BRUNRELSERV	1.5016	0.0566	1.2625	0.1017	1.5874	0.0669	2.5511**
DEPSERVFOC	0.6633	0.0271	0.700	0.0515	0.6502	0.0320	0.8064

Group t-Test for difference of means; * p<0.1; ** p<0.05; *** p<0.01

Table 3 – Results of fitting univariable conditional logistic regression models

	Coeff.	Std. Err.	z	p > |z|		95%CI
SIZE	-0.4051	0.0853	-4.75	0.000	-0.5723	-0.2379
AGE	-0.0125	0.0039	-3.16	0.002	-0.0203	-0.0047
LIQ	-0.3041	0.1492	-2.04	0.042	-0.5965	-0.0116
LEV	-0.5699	0.1929	-2.95	0.003	-0.9481	-0.1917
INDPROF	-4.6542	2.5794	-1.80	0.071	-9.7098	0.4014
INDMUN	0.4339	2.6520	0.16	0.870	-4.7640	5.6318
INDTURB	0.4037	1.9523	0.21	0.836	-3.4228	4.2303
INDPOW	0.0007	0.0098	0.07	0.941	-0.0185	0.0199
BUSDIV [a]	-2.4643	0.6547	-3.76	0.000	-3.7476	-1.1811
SLACK [a]	-3.3708	0.6600	-5.11	0.000	-4.6645	-2.0772
PASTPERF [a]	-0.0860	0.0178	-4.81	0.000	-0.1211	-0.0510
BRRELSERV [a]	-0.3163	0.1552	-2.04	0.042	-0.6207	-0.0120
BRUNRELSERV [a]	-0.3577	0.1876	-1.91	0.057	-0.7255	0.0100
DEPSERVFOC [a]	0.4860	0.3773	1.29	0.198	-0.2535	1.2255

SIZE = Firm size, AGE = Firm age; LIQ = Firm Liquidity; LEV = Firm Leverage; INDPROF = Industry Profitability; INDMUN = Industry Munificence; INDTURB = Industry Turbulence; INDPOW = Industry Power; BUSDIV = Product Business Diversification; SLACK = Resource Slack; PASTPERF = Past Product Sales Performance; BRRELSERV = Breadth of Product-Related Services; BRUNRELSERV = Breadth of Product-Unrelated Services; DEPSERVFOC = Focus on Product Dependent Services

[a] Value of variable is mean-centred

Table 4 - Results of conditional logistic regression analysis

	Parameter estimation							
	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Controls								
SIZE	-0.2926***	-0.2771***	-0.2870***	-0.3781***	-0.3184***	-0.3066***	-0.4478***	-0.4544**
AGE	0.0004							
LIQ	-0.0345							
LEV	-0.5072**	-0.5270**	-0.5297**	-0.6238***	-0.5503***	-0.5560***	-0.6708***	-0.6839**
INDPROF	-2.7368		-2.5980	-1.9208	-3.1657	-2.8191	-2.1231	-2.5583
Main Variables								
BUSDIV [a]	-2.2411**	-2.1811**	-2.2370**	-2.1915**	-2.4183**	-2.5156**	-2.5081***	-2.6483**
SLACK [a]	-2.1250***	-2.2213***	-2.1270***	-2.4738***	-2.5757***	-1.9769***	-3.1113***	-2.8238**
PASTPERF [a]	-0.0409**	-0.0422**	-0.0411**	-0.0497**	-0.0412**	-0.0448**	-0.0531**	-0.0503**
BRRELSERV [a]	-0.1073	-0.0582	-0.0959	-0.1323	-0.0899	-0.1137	-0.1255	-0.1746
BRUNRELSERV [a]	0.1994	0.1713	0.1924	0.3507	0.2583	0.2386	0.5152	0.4832
DEPSERVFOC [a]	0.2515	0.2957	0.2690	0.0805	0.3612	0.0806	0.1180	-0.0439
Interactions								
BRRELSERV x BUSDIV				-1.4648**			-1.6469**	-1.6566**
BRUNRELSERV x SLACK					-1.5215*		-1.9309**	-1.7238**
DEPSERVFOC x PASTPERF						-0.0528		-0.0509
Number of obs.	273	273	273	273	273	273	273	273
-2 Log-Likelihood	89.2185	89.7169	89.2587	81.5766	86.4004	87.1586	77.5758	76.2516
Chi-square	90.42	89.92	90.38	98.06	93.24	92.48	102.06	103.39
d.f.(p-value)	11(.0000)	8(.0000)	9(.0000)	10(.0000)	10(.0000)	10(.0000)	11(.0000)	12(.0000)
Nagelkerke R-squared	0.774	0.771	0.773	0.805	0.786	0.782	0.821	0.826
Correctly predicted (%) [b]								
1 (Bankrupt)	66.21	66.21	66.21	71.61	70.26	66.21	79.72	75.67
0 (Non-Bankrupt)	94.47	94.47	94.97	93.97	94.47	94.97	94.47	94.97
Overall	86.81	86.81	87.17	87.91	87.91	87.17	90.47	89.74

Coefficients are reported; * p<0.1; **p<0.05; *** p<0.01

[a] Value of variable is mean-centred

[b] Cut-off value is 0.5

Table 5 – R-square change F-Test

	Model 2	Model 6	Model 5	Model 7
Nagelkerke R-square	0.773	0.821	0.782	0.826
df1		2 [a]		2 [b]
df2		261 [a]		260 [b]
F		34.99 [a]		32.87 [b]
p		< 0.001 [a]		< 0.001 [b]

[a] Comparing Model 6 to Model 2
[b] Comparing Model 7 to Model 5

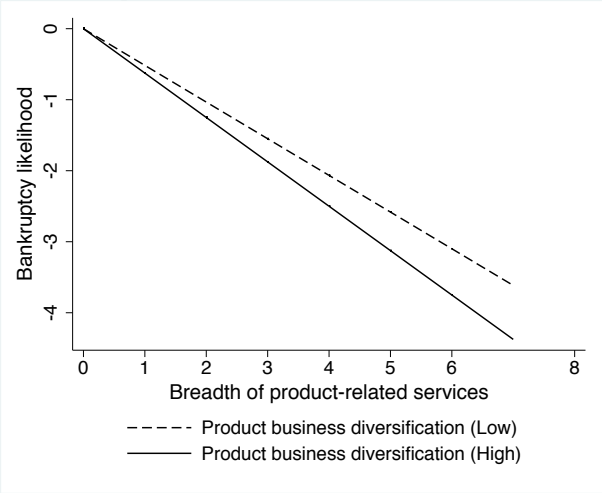
Table 6 – Correlations among independent variables in the final model

Variable	Mean	SD	VIF	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1. SIZE	7.039	0.151	1.41	1								
2. LEV	2.028	0.078	1.14	-0.228	1							
3. INDPROF	0.055	0.005	1.04	-0.087	0.031	1						
4. BUSDIV [a]	0.239	0.022	1.25	0.374	-0.113	-0.061	1					
5. SLACK [a]	0.043	0.039	1.27	0.271	0.054	0.068	0.191	1				
6. PASTPERF [a]	0.897	0.814	1.31	0.233	0.201	0.140	0.071	0.371	1			
7. BRRELSERV [a]	1.678	0.107	2.04	0.131	-0.097	-0.040	0.223	-0.081	-0.048	1		
8. BRUNRELSERV [a]	1.502	0.058	1.35	0.277	-0.067	-0.042	0.243	0.110	0.103	0.368	1	
9. DEPSERVFOC [a]	0.674	0.028	1.76	-0.041	0.093	0.016	-0.168	0.032	0.130	-0.612	-0.035	1

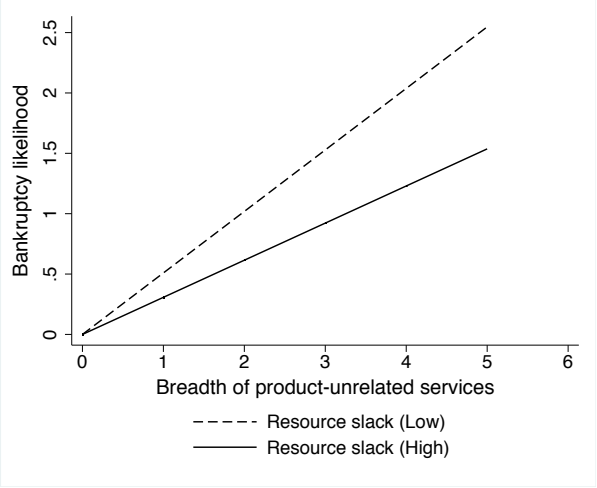
[a] Mean and SD refer to non-mean-centred values

Figure 2 – The moderating effects of product business diversification and resource slack

A: Effect of product business diversification



B: Effect of resource slack



Appendix – Definition of service categories

Service Category	Examples	Classification	Product-dependent
1. Trading and Distribution Services	Trading, import, brokerage, sale of used assets, distribution, retailing, direct selling	Unrelated	Yes
2. Logistic Services	Logistics, transportation, trucking, delivery, warehousing, inventory management, inventory planning, inventory control, packaging, shipping, order fulfilment, material handling	Unrelated	Yes
3. Procurement and Purchasing Services	Procurement, purchasing, vendor management services, sourcing services	Unrelated	Yes
4. Maintenance and support Services	Maintenance, repair, calibration, overhaul, spare parts, accessories, product related education/training, helpdesk, technical/operational support	Related	No
5. Certification and testing services	Certification, testing, inspection, auditing, quality assurance, commissioning	Related	No
6. Design and development services	Design, development, engineering, reengineering, prototyping, research services	Related	No
7. Consultancy Services	Consultancy, business advisory services, process optimization, professional education/training, problem analysis	Related	No
8. General outsourcing Services	Real estate management (operation/control/oversight), staffing services, surveillance, finance/HR/accounting/payroll services, IT outsourcing, fleet management, operating services, project management, planning, data collection, data processing	Unrelated	No
9. Financial Services	Financing, leasing, rental, insurance, extended warranty	Unrelated	Yes
10. Renewal and upgrade services	Product modification, conversion, enhancement, improvement, upgrade, renewal, refurbishing, reconditioning, retrofitting	Related	No
11. End-of-life services	Remanufacturing, recycling, collection, decommissioning, de-installation, dismantling, disposal	Unrelated	No
12. Installation and implementation services	Installation, implementation, configuration, integration of products into the customers' systems	Related	Yes
13. System integration	System integration, integrated solutions	Related	Yes