THE SERVITIZATION OF MANUFACTURING: AN ANALYSIS OF GLOBAL TRENDS

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ABSTRACT
Manufacturing in developed economies is under massive pressure. Swaths of industrial sectors have been lost to the emerging economies in the Middle and Far East. Commentators have advocated that manufacturing firms in developed economies should respond by moving up the value chain, seeking to innovate and create more sophisticated products and services so that they do not have to compete on the basis of cost alone (Porter and Ketels, 2003). While this strategy is proving increasingly popular with policy makers and academics there is limited empirical evidence exploring whether it is being adopted in practice. And if so, what the impact of this “servitization” of manufacturing might be. This paper seeks to fill a gap in the literature by presenting international empirical evidence on the range and extent of servitization. Data are drawn from the OSIRIS database on 10,078 firms incorporated in 23 different countries. The paper presents an initial analysis of these data which suggests that: [i] there are significant differences between countries in terms of the extent to which manufacturing has servitized – servitization is most prevalent in the US and least prevalent in China; [ii] there are twelve different forms of service offering that manufacturing firms adopt and [iii] there is evidence that larger firms, measured both in terms of number of employees and turnover, are more likely to servitize. Clearly, given the richness of the data set on which this paper is based, further work is both feasible and desirable.

Keywords: Manufacturing, service, servitization, product-service systems, value added, globalisation, international comparison

INTRODUCTION
How can manufacturing based in developed countries compete in today’s global economic system? Data suggest that US manufacturers have to cut the costs of their products by 30% to compete with Chinese producers (Wu et al., 2006). Add to this the market opportunities offered by emerging economies and the burgeoning regulation and legislation imposed on firms based in the European Union, and it is little surprise that offshoring is becoming a key strategy for manufacturing firms.

Is this process of offshoring an inevitable one? Is it simply a consequence of globalisation and the industrialisation of emerging economies (Friedman, 2005)? If so, what future does manufacturing have in the UK, or in any other developed economy, for that matter. Already over 70% of people employed in the UK are now employed in the service sector. Should developed economies abandon manufacturing and accept that Margaret Thatcher was right all those years ago when she claimed that we could live on services?

The problem with headline grabbing figures such as these is that they mask the real trends that underlie the data. In fact the boundaries between manufacturing and service firms are breaking down across the globe. As they have been for at least a decade. Rolls-Royce Aerospace no longer sells aero engines, it offers a TotalCare Solution, where customers buy the capability the engines deliver – “power by the hour”. Rolls-Royce retains responsibility for risk and maintenance, generating revenues by making the engine available for use. Other traditional “manufacturing” firms, such as IBM, have fundamentally reinvented themselves as service businesses, moving away from the production of hardware to offer business solutions. Yet others have integrated service operations with traditional manufacturing. BP and Shell both manufacture oil, yet they also both run extensive service retail operations.

The point is that to survive in developed economies it is widely assumed that manufacturing firms can rarely remain as pure manufacturing firms. Instead they have to move beyond manufacturing and offer services and solutions, delivered through their products. Recent technological developments – especially in data capture and information processing – are enabling manufacturing firms to develop new business models, exploiting the potential of informatized products. This trend to servitize manufacturing was first discussed by Vandermerwe and Rada in the late 1980s, but appears to have received relatively little attention in the mainstream engineering and management literatures (Baines et al., 2007; Vandermerwe and Rada, 1988). Clearly there are notable exceptions (Davies et al., 2006; Tuukker and Halen, 2003), but these are generally based on case evidence and many of them focus on the potential environmental benefits of product-service systems as oppose to their commercial advantages (Baines et al, 2007; Cook et al, 2006; Goedkoop et al, 1999; Manzini and Verzrolli, 2002; Mont, 2004; Mont and Plepys, 2003; Morelli, 2002).

This paper seeks to fill a gap in the literature by presenting an empirical analysis of the blurring of manufacturing and service boundaries – the servitization of manufacturing. The paper seeks to explore questions such as to what extent are manufacturing firms of different sizes servitizing? If they are servitizing, how are they servitizing and do the
observed trends vary depending on size and/or country of firm incorporation? The contribution of the paper lies in the fact that it is one of the first to unpack the notion of servitization empirically.

**RESEARCH METHODOLOGY**

Data were downloaded from the OSIRIS database in the first week of January 2007. The OSIRIS database contains information on 44,000 publicly listed companies from around the world. The initial search involved identifying all companies with primary or secondary US SIC codes in the range 10-39 inclusive. This search resulted in the identification of 22,952 companies. The second search involved adding a control from company size. Only companies with over 100 employees were included in the sample, resulting in the sample being reduced to 12,521.

Initially data were manually coded by a single coder. The OSIRIS dataset contains a field “description and history” for each firm. This field includes a text-based description of the firm, detailing its history and main activities. The coder reviewed the descriptions of each of the first 50 firms in the dataset and developed from these a set of coding categories, summarising the different sort of services that manufacturing firms offered. For example, the first firm in data set was Siemens. In the business description phrases such as “Information and Communication Networks (ICN) - ICN develops, manufactures and sells public communication systems, private business communication systems and related software, and provides a wide variety of consulting, maintenance and other services” were interpreted as Siemens offering systems, consulting, maintenance and general services.

Having coded the first 50 firms twelve different types of service offering were identified: [i] Consulting Services; [ii] Design and Development Services; [iii] Financial Services; [iv] Installation and Implementation Services; [v] Leasing Services; [vi] Maintenance and Support Services; [vii] Outsourcing and Operating Services; [viii] Procurement Services; [ix] Property and Real Estate; [x] Retail and Distribution Services; [xi] Systems and Solutions; and [xii] Transportation and Trucking Services.

Using these terms [and their variants as keywords] an automated coding process was then developed using the SEARCH function. Strings of words that identified whether firms offered specific services – e.g. IF(ISNUMBER(SEARCH("consult*",$D4)),1,0) – were developed and used to automatically code the 50 firms that had previously been manually coded. To check the effectiveness of the automated coding process a comparison between the manual coding and the automated coding was carried out. Every discrepancy was examined and the reason for it identified. This process resulted in some modifications to the search strings, with additional phrases being introduced as appropriate. At the end of this process 96 coding discrepancies between the original manual coding and the automated coding remained [12.8% of total codings]. 57.3% of these were due to errors in the original manual coding, leaving 5.5% coding errors caused by the automatic process. Further modification of the search strings made the number coding discrepancies increase, so at this stage the search strings were frozen and applied to the entire data set.

A conservative approach to coding was adopted. All firms were automatically classified as pure manufacturing unless there was clear evidence to classify them either as combined manufacturing and service or pure service. Having completed the automatic coding a random sample of firms was selected and the codings reviewed. No significant miscodings were identified at this stage, so the coded data were imported into STATA for further statistical analysis.

**PRELIMINARY FINDINGS**

As mentioned previously the initial sample consisted of 12,521 firms. However for 1,478 firms there was no business description and hence the firms could not be coded. Additionally 216 firms had gone bankrupt. After these two groups were eliminated from the data set the remaining usable sample was 10,827 firms. Despite the fact that all of these 10,827 firms were classified as manufacturing, in terms of their primary SIC codes, 29.52% of them offering a combination of manufacturing and service, while 1.78% of them appeared to be pure service firms. A more detailed breakdown highlights that the most common service offerings include design and development services [21.92%], followed by systems and solutions [15.70%], retail and distribution [12.18%] and maintenance and support [11.94%].

Interestingly of those 216 firms that had declared bankruptcy, 113 were combined manufacturing and service firms (52.31%) and 99 were pure manufacturing firms (45.83%). As stated previously, the sample as a whole consisted of 29.52% combined manufacturing firms and 68.70% were pure manufacturing. Hence considerably more of the combined manufacturing and service firms went bankrupt than might be expected, suggesting that the transition from a manufacturing firm to a combined manufacturing and service firm might be problematic for some organisations. In some ways this is not surprising as increased diversification – moving to product and service offerings – might hold some significant challenges for firms, not least because of the increased investment required and changed risk profile.

Of the usable sample of 10,827 firms, 10,078 firms were incorporated in just 23 countries. Countries with less than 70 firms were excluded from the analysis. Countries with the highest number of combined manufacturing and service firms tend to be well-developed economically – the United States (58%); Finland (51%), Malaysia (45%), the Netherlands (40%) and Belgium (37%) having a higher number of combined manufacturing and service firms than other countries. Perhaps, not surprisingly given its recent rate of development, China is the country with the highest number of manufacturing only firms (97.8%).
Figure 1 shows a breakdown by firm size, measured in terms of number of employees. These data clearly show that the larger the firm, in terms of number of employees, the greater the likelihood that the firm will offer a combination of manufacturing and service. Only countries with significant numbers of firms are included in this analysis.

Similar analysis can be repeated for financial data. 2004 was chosen as the initial year for analysis as this was the most complete year with data being available for 7,841 of the 10,078 firms in the sample. The data show that it is only in the top decile [measured in terms of firm turnover] that the majority of firms offer a combination of manufacturing and service. The majority of firms concentrate on manufacturing only in all other deciles [measured in terms of firm turnover]. This has important implications for the question of servitization. Is servitization only a strategy for the larger firms? If so, how do their first, second and third tier suppliers, support the larger firms in their efforts to servitize their offering? Perhaps servitisation is a recent phenomenon and hence has not trickled down through the supply chain yet. If this is the case then comparing the data with similar data for a decade ago should shed some light on the question.

Of particular interest, see Figure 2, is the change in make-up of firms offering a combination of manufacturing and service between 1994 and 2004 when considered in terms of deciles of firm turnover. Figure 2 suggests that a decade ago more firms, regardless of their total turnover, offered a combination of manufacturing and service than today. How can this observation be explained and how does it sit with current arguments that manufacturing is servitising?
First a caveat – the coding is based on the description of the firm’s activities when the data were downloaded in 2007 [not a description of their activities in 1994] – hence the analysis assumes that a firm’s activities today are a reasonably proxy for their activities in 1994. An additional round of data collection would be required to verify this assumption. Second, the analysis presented in Figure 2 uses data from all firms in the data set in 2004 and only the data that are available from 1994 for the 1994 analysis. Hence Figure 3 repeats the analysis, but this time includes only those 3,001 firms where data on total turnover exists in both 1994 and 2004. The distinction here is far less dramatic, although still very interesting. First Figure 3 shows that there is some reduction in servitization amongst smaller firms measured in terms of total turnover between 1994 and 2004, while there is some increase in servitization amongst larger firms over the same time period. Second, the fact that the differences in Figure 3 are not as marked as those shown in Figure 2 suggest that some of the observed change in Figure 2 might be due to a changed sample of firms in the data set.

![Figure 3: Comparison of Firms that Survived from 1994 to 2004](image)

This, in itself is an interesting observation. Why has the sample changed from 1994-2004? Is it a function of entry and exit? We have already seen that more combined firms went bankrupt in the study period than pure manufacturing firms. Perhaps the old Peters and Waterman theme – stick to the knitting – has some ring of truth. Those firms – especially smaller firms - that diversified too far and sought to combine manufacturing and services have gone bust, while others entering the sample have decided that focus is a better strategy than diversification.

One way of exploring this is to examine the make up of firms in the data set. Figure 4 does this, demonstrating how the sample proportions have changed over the years.

![Figure 4: Proportion of Firms in the Sample from Different Countries](image)
While the US is consistently dominant in terms of the number of firms sampled, by 2004 the US accounted for only 26% of the firms in the sample, down from 65% in 1990. This contrasts with China which accounted for less than 0.2% of firms in the sample until 1998, but by 2004 accounted for 10% of firms in the sample. Hence the data shown in Figures 2 and 3 have to be re-interpreted within countries. Have the US and other developed economies seen a shift to servitization, while the developing economies have not? 1,598 US firms have data turnover data available in 1994 and 2004. An analysis of these data suggests that regardless of the time period – 1994 or 2004 – larger firms were more likely to offer a combination of manufacturing and services than smaller firms. The proportion of firms in each turnover decile, however, has not changed significantly.

**IMPLICATIONS FOR THEORY AND PRACTICE:**

So what can we learn from this descriptive analysis? First, there are multiple different forms of service that manufacturing firms offer. The empirical data suggests that these can be categories in terms of: Consulting Services; Design and Development Services; Financial Services; Installation and Implementation Services; Leasing Services; Maintenance and Support Services; Outsourcing and Operating Services; Procurement Services; Property and Real Estate; Retail and Distribution Services; Systems and Solutions and Transportation and Trucking Services.

Second, the servitization of manufacturing is clearly influenced by local economic circumstances. There tend to be more manufacturing firms that offer a combination of manufacturing and service in highly developed economies than in industrialising economies [e.g. US versus China]. While not universal [e.g. Austria] this finding is consistent with current policy debates (Delbridge et al, 2006).

Third, the analysis raises some interesting potential avenues of future research. Questions of how manufacturing firms servitize. What this process involves and how firms make the change are fundamental, especially given the comparative data on bankruptcy, with more combined manufacturing and services firms going bankrupt than pure manufacturing firms.

A framework for thinking about these research questions has recently been developed by the Cranfield Innovative Manufacturing Research Centre. Shown in Figure 5, this framework recognises the need to explore the servitization of manufacturing at multiple levels. While large scale data sets, such as the one used in this paper, offer some useful opportunities for research, they obfuscate the nuance of organisational practice. Manufacturing firms today are exploring informed products – integrating prognostic and diagnostic technologies into their products to open up new service business opportunities. The classic example is the Rolls-Royce TotalCare Solution, in which Rolls-Royce agrees a per engine flying hour rate with its customers. Studying such Product-Service Systems in detail, as well as through aggregate datasets will deliver valuable insights into the servitization of manufacturing.

![Figure 5: The Cranfield Framework for Studying the Servitization of Manufacturing](image-url)

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