LEADERSHIP IN HIGH-VALUE SERVICES FOR MANUFACTURERS: ADVANCED SERVICES AND THEIR IMPACT ON VERTICAL INTEGRATION

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ABSTRACT
The debate about services-led competitive strategiescontinues to grow with much interest emerging around the differing practices between production and servitised operations. This paper contributes to this discussion byinvestigating the vertical integrationpractice (in particular the micro-vertical integration otherwise known as the supply chain position)of manufacturerswho aresuccessfulin their adoption ofservitization.Although these are preliminary findings from a longer-term research programme, through this technical note we seek to simultaneously contribute to the debate in the research community and offer guidance to practitioners exploring the consequences of servitization.
Keyword: Servitization, Product-Service Systems, Through-life Services.

1. INTRODUCTION

There is a growing interest amongst both the research community and manufacturers in advanced services linked to products (see Baines and Lightfoot, 2012a;Baines et al, 2012a; Baines et al, 2012b; Lightfoot et al, 2011a; Baines, et al 2011b; Baines, et al, 2010; Baines et al, 2009, Baines et al, 2005). Examples are frequently given of companies such as Rolls-Royce Aerospace, who now generating a large portion of their business revenues through availability and capability based maintenance contracts. Supporting such services demands, however, that the manufacturer adopts new and alternative practices and technologies to those traditionally associated with production operations (Baines et al, 2009). A prevailing challenge is to understand these differences and their underpinning rationale.

Our research programme has therefore set outto explore how the pursuit of a services-led competitive strategy impacts the broader operations of a manufacturer. To achieve this we have investigateda cross-section of companies who are successfully delivering advanced services coupled to their products. Our initial results indicate that several areas of operations are indeed impacted, and these include facilities, information and communication technologies, performance measurement systems, organisational processes, and human resources. In each case we have been anxious to share our findings with the broader research community to both contribute to the debate and provide initial guidance to manufacturers.

On this basis, differingpractices haverecently become apparent in the area of vertical integration. In particularthe extent and position (within the wider supply chain) of the operations that are under the direct control of the servitized manufacture.This aspect of vertical integration is sometimes referred to as micro-vertical integration or supply chain position. Therefore, in this technical note wereporton the practices of our case companies, explore the rational underpinning these, and propose anhypothesisfor the impact on vertical integration of successful servitization.

To realise the purposeof this paperwefirst reflect on the topic of vertical integrationwithin the context ofconventional production operations. Wesubsequently describe the design of our study.The main body of the paper then deals with the practices we have observed in situ and the factors that appear to explain them. Finally we conclude and set out a programme for further work.

2. VERTICAL INTEGRATION PRACTICES WITHIN CONVENTIONAL PRODUCTION OPERATIONS

The term vertical integration is usually taken as the extent to which a firm owns and takes responsibility for its upstream suppliers and its downstream customers.A business is seen as being vertically integrated when it is engaged in different aspects of production, such as growing raw materials, manufacture, transportation, and retailing. Here, backwardsvertical integration refers to taking over activities of suppliers of in-bound materials, whereas forwardsvertical integration is concerned with taking control of activitiesin the outbound supply chain and otherwise carried out by customers. Vertical integration can be thought of at amacro-level (dealing with the combination of businesses) or at the micro-level (dealing with the combination of business activities). This micro-level of vertical integration can also be referredto as the span-of-process or supply chain position(Baines et al, 2005), and is the focus for the remainder of this paper.

Modern manufacturers appear significantly less vertically integrated than their predecessors. Evidence is apparent in the practices of Henry Ford with his production of the Model T in the early 20th Century. Ford chose extensive vertical integration to control quality conformance which in turn helped to minimise the overall cost of vehicle production (Womack et al, 1990). Since then improvements in capabilities within the supply base have relaxed the need for such vertical integration, and concepts such as core competences have motivated manufacturers to divest and relinquish such integration.

Choosing the appropriate position and extent of vertical integration is a complexdecision making activity. Within the context of more conventional manufacture (which we refer to as production-centric operations) a wide range of studies have taken place. Some authors take a broad and integrated view of in-bound and out-bound supply chain boundaries through such concepts as core competences and competitive space (cf: Baines et al, 2005). Others have addressed vertical integration by focusing in-depthon particular boundaries between operations and the wider supply and customer networks. For example, research that specifically targets the in-bound material supply chain is addressed under make-versus-buy (cf:Probert, 1996), outsourcing (cf: Lonsdale and Cox, 1998) and strategic sourcing (cf: Greaver, 1999). Similarlythe out-bound customer interface tends to be covered in the marketing literature (cf: Jones and Clark, 1990; Christopher, 1998).

The concepts of servitization and vertical integration are closely related (Schmenner, 2009). This is especially the case with advanced services which are closely coupled to manufacturer's products. Such product-centric services, such as availability contracts, require the provider to take on maintenance activities that were otherwise performed by the customer. This can be thought of as forwards integration of the manufacturer. However, questions then arise as to whether or not such forwards integration is reflected in the relaxing of backwards integration, or if the extent of vertical integration actually increases with the effective execution of a servitization strategy? Furthermore, what are the factors and relationships that begin to explain the decisions taken by manufacturing organisations.

3. RESEARCH DESIGN SUMMARY

Our exploration of vertical integration has taken place as part of a larger study to understand the impact of successfulservitization on the operations of the manufacturer. In brief, our research methodology has been to carry out in-depth and multi-disciplinary case-studies of four manufacturers leading in delivery of advanced product-centric services. Data has been collected over a 15 month periodthrough semi-structured interviews witha wide range of personnel in such companies. Typical these have been interviews with maintenancetechnicians, customer services personnel, through to marketing, technical, and managing directors.

Analysis has then been conducted by systematically searching for data clusters where our case companies coincide in terms of the practices they follow. For each cluster we have then sought to rationalise the data as a prevailing practice, along with the underlying logic that explains it's adoption. Once this has been completed for each data cluster, we have then set out to describe and disseminate these preliminary findings as technical notes and short communications. Thus heightening our engagement with both communities of practice and research, and through their feedbackhelping to strengthening the validity of our results.

Following this approach,preliminaryresults have indicated that the adoption of servitizationstrategieswill impact facilities, information and communication technologies, performance measurement systems, organisational processes, human resources, and vertical integration. The remainder of this paper describes our findings for vertical integration and concludes by summarising why these appear to occur for successfully servitizing manufacturers.

4. VERTICAL INTEGRATION PRACTICES WITHIN SERVITIZING OPERATIONS

Rather than the largely limited extent of vertical integration that is now apparent in many production-centric operations, it appears that those manufacturers deliveringproduct-centric servicessuccessfully,retain a somewhat unexpected tail of design and production capabilities. Figure 1 sets out to illustrate these phenomena.

The vertical integration of a conventional manufacturer tends to be arranged around design and productioncapabilities (see 'A' on figure 1). Often basic services are offered, such as spare parts, but typically these are produced alongside normal production and delivered to the customer through a relatively independent network of dealers and distributors. Such a model is often found in the automotive industry where manufacturers such as Toyota and Audi will have a franchised distributor network. Such distributors are themselvesconventional service providers and offer a channel to the market for the manufacturer (see 'D' on figure 1). Typically they will be entirely focused on services such as show-rooms, demonstrations, and sales.

The extent of vertical integration for product-centric servitization is more difficult to observe as this picture is somewhat blurred by the structure of the host organisation. For example, manufacturers such as Rolls-Royce aerospace initially appear as having extensive vertical integration. In practice, much of this is because the company is active in both original equipment manufacture and product-centric services such asmaintenance, repair and overhaul (see 'B' on figure 1).

A more clinical picture of vertical integration supporting product-centric servitization is apparent in those companies that have focused entirely on servicing their existing installed asset base. Although rare, such businesses do exist (Alstom train-life services being one example). As mentioned earlier, forward vertical integration occurs as the manufacturer takes over operations that would have otherwise been carried out by the customer. However, our study indicates that these companies also set out to retain a tail of design and production capabilities (see 'C' in figure 1). Overall, this results in their operations being considerably extended.

Evidence indicates that this tail has been purposely retained, and is not simply a legacy of a move from production-centric operations. Alstom Train-life services, for example,appear to have intentional re-integrated. Alstom holds responsibilities for the advanced services contracts on both the West Coast Mainlines and Northern Line of the London Underground. Historically subsystems such as air-conditioning units, door actuators, and coffee machines were sourced from external suppliers. More recently the overhaul and re-manufacture of some such equipment has been re-integrated into the Alstom organisation. Though such facilities are not of the scale associated with conventional manufacture, both design authority and production capabilities have been established for these sub-systems.

This tail of backward integration is illustrated in figure 1 by a triangle penetrating design and production (see particularly 'B' and 'C'). Such integration exists even when conventional manufacture and product-centric servitization occur in one company (as per the case with Rolls-Royce). Here, there is both close integration and some duplication in activities. For example, both functions of such an organisation may have assembly and test facilities. The extent of this penetration is however reduced, partly because some activities may be shared, and partly because of stronger supply chain leverage held by such a larger organisation.

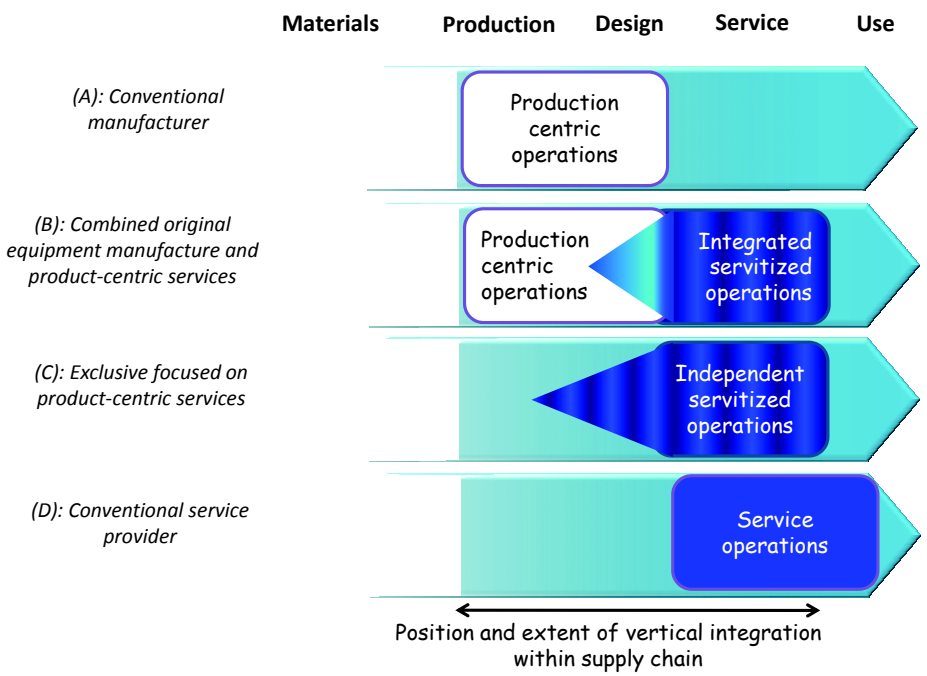

Figure 1: Vertical integration practices for production, servitizing, and service operations

5. RATIONALE UNDERPINNING THE VERTICAL INTEGRATION PRACTICE

Our study indicates that the vertical integration practices, of those manufacturers who are leading in the delivery of advanced service provision, are principally in response to two types of business pressures. A pressure to fulfil contractual obligations to customers, coupled with an internal pressure to deliver these as economically as possible. An appreciation of these pressures is requisite to understanding the impact of servitization on vertical integration.

All operations strategies are set out to deliver customer value economically. For advanced services, delivered throughcapability contracts, customer value is centred on the 'outcome' from services rather than the services activities themselves. These outcomes are principally measured in terms of asset performance, availability and reliability. Performance is concerned with the extent to which the full capability of an asset is accessible, for example the power delivered by an engine as a percentage of that specified. Availability is typically measured as the amount of time that a product or asset is available for use as a proportion of the scheduled availability. Reliability is typically taken as a measure of mean-time between in-service failures. The challenge within operations is to deliver against these customer metrics as economically as possible. An important business measure associated with a firm's internal economics, in such instances, is the cost of delivering an advanced service contract.

The underlying logic has two purposes: (1) Maximise the speed and effectiveness of response, and (2) Minimise the cost of response. Supporting advanced services contracts demands an ability to provide a rapid and effective response should an asset fail when in-service. For example, if an Alstom train breaks down then reliability penalties will be incurred immediately by the manufacturer (Alstom), and they are closely followed by escalating penalties for lack of availability or 'up-time'. Rapid maintenance action is aided by the readiness of spare and replacement parts. Some commodity parts and consumables(such as hydraulic oils, filters, fasteners, and brake components) can be readily held in stock and used on a call-off basis. However, with high value subsystems, economics demand that these are overhauled and re-manufactured. Retention of a production capability helps to ensure that such subsystems will be dealt with as quickly as possible, along with buffering the manufacturer

from any issues they may encounter with their own suppliers. Retaining design authority also aidscontinuous improvements in asset design. For example, equipment can be readily re-engineered to improve reliability and maintainability (such as improving access to inspection points, lubrication, and serviceable items). Likewise, many improvements in working practices (such as those achieved through Lean techniques) have originated from the production environment. Adoption of such techniques in maintenance activities is likely to be assistedif the organisation already has expertise of implementing them in production.

Extended design and production capabilities also provide the manufacturer with greater control over the cost of responding. As mentioned above, improvements in working practices and component design impact both the effectiveness and cost of delivering an advanced service. Likewise, the cost of stock holding in the supply chain is reduced. Finally, as maintenance operations are notoriously unpredictable, demanding high levels of buffer capacity in order to deal with unpredictable events, insourcing provides opportunities to better exploit such capacity. A practical example of this is with Alstom on the Northern Line, where the maintenance depots have chosen to insource the refurbishment of door actuators. A relatively low skilled and labour intensive activity that immediately appears as a candidate for outsourcing if not offshoring. Yet, carrying out such activities internally provides useful employment of standby maintenance staff and also helps to reduce stock holding costs of such items.The downside of this integration is that the business will invariably need to increase investment in management and resources, and this can negatively impact the cost of delivering an advanced services contract.

The extent of vertical integration is however moderated by a range of factors. Highly significant is the contractual relationship with the suppliers to the manufacturer. Stock holding costs can be reduced if suppliers can themselves be persuaded to enter an outcome-based contract that reflects the advanced services offered by the manufacture. Unfortunately, many suppliers are engaged largely around product design and manufacture with perhaps, too little consideration of their longer-term willingness or ability to support advanced services. Nevertheless, even when transactional relationships are retained with suppliers, the stockholding costs are still highly influenced by the information systems that the manufacturer has in place to track materials in the supply chain.

Investments in design and production capabilities are of course also influenced by the facilities decisions. Facilities that are located close to and distributed throughout customers operations help to reduce stockholding costs at the sacrifice of manpower and equipment utilisation. This is similarly impacted by the availability and skill sets of such resources and in particular the design capabilities. Such capabilities are difficult to re-establish once lost to the organisation. These underpin the particular advantages that manufacturers hold over more conventional service providers, indeed intellectual property can be generated that can reinforce the manufacturers own authority over their suppliers. Even when, for example, a subsystem has been sourced from the external supply base the manufacturer can acquire access to intellectual property and develop expertise in the design of equipment for serviceability that can exceed the knowledge of the supplier.

6. CONCLUDING REMARKS AND FUTURE RESEARCH

This short technical note reports on our work to understand the vertical integration practices of a cross-section of manufacturers who have embraced the servitization trend. In particular, it highlights that such companies retain capabilities in design and production, and do so because this benefits their speed, effectiveness and costs of supporting assets on advanced services contracts. We have captured these findings in the following hypothesis:*Delivery of an advanced service contract is positively impacted by the vertical integration into capabilities for subs-system design and production,as this ensures speed and effectiveness of response while minimising costs.*

Fundamentally this is because the business pressures associated with advanced services differ to those in original equipment manufacture. Production tends to focus on cost, quality and delivery, where as advanced services contracts centre on performance, availability, reliability and cost. These demand that a manufacturer is responsive and, to often to achieve this, they may have to vertically integrate if they are to avoid either excessive costs for stock holding or incur penalties for failing to deliver against a services contract.

Such pressures are mitigated by the a range of other contextual factors, such are the form of the contractual relationship with the manufacturers own suppliers, the location and structure of facilities,

and the sophistication of technology systems monitoring the asset condition in service. All such factors interact to determine the operations strategy that is most appropriate to an individual manufacturer. Our future work will now continue to explore these other factors in greater detail, and we will report on these in the near future.

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