Abstract

A lean perspective on servitization of manufacturing

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Abstract

Servitization of manufacturing is a fairly recent approach addressed in literature. The term is recognized as the process of creating value by integrating products with services. Servitization is supposed to contribute to a sustainable society through its potential to support dematerialization, i.e. reduction of materials used in production and consumption. Key aspects of lean are resource efficiency and customer-orientation. Though lean production has gained a high degree of attention, few studies have addressed the potential relationships between lean and servitization. Servitization is however not only relevant from a sustainability perspective, but can be regarded as “the next step” to create user value. This paper aims at providing a better understanding of the relationships between lean and servitization through an analysis of literature where the lean and servitization approaches are compared and contrasted. The underlying assumption is that a lean approach might support a manufacturing organization’s transition towards a servitization organization.

Keywords: Servitization, Product-service systems, Lean, Sustainability

1. Introduction

Servitization has been around for many years, trying to combine products and service into attractive packages (Tukker and Tischner, 2006). Though different definitions appear in the literature such as product-service systems (PSS), functional products, or integrated solutions (e.g. Mont, 2004; Windahl and Lakemond, 2006; Baines et al, 2009a; Baines et al, 2009b; Sakao et al, 2009), the concept refers to combinations of products and services. This combination of product and service enables the provider to deliver extra value to the customers thus competing by more than merely cost (Porter and Ketels, 2003). Servitization can provide improvements in revenue and profit margins, a closer customer relationship as well as better understanding of customer needs and requirements (Neely, 2007). Servitization makes, through the integration of products and services, the offer more complex. As a consequence, the customer may be more depending on the supplier
and tends not to switch to a competing supplier unless the delivery is extremely poorly provided. Companies that have done this transition towards servitization over the years are e.g. IBM, going from a very high hardware focus to business solutions, and SKF, who sells not only bearings but the whole technical solution including service and maintenance.

Given the situation that servitization has attracted increasing attention among scholars and industry, surprisingly little attention is devoted to how it relates to manufacturing strategy. One exception is presented by Baines et al (2009a) who, based on a literature study combined with a case study, outline a framework in which operations strategy is linked to servitization. However, this framework is rather generic and thus does not address specific production philosophies. Therefore, this paper sets out to investigate links between the Lean production philosophy and servitization. More precisely, by taking the starting point in manufacturing decision criteria elaborated from Hayes and Wheelwright (1984), an analysis of the links is presented.

The paper is structured as follows. First, the method uses is introduced and then we briefly describe the manufacturing strategy research field. Thereafter, the lean production philosophy is presented and then the servitization concept is outlined. The analysis follows then and finally some conclusions are drawn.

2. Methods
The lack of understanding of the relationships between the Lean production philosophy and the servitization concept is the problem at hand in this paper. The objective is to explore these relationships in order to contribute to manufacturing theory and practice. Based on a study of extant literature, the two concepts are described, compared, and contrasted.

3. Manufacturing strategy
The manufacturing strategy area has been around for many decades, but the development in modern times starts with the seminal article by Skinner (1969). He identified a number of manufacturing outputs that are important to the competitiveness of a company. Marucheck et al. (1992, p. 93) defined manufacturing strategy as “a collective pattern of coordinated decisions that act upon the formulation, reformulation, and deployment of manufacturing resources and proved a competitive advantage in support of the overall strategic initiative of the firm or the business unit.”

The list of manufacturing outputs has been further developed by Hayes and Wheelwright (1984), who also added a list of decision categories and a grading system for classifying the performance regarding these decision categories. Other researchers have been occupied with the issue of relations between manufacturing strategies and the design of the production system (e.g. Hill, 1995; Miltenburg, 1995; Platts and Gregory, 1992). These more recent authors have moved away from the top-down approach to an approach where the strategy formulation process is an interaction between the corporate management’s view and conditions at operational level. They suggest that the process of
formulating and implementing manufacturing strategies is a continuous loop involving all operational level strategies as well as corporate level strategies.

Bates et al. (2001) defined that manufacturing strategies are the processes that companies use to build the resources and the capabilities to create competitive advantages and to align their competitive priorities with the marketing function. One key question is how to establish manufacturing strategies that support the overall objectives and strategies of the company. According to Dangayach and Deshmukh (2001, p. 887), the manufacturing strategy formulation process outlines “a pattern or procedure in which manufacturing strategy is developed and implemented”.

The literature presents different models or frameworks of the manufacturing strategy formulation process (Lindström, 2008). Hill (1995) declared that there is no shortcut to success in the process of formulating strategies and designing supportive manufacturing processes. He proposed a structure of actions in five steps: 1) Define corporate objectives, 2) Determine marketing strategies to meet these objectives, 3) Assess how different products qualify in their respective markets and win orders against competitors, 4) Establish the most appropriate process to manufacture these products (process choice), and 5) Provide the manufacturing infrastructure to support production. This step by step structure is, however, based on a top-down approach. In reality there are iterative loops between all of these steps. Säfsten et al. (2007) emphasized the need for both top-down and bottom-up perspectives, which guarantee that the decisions are well-grounded in the company capabilities. Another model of the strategy formulation process was presented by Platts (1994). It involves four aspects: point of entry, participation, procedure, and project management.

Acur et al. (2003) described the relations between the process of formulating manufacturing strategy based on a competitive analysis on the one hand and linking it to the decision criteria on the other, i.e. how it should be realized (see figure 1).

![Figure 1](image-url)  
Figure 1. Issues related to formulation and implementation as well as content in manufacturing strategy (Acur et al. 2003).

The decision criteria should support the different competitive priorities (Swink and Way, 1995; Dangayash and Deshmukh, 2001). The lists of competitive priorities vary in
traditional manufacturing strategy literature, but commonly the competitive priorities are cost, quality, delivery and flexibility.

According to Hill (1995), order qualifiers and order winners should be defined for each competitive priority. Order qualifiers are basic criteria that must be fulfilled if a company is to be an actor in the marketplace. Order winners are the specific criteria that help a company to win specific orders in a competitive situation. The distinction between these two categories is often hard to make, but important if correct decisions are to be made. If a company only provides qualifiers, it is only as good as its competitors. In order to provide order winners, the company needs to be better than its competitors. There is also a third category denoted order loosing sensitive qualifier. If a company already is a supplier in the marketplace, but fails to satisfy this category, it will lose customers. Once the customers develop a poor impression of a supplier, they are reluctant to accept this supplier again.

Which decision criteria are important when making strategic decisions? Hayes and Wheelwright (1984) presented eight strategic decision criteria, each comprising several characteristics to be considered regarding how to carry out the manufacturing. Table 1 presents an overview of the decision criteria and associated characteristics.

Table 1. The decision criteria and some of their main characteristics (Hayes and Wheelwright, 1984).

<table>
<thead>
<tr>
<th>Decision criteria</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>Equipment, automation, linkages</td>
</tr>
<tr>
<td>Facilities</td>
<td>Location, size, specialization</td>
</tr>
<tr>
<td>Capacity</td>
<td>Amount, timing, type</td>
</tr>
<tr>
<td>Vertical integration</td>
<td>Direction, extent, balance</td>
</tr>
<tr>
<td>Quality</td>
<td>Defect prevention, monitoring, intervention</td>
</tr>
<tr>
<td>Workforce</td>
<td>Skill level, wage policies, employment security</td>
</tr>
<tr>
<td>Organization</td>
<td>Structure, control/reward systems, role of staff groups</td>
</tr>
<tr>
<td>Production planning/material control</td>
<td>Sourcing policies, centralization, decision rules</td>
</tr>
</tbody>
</table>

Each decision criterion is important for the success of a manufacturing organization. Poor results regarding a specific decision criterion can obstruct the success of the entire organization.
The next section will present the Lean production philosophy, which is an interpretation of Toyota Production System, TPS.

4. **The Lean production philosophy**

Toyota Production System (TPS) is the origin of the Lean production philosophy that was introduced in the early 1990’s (Womack et al, 1990; Womack and Jones, 1996). The concept is widely accepted among scholars and supposed to contribute to sustained competitiveness. Strong focus is set on value creation and waste reduction in the manufacturing processes. The Lean production philosophy relies on certain principles such as standardized processes, leveled production, Just-In-Time (JIT) practices, visual inspection, and continuous improvement.

Lean production focuses strongly on reduction of the 7 wastes (Over-production, Waiting time, Transportation, Over-processing, Inventory, Motion, and Scrap) in manufactured products. By eliminating waste, quality is improved, production time is reduced, and cost is reduced. Lean "tools" include constant process analysis (kaizen), "pull" production (by means of kanban), and mistake-proofing (poka yoke). Feld (2001, pp. 4-5) defined the five primary elements of Lean:

- Manufacturing Flow: The aspect that addresses physical changes and design standards that are deployed as part of the cell.
- Organization: The aspect focusing on identification of people’s roles/functions, training in new ways of working, and communication.
- Process Control: The aspect directed at monitoring, controlling, stabilizing, and pursuing ways to improve the process.
- Metrics: The aspect addressing visible, results-based performance measures; targeted improvement; and team rewards/recognition.
- Logistics: The aspect that provides definition for operating rules and mechanisms for planning and controlling the flow of material.

Each of these five primary elements consist of a number of “tools”, such as Kanban, poka-yoke, and SMED, Single Minute Exchange of Die.

One crucial insight is that most costs are assigned when a product is designed. Often an engineer will specify familiar, safe materials and processes rather than inexpensive, efficient ones. This reduces project risk, that is, the cost to the engineer, while increasing financial risks, and decreasing profits. Good organizations develop and review checklists to review product designs.

The key lean production principles:

- Perfect first-time quality - quest for zero defects, revealing & solving problems at the source
- Waste minimisation – eliminating all non-value adding activities & safety nets, maximise use of scarce resources (capital, people, and space)
- Continuous improvement – reducing costs, improving quality, increasing productivity, and information sharing
• Pull processing: products are pulled from the consumer end, not pushed from the production end
• Flexibility – producing different mixes or greater diversity of products quickly, without sacrificing efficiency at lower volumes of production
• Building and maintaining a long term relationship with suppliers through collaborative risk sharing, cost sharing, and information sharing arrangements

Lean is basically all about getting the right things, to the right place, at the right time, in the right quantity while minimizing waste and being flexible and open to change.

5. The Servitization concept

The principles of servitization, which aims at delivering product-service solutions, are according to Mont (2004):

• The sale of the use of the product instead of the product itself
• The change to a ‘leasing society’
• The substitution of goods by means of services
• A repair-society instead of a throw-away society
• The change in consumer attitudes from sales to service-orientation

Product-service offers can appear in different forms (Baines et al, 2009a). That is, the offerings range on a continuum where at the one end the product constitutes the key part whereas added services only are provided to a limited degree. At the other end, the service is the key part of the offering and the product is of less importance. This continuum is illustrated in figure 2 below.

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Figure 2. The product-service continuum (Based on Tukker, 2004; Oliva and Kallenberg, 2003).
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The transition towards servitization not only changes the business offer, but also how the business operates (Sakao et al, 2009). If the internal servitization process is designed and implemented in the wrong way it may be counterproductive and damaging to the business and its customer base (Neely, 2007). Thus, there are a number of challenges associated with the transition from a “traditional” manufacturing company towards one that is based on servitization. Ritzén and Ölundh (2002), found in a study of Swedish companies providing product-service offerings three types of challenges:
1) economic challenges (e.g. risks and internalization of costs for service and maintenance)
2) internal challenges (e.g. need for changes in the company culture)
3) customer-related challenges (e.g. need for new relationships with the customers).

On the basis of a study of a UK company, Martinez et al (2010) identified similar challenges structured into five categories:
1) embedded product-service culture (which implies a need for changed culture)
2) delivery of integrated offering (which calls for a greater number of customer touchpoints)
3) internal processes and capabilities (which calls for acquisition of new capabilities)
4) strategic alignment (that means alignment of mindset and understanding towards service delivery)
5) supplier relationships (which indicates a need for a greater degree of cooperation between a provider and its supporting network)

A key factor pointed out in literature is that when developing product-service offers, a life cycle perspective becomes central. Combining products with services might imply a different focus during product development. It is not uncommon that when manufacturers develop product-service offerings, they do so based on existing standard products and add service contents. However, product-service offers “place new requirements on products in comparison to traditionally sold products” (Sundin et al, 2009 p. 749).

Despite the challenges associated with the transformation towards servitization, an underlying idea is to create increased customer value. Servitization is also expected to provide better possibilities to achieve more sustainable operations, since equipment and other resources are better incorporated in the continuous offer, including product and service.

6. The Lean production philosophy and Servitization concept from a manufacturing strategy perspective

This section presents a tentative analysis of how Lean production and Servitization relates to the different manufacturing decision criteria. Table 2 summarizes the analysis, which is further detailed below.
Table 2. Interpretation of decision criteria from Lean production and Servitization perspectives (elaborated from Hayes and Wheelwright, 1984).

<table>
<thead>
<tr>
<th>Decision criteria</th>
<th>Lean (L)</th>
<th>Servitization (S)</th>
<th>Comparison L and S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>Aimed at creating stable production processes with minimal disturbances and waste</td>
<td>Used to combine product and service offerings</td>
<td>Servitization might call for an extended technology base to be able to deliver combinations of product-services</td>
</tr>
<tr>
<td>Facilities</td>
<td>Plants that are suitable for creating flow and located where they are efficient but also close to suppliers/market to reduce lead-times</td>
<td>Centralized plant for production of products, along with several local facilities for maintenance and repair</td>
<td>Could be contradictory since L prefers larger facilities to get flow and economies of scale and S also call for other priorities regarding location close customers</td>
</tr>
<tr>
<td>Capacity</td>
<td>Lagging strategy reduces the risk for overproduction</td>
<td>More possibilities to achieve a smoothing capacity strategy since the degree of customization increases which consumes more labor resources that are easier to relocate</td>
<td>Somewhat contradictory since smoothing sometimes implies over-capacity</td>
</tr>
<tr>
<td>Vertical integration</td>
<td>Long term relationship with suppliers through collaborative risk sharing, cost sharing and information sharing arrangements</td>
<td>Probably more service partners that need to be coordinated and involved in the corporate strategy development. Very long-term! Customer contact will also be closer since the provider accepts a more long-term responsibility for the product/service</td>
<td>Synergetic, since both support long term relationships with suppliers</td>
</tr>
<tr>
<td>Quality</td>
<td>Continuous improvement is strongly in focus</td>
<td>Servitization makes it even more interesting to provide quality that stretches beyond warranty time</td>
<td>Synergetic, since both perspectives promote doing things right from the beginning</td>
</tr>
<tr>
<td>Workforce</td>
<td>Discipline, standardized work and skilled workforce</td>
<td>Workforce trained in servitization</td>
<td>Synergetic, since both require skilled personnel and plans for continuous learning</td>
</tr>
<tr>
<td>Organization</td>
<td>Key aspects are to identify people’s roles/functions, new ways of work training, and communication</td>
<td>More complex, since it involves both making of product and service</td>
<td>Synergetic, since both involves high degree of workforce empowerment</td>
</tr>
<tr>
<td>Production planning/ material control</td>
<td>JIT-production requires good knowledge and control of the flow</td>
<td>Minimization of material and other resources calls for good control of the entire production flow, as well as incorporating the service offer</td>
<td>Synergetic, but re-use of material or components may complicate flow and reversed supply chain management is still to be further developed</td>
</tr>
</tbody>
</table>

The technology criterion emphasizes stable processes in order to minimize waste within Lean production. Within Servitization, depending on to what degree it is implemented, may cause even more difficult technology aspects, since it may include reversed supply chain and remanufacturing of equipment that needs to be updated. There will also
probably be a higher degree of customization, which will complicate the material flow and manufacturing processes.

The facilities criterion will be contradictory since Lean prefers larger units where continuous flow can be created in an efficient way. Servitization would rather prefer distributed facilities that can be used quickly and flexibly close to the customer.

Regarding capacity, Lean would prefer a lagging strategy which will not create any over-production. Servitization would probably prefer more overcapacity, or smoothing, which would lead to shorter service times and higher customer responsiveness.

Both strategies are supported by long-term supplier relationships. Servitization also increases the relationships with customers.

Quality is important to both philosophies, but even more to Servitization since the provider will directly benefit from longer product life.

Both philosophies require skilled personnel.

The organizational issues will be more complex in Servitization since it has to take care of both product realization and service development.

Production planning and control will be even more complicated in Servitization since the flow of material will have to handle both making of new products and updating old products for re-use.

7. Conclusions

The purpose of this paper was to develop a comparison between the two concepts of Lean Production and Servitization. The results show that they are both supporting sustainability aspects and long-term relationships with suppliers and, for Servitization, also with customers. The reversed supply chain for Servitization, however, is an extra challenge since it makes planning issues more difficult. Organizational development and personnel competence are extremely important for both concepts.

The theoretical value of the comparison presented in this paper is that it provides a starting point for further studies that add to the scarce empirical research on the relationships between the concepts. Such studies are urgently needed in order to extend current manufacturing theory towards a more holistic theory on resource productive manufacturing. For practitioners, the findings presented in this paper enhance the possibilities to improve current manufacturing practice. Understanding of the similarities and differences between the concepts will be helpful if only one of the concepts is implemented and the company wants to implement also the other concept in order to maintain competitiveness in the global marketplace.

There are several options for future research directions. The analysis in this paper has resulted in insights into implications for the decision criteria for Lean Production as well
as when the degree of service content within product offers is increased. The list of implications presented in this paper is, however, tentative and not complete. Hence, empirical studies are needed to validate the relevance of the implications outlined in the paper and to find additional implications.

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