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A Conceptual Model for Evaluating Product-Service Systems Leanness in UK Manufacturing Companies

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Abstract

The purpose of this paper is to present a conceptual model that can be used in measuring the degree of Product-Service System (PSS) leanness in UK manufacturing companies. The model will assess Product-Service System leanness based on five lean enablers (supplier relationship, management leanness, workforce leanness, process excellence, and customer relationship), 21 criteria (supplier delivery, culture of management, process optimisation, etc.) and finally 73 attributes. This proposed model will be the base of developing an index used as quantitative measure of the degree of Product-Service System leanness in manufacturing companies.

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1. Introduction

In today's competitive market, manufacturing companies are more focused on the improvement of core competitiveness. Manufacturing companies try to improve and develop their ability for competition through modern manufacturing initiatives and from these initiatives are lean manufacturing and Product-Service System (PSS). Lean and PSS can lead to dematerialisation through reducing the creation of wastes and the consumption of raw materials, improving customers' satisfaction by meeting customers' needs better and improving competitiveness through increasing customers' value.

In manufacturing companies the trend of servitisation of products is obvious. Through PSS companies can add value to customers, enhance their competitiveness and provide new business opportunities. PSS can be defined as a mix of tangible products and intangible services, designed and combined to be competitive, satisfy customer needs and have lower environmental impact. The idea beyond PSS is the 'sale of use' rather than the 'sale of product', so customers pay for using the product rather than its purchase.

Besides PSS, lean manufacturing was developed from the Toyota Production System (TPS). With the publication of the book *The* Machine That Changed the World, lean manufacturing practices have found acceptance in many manufacturing operations over more traditional mass production techniques. The main goal of Lean operations is the elimination of wastes occurring in the manufacturing process, thereby facilitating cost reduction [1]. There are seven types of wastes prone to occur in any manufacturing process. The seven wastes are overproduction, waiting, transport, inappropriate processing, unnecessary inventory, unnecessary motion and defects [2]. Literature on lean concentrates mostly on the manufacturing sector and especially in the automotive industry where it started. But recently because of the possible benefits gained by applying lean, other types of sectors such as service sector (insurance companies, banks and fast food restaurant) [3,4,5,6,7], public sector (NHS, court system and government councils) [8,9,10] and education sector [11,12,13] have recently taken up the concept of lean and introduced it to their own management activities. According to Womack et al [14] lean thinking is not a manufacturing tactic only, but a management strategy that is

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applicable to all organizations because it has to do with improving processes.

Despite the vast research published on lean either on manufacturing or service, the concept of leanness is immature because it lacks a holistic and unifying measure [15]. The term leanness refers to the degree of the adoption and implementation of lean philosophy in the organisation [16]. Few researchers focused on measuring leanness in the manufacturing sector and fewer attempted to measure leanness in the service sector. But very limited researchers contributed to the approach of measuring leanness in PSS. So the aim of this paper is to present a conceptual model that can be used in measuring the degree of PSS leanness.

2. Related research

Although many companies have applied lean concepts across their operations, more than 90% of them failed to recognise measurable improvement in performance [17]. This was because: (a) lean is often loosely defined in terms of its objectives, and (b) lean lacks a holistic, unifying measure.

Developing a standard measure that integrates the results of the lean practices into one scalar becomes necessary for a successful lean implementation [4]. Several researchers examined leanness in organisations through some measures.

Karlsson and Ahlström (1996) used a set of measures in a form of checklist to assess the extent of leanness. The nine variables that they have used are: elimination of waste, continuous improvement, zero defects, JIT deliveries, pull of materials, multifunction teams, decentralisation, integration of functions, and vertical information system [18]. Based on Karlsson and Ahlström variables, Soriano-Meier and Forrester (2002) developed a model to assess the leanness levels of 30 UK ceramic tableware manufacturers.

The Lean Enterprise Self-Assessment Tool (LESAT) a model presented by Nightingale and Mize (2002) assessed the state of a company's leanness and measured its readiness to change by evaluating three groups of processes; life-cycle processes, enabling infrastructure processes and enterprise leadership processes [19].

Goodson (2002) evaluated companies' leanness with a rapid plant assessment tool (RPA), using a tool kit that aided experts to decide if factories are truly lean [20]. Shah and Ward (2007) developed a multi-dimensional measure of lean production. They mapped the various conceptual measures of lean manufacturing. Some of the measures of lean production include; setup time reduction, simplicity in product design, customer focus, workforce management, etc [2]. Bayou and De-Korvin (2008) compared the leanness of General Motors and Ford Motor Company. They found that Ford's system is 17% leaner than General Motors's system over a period of three years. They argued that the systematic measure of leanness has seven characteristics: relative, dynamic, long-term fuzzy logic, objective, integrative and comprehensive [15]. Bhasin (2011) used a total of 104 indices, which are grouped within 12 distinctive categories to measure the leanness of 20 manufacturing organisations in the UK [17]. Vinodh and Chintha (2011) developed an index for measuring leanness by using multi-grade fuzzy approach. They have used a measurement system that consists of three levels. The first level consists of five leanness enablers; the second level consists of 20 lean criteria, and the third level consists of several lean attributes. By using this system they have specified the degree of leanness and the areas for leanness improvements [16]. Also Vimal and Vinodh (2013) used their previous system, but they have applied artificial neural network with fuzzy logic in the leanness assessment process [21].

All the previous researches focused mainly on the manufacturing sector. The question now is whether or not manufacturing and service operations can be managed based on the same concepts. Some stress the significance of distinctive service features. Grönroos (1990) claimed that there are four basic characteristics used in identifying services, namely: services are more intangible, services are activities or a series of activities rather than things, services are at least to some extent produced and consumed simultaneously and finally customers participate in the production process at least to some extent [22].

On the other hand, there are many authors who argued that the distinctive features of services should not be an excuse for avoiding manufacturing concepts as a means of increasing the efficiency of service operations. For example, Bowen and Youngdahl (1998) argued that lean ideas transfer well from manufacturing to services provided they were employed with minor alterations [3]. Additionally Allway and Corbett (2002) claimed that lean principles can be applied to many service sector firms, with equally the impressive results achieved in the manufacturing sector [23]. In 2006 Radnor asserted that lean is transferable to the public sector and can be used to develop more seamless processes, improve flow, reduce waste and develop an understanding of customer value [9]. He found that lean is a suitable methodology for improving performance and embedding a continuous improvement culture in the public sector. Similarly Swank [5], Piercy and Rich [6], Delgado and Ferrerira [7] confirmed that lean approach can be applied to services.

There are some authors who suggested that services can benefit and gain the same advantages achieved through lean manufacturing, if the lean concept and tools are adapted and adjusted to cope with the organizational context. For example, Ahlstrom (2004) claimed that the principles of lean manufacturing can be applied in service operations, but with contingencies [24].

Apart from this debate, there are some existing instruments for evaluating lean in the service sector.

Kollberg *et al*. (2007) developed a model called "flow model". This model used to explore lean thinking initiatives in the Swedish health care. The main focus of the model was not measuring lean, but to measure lead times and their improvement in health care [25]. Also Sanchez and Perez (2004) assessed the changes towards leanness in services. Their model was implemented in Spanish service companies [26]. Furthermore Cuatrecasa (2004) assessed lean adoption in a hotel check-out service. Cuatrecasa established a methodology used in measuring the operations efficiency for the hotel check-out service [27]. Finally, Apte and Goh (2004)