

Introduction

Lean thinking is an extension of the Toyota Production System (TPS) (Womack, Jones, & Roos, 1990). Many existing studies and practical applications show that this methodology can effectively reduce the waste of production processes and can successfully perform pull production based on customer demand. Enterprises utilize lean thinking to reduce cost, improve quality and increase productivity (Riezebos, Klingenberg, & Hicks, 2009). However, there is a certain degree of difficulty in applying the concepts of lean thinking into the product development process (Haque & James-Moore, 2004). There are limited references to applying either lean thinking or TPS to the product development process. Related research mostly focuses on case studies to illustrate the seven types of waste as well as the ways to carry out lean product development.

The value stream mapping is an important tool to analyze the production process in order to identify the sources of waste in the process (Serrano, Ochoa, & De Castro, 2008). Since, a product development process, which is highly interactive, may involve hundreds of processes and may take several years to complete (McIvor, Humphreys, & Cadden, 2006), and certain wastes may exist during the process. Due to the nature of the tool, value stream mapping tools used in existing production systems, might not be suitable for applications in such complex product development processes. The main purpose of this study is to discuss how a design structure matrix (DSM), an engineering approach which is applied typically as a representation of complex development processes (Sharif & Kayis, 2007), may be applied as a value stream mapping tool in the product development process in order to reduce certain wastes.

In the analysis of a product development process based on DSM, the tool would become useful in identifying the seven types of waste (overproduction, waiting, transport, inappropriate processing, unnecessary inventory, unnecessary motion, and defects) in lean product development. Now that the types of waste could be identified, managers would have a better insight of the product development process and develop appropriate policies to reduce different types of waste. A simplified case will be included in this study to illustrate how the methodology developed by this manuscript can enable the enterprises in early supplier involvement and information system application in order to reduce waste in the product development process and become leaner in the collaborative environment.

Related Research

Lean Product Development

Lean product development applies the concept of lean thinking to the product development process. The focus of lean product development is to reduce waste. Lean product development was initially proposed in *The Machine that Changed the World* in 1990. Cases about product development performance were compared and the results showed that lean product development can result to shorten product development time, reduce working time and improve product quality (Womack et al., 1990). Lean product development consists of several characteristics: leadership, teamwork, communication and simultaneous development. Currently, there are still few studies about lean product development. Karlsson and Ahlstrom (1996) discussed that supplier involvement, cross-functional teams, simultaneous engineering, integration of activities, strategy management, block-box engineering and other methodologies could assist enterprises in implementing lean product development.

Haque and James-Moore (2004) developed five steps of lean thinking: specify value, identify the value stream and eliminate waste, make the value flow, let the customer pull the process, pursue perfection, and how the steps can be applied in new product development. As for the definition of the seven types of waste, existing studies defined them using the product development information management perspective (Haque & James-Moore, 2004; McManus & Millard, 2002). Definitions of seven types of waste by different scholars are listed in Table 1.

Methodology and skill utilized in structurization to describe the business process, enabling sources of waste in the process to be identified, and helping wastes to be reduced (Abdulmalek & Rajgopal, 2007; Serrano et al., 2008). Most of the previous studies focus on exploring the application of value stream mapping tools in the production process of enterprises. Tools for value stream mapping include process activity mapping, supply chain response matrix, production varietyfunnel, quality filter mapping, demand amplification mapping, decision-point analysis, and physical structure mapping (Hines & Rich, 1997). Note that existing studies have not explored the value stream mapping tools utilized in lean product development in depth. Limited stream value mapping tools are mentioned in the previous studies besides Gantt and PERT charts, IDEF0 and IDEF3 (Haque & James-Moore, 2004).