A Simulation Study of the Effects of Applying JIT Manufacturing Techniques in a Job Shop Environment with Kanban-based Production Control

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ABSTRACT

Just-in-Time (JIT) manufacturing has long been considered effective for improving the performance of job shop manufacturing. For application in a job shop environment, the most often suggested JIT techniques include: cellular manufacturing, processing and transporting parts one at a time (i.e. single-unit production and conveyance), demand-pull production control with the Kanban (i.e. a visual signal), employing faster material handling facilities, and reducing the variability of setup / processing time.

However, how and to what extent these suggested JIT techniques can affect the performance of job shop manufacturing is still not well explored. Accordingly, the motivation behind this study was to gain more understanding of the effects of implementing the suggested JIT techniques on the production performance in a job shop environment. Two simulation experiments were carried out to investigate the effects of five influential factors that are related to the application of the JIT techniques in a job shop.

The findings through this study show that functional layout was more suitable for a Kanban-controlled job shop when the achievable amount of setup time reduction through the use of cellular manufacturing was small. On the other hand, if a large setup time reduction was achievable through cellular manufacturing, cellular layout should be adopted. As for a medium amount of setup time reduction achievable through cellular manufacturing, the performances for the two layouts were similar, except that cellular layout was more suitable with a medium to low setup time variability.

Although the use of single-unit production and conveyance (SUPC) in cellular layout had been emphasised by many JIT proponents, we found that SUPC was only suitable for a Kanban-controlled job shop with unidirectional intra-cell production flow and a large amount of setup time reduction achievable through cellular manufacturing.

The effects of material handling speed and variability of setup / processing time were not as essential as those of other influential factors. Therefore, to attain better performance for job shop manufacturing with Kanbans, employing faster material handling facilities and reducing setup / processing time variability should only be considered after the selection of appropriate shop layout and production flow patterns.

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