

Chapter 5

Workload Control: Emphasizing Speed to Beat the Competition

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ABSTRACT

Global competition and changing customer requirements are putting major challenges in the production planning and control systems of manufacturing enterprises. Production planning and control requires robust methods able to cope with demand variability, processing times variability, routing sequences, resource availability, etc., between other sources of variation. Production planning and control significantly influences target performance criteria such as the delivery time, on-time delivery, work-in-process inventory, and resources utilization. Therefore, production planning and control is strategically important for the economic success of these enterprises and innovative production planning and control methods are required. This chapter describes how workload control, a leading production planning and control system for small- and medium-sized enterprises, operates and illustrates how it aids in shortening and stabilising throughput times based on a simulation study of a small made-to-order production system.

1. INTRODUCTION

In today's highly competitive and globalized markets, offering short and reliable delivery dates is essentially for the generality of the manufacturing enterprises. For these enterprises competing by implementing speed means finding ways to reduce the responding time to customer demands. Time-based competition focus on throughput time reduction throughout the production system, from the time the customer places an order until the customer receives the product. This includes the

ability to reduce the time it takes to manufacture products (manufacturing throughput time) as well as the ability to reduce the time between taking a customer's order and delivering the product (delivery speed). To attain these goals, both innovative manufacturing system and innovative Production Planning and Control (PPC) are required.

WorkLoad Control (WLC) (Bertran & Wingaard, 1986; Kingsman 2000; Stevenson & Hendry, 2006) is PPC approach that attempts to manage the manufacturing throughput time, and thus the delivery speed. It is particularly appropriate for

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the high-variety and low-volume production, characteristic of the small and medium-sized enterprises (SMEs) operating in the make-to-order (MTO) sector of industry (Stevenson, Huang, Hendry & Soepenbergh, 2011; Hendry, Huang & Stevenson, 2013), either Repeat Business Customizers or Versatile Manufacturing Companies. It is based on the well-known Little's formula (Little, 1961) aiming at firmly controlling throughput times by means of input/output control (Wight, 1970), where the input rate of work is controlled in accordance with the output rate. Input/output control makes it possible to control the length of the queues on the shop floor and reduce shop congestion, thus shortening and stabilising throughput times. Predictable throughput times, in turn, can be used to establish reliable and competitive due dates for customers' orders.

Several WLC methods have been proposed in the literature (see e.g., Land & Gaalman, 1996). The most comprehensive encompass four stages of input/output control, namely: customer enquiry, job entry, job release and priority dispatching. The effectiveness of WLC methods has been demonstrated throughout a number of simulation studies, see e.g., Oosterman, Land & Gaalman (2000), Land (2006), Thürer, Stevenson, Silva, Land & Fredendall (2012) and Fernandes, Land & Carmo-Silva (2014). However, reports of successful implementation in practice are limited (e.g., Bechte, 1988, 1994; Hendry et al., 2013). Part of the reason for this is that practitioners are often unfamiliar with WLC (Stevenson and Silva, 2008).

This paper details the WLC approach to PPC and illustrates its benefits to shortening and stabilising throughput times by means of a simulation study of a simple production system. The simulation study provides a preview of the expected operation as well as estimations of key performance indicators when the production system is operated under workload control.

2. LITERATURE REVIEW

Simulation has been the predominant research method in the WLC literature until now. A number of implementation issues, towards the alignment between WLC theory and practice, have been discussed. Hendry, Land, Stevenson & Gaalman (2008) produced a comprehensive list of issues, categorised into the following categories: customer/market related; production process issues; WLC system issues; organisational embedding issues; and information flow issues.

This section makes a concise review of simulation studies in WLC literature relating performance to aspects of the production process to be controlled. This includes aspects such as, shop floor routings, sequence-dependent set-up times, assembly requirements and bottlenecks issues.

Concerning the impact of shop floor routings on WLC, Oosterman et al. (2000) studied the influence of the routing direction on the performance of release methods. Simulation results indicate that the relative performance of these methods changes with the presence or absence of a dominant flow direction in the shop. The corrected aggregate load approach to workload accounting showed to be the most robust to variations in flow characteristics.

Later, Henrich, Land & Gaalman (2006, 2007) studied the effect of grouping machines into capacity groups and controlling the load of the capacity groups rather than the load of each individual machine. It was verified that increasing machine interchangeability, leads to performance improvements and that deciding on the job routing as late as possible, with a common queue for the machines of each capacity group, results in the best performance. However, under a low degree of interchangeability it was observed that it is more attractive to place machines in separate capacity groups and to make the routing decision at job release. This enables more detailed load balancing.

Sequence-dependent set-up time is an issue that has received attention in the WLC literature in recent years. Contributions for understanding

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