Chapter III

The Effects of Uncertainty on ERP-Controlled Manufacturing Supply Chains

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Abstract

The use of enterprise resource planning (ERP) is becoming increasingly prevalent in many modern manufacturing supply chains. However, knowledge of their performance when perturbed by several significant uncertainties simultaneously is not as widespread as it should have been. This chapter presents the developmental and experimental work on modelling uncertainty within an ERP multi-product, multi-level dependent demand manufacturing supply chain in a simulation model developed using ARENA/SIMAN. To enumerate how uncertainty affects the performance of an ERP-controlled manufacturing supply chain, the percentages of finished products delivered late (FPDL) and parts delivered late (PDL) are measured. Sensitivity
Analysis shows that PDL gives a more accurate effect. Simulations results are analysed using analysis of variance (ANOVA), which identifies four uncertainties namely late delivery from suppliers, machine breakdowns, unexpected/urgent changes to machine assignments, and customer design changes significantly affect PDL. Some uncertainties are found significantly interactive in two and three-way. They produce either knock-on and/or compound effects, a factor not generally recognised as a criterion for decision-making.

Background and Literature

Modern manufacturing supply chains are facing increasing pressure to improve its responsiveness to market dynamics. Central to this are the issues addressed by production planning and scheduling system. Customer expectations for shorter delivery lead-times, greater agility, improved quality, and reduced costs have made the effective application of an appropriate system a significant determinant of survival for many manufacturing enterprises. Within a batch manufacturing supply chain, material requirements planning (MRP), manufacturing resource planning (MRPII), or enterprise resource planning (ERP) is the ideal system for producing work order (Enns, 2001). Since MRP logic is deployed within MRPII and ERP, when they are used for planning and scheduling, the planned order release (POR) schedule outputs are identical (Koh & Saad, 2002; Moon & Phatak, 2005). This research refers to the use of these systems in batch manufacturing enterprises as ERP-controlled manufacturing supply chains.

To elaborate the emergence of ERP and how this system yet is still incapable in tackling uncertainty, let’s discuss the characteristics of this system. In the 1960s, Oliver Wight and Joseph Orlicky introduced MRP (Wight, 1981). It was designed and developed to operate within a stable and predictable batch manufacturing environment; and it was defined as a set of back scheduling techniques that uses bill of materials (BOM) data, inventory data, and a master production schedule (MPS) to calculate net requirements for materials. MRP run takes place by offsetting parts’ due date with planned lead-time from the upper to the lower levels in the BOM. Output from the run is a POR schedule, which contains order number, part number, net requirement, release date, and due date for all orders in the MPS. The POR schedule is used to release order to the manufacturing supply chain and execute purchase or manufacture operations.

MRP assumes infinite capacity as no consideration is given to used and available resources capacity in generating the POR schedule. Both planned purchase and manufacture lead-times are pre-determined, which ignore variation in lead-times, for instance, delay resulting from late delivery from suppliers or machine breakdowns.
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