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Lean *vs.* Theory of Constraints in the wider supply chain: Delving into the impact of noise

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Keywords: Supply Chain Management; Kanban; DBR; Multi-Agent System.

1 Introduction

LM and TOC have largely proven to define efficient strategies for managing production systems (e.g. Watson and Patti, 2008; Puche et al., 2019). There are important similarities between them, with the main divergence emerging from their operational goal: LM aims to increase profits by minimizing waste, while TOC prioritizes the maximization of the throughput (Moore and Schinkopf, 2008).

Nowadays, the design of collaborative strategies for supply chains is gaining ground as a key source of competitive advantages (Simatupang and Sridharan, 2002). Accordingly, an increasing number of organisations is moving the scope of their Lean Management (LM) (Ohno, 1988) and Theory of Constraints (TOC) (Goldratt, 1990) solutions from the production system to the wider supply chain.

2 Objectives

Building on previous works in production systems (e.g. Grünwald et al., 1989; Koh and Bulfin, 2004; Watson and Patti, 2008), we extend the LM *vs.* TOC analysis to the supply chain context. We investigate their robustness against the noise, by expanding the two-level scenario considered by Puche et al. (2019).

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3 Methods

We study a four echelon supply chain with the following noise sources: demand variability, lead time variability, defective products rate, capacity constraints, and production, shipping, and storage costs. We explore the supply chain when it operates according to the Kanban and the Drum-Buffer-Rope (DBR) inventory control systems, respectively from the LM and TOC paradigms. We measure the supply chain net profit through agent-based modelling and simulation techniques. We use ANOVA techniques to analyse the results obtained with both control systems.

4 Results

By considering six increasing levels of compound noise, we observe a negative relationship between the net profit and the severity of the noise for both the LM- and TOC-based supply chains. That is, both lose profit as the noise become more severe. However, the strength of the relationship is more noticeable for the Kanban system; the DBR-based supply chain thus being more robust against noise. Interestingly, we observe that the difference in performance between them, favourable to DBR, grows significantly as the noise becomes more demanding.

5 Conclusion

This study provides clear evidence that the LM *vs.* TOC dilemma in supply chain settings strongly depends on the severity of the noise environment. We observe that TOC is a better option in uncertain and/or dynamic supply chain scenarios, while Kanban offers a similar performance at a lower implementation cost in foreseeable and/or static ones. Further studies are necessary to investigate in detail the relationship between noise and net profit. Ungrouping the noise compounds into their individual components may be a research avenue worth pursuing.

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