

A branch and bound algorithm equipped with tighter lower bound values for makespan minimization on a batch processing machine

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Abstract: In this paper, the problem of scheduling jobs with non-identical sizes has been studied on a single-batch processing machine, in order to minimize the makespan. Using new lower bounds, a branch and bound algorithm has been proposed to solve the problem. In this algorithm, two new methods have been used to generate lower bounds and results have been compared with the existing lower bound in literature. In order to evaluate the performance of the proposed method, test problems have been randomly generated and branch and bound algorithm has been tested with different lower bounds on these cases. Findings indicated that when the size of the jobs is large compared to the capacity of the machine, the branch and bound algorithm with the new lower bound has the best performance. When the size of the jobs is small compared to the capacity of the machine (up to half the capacity of the machine), the algorithm with existing lower bound has better performance. In addition, when the size of the jobs is neither large nor small, the lower bounds provide the best performance.

Introduction: Based on predictions, services are a key component of the growth of the global economy in future (Arnold et al. 2011). According to Jane and Kumar (2012), services play a critical role in a supply chain. Also, according to Wang et al. (2015), a "product" or "service" must exist in each supply chain which is produced by the upstream sectors and delivered to downstream. Recently due to increasing customer expectations, companies' competition has been replaced by the supply chains competition and as a result, competition has been increased in the simultaneous supply of products and services. This has led to challenges in integrating companies and in coordinating the materials, information and financial flow that were previously overlooked. Accordingly, a new managerial philosophy has been developed known as Product-Service Supply Chain (PSSC) (Stanley & Wisner, 2002). This study seeks to develop a performance evaluation model for the product-service supply chain in the home appliance industry, which is finally solved using Adaptive Neuro-Fuzzy Inference System (ANFIS).

Design/Approach: In this paper, performance evaluation constructs and criteria of service supply chain are identified by reviewing the literature and exploratory and confirmatory factor analysis and then, the performance evaluation of service supply chains in Iran's home appliance industry has been performed using these constructs, criteria and ANFIS.

Findings and Discussion: Based on the findings, ten main extracted constructs can be suggested for the performance evaluation of the supply chain. They include "Operational Performance (OP)", "Strategic Performance (SP)", "Financial Performance (FP)", "Performance of Information and

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Communication Technology (PICT)", "Return Performance" (REP), "Risk Performance (RIP)", "Logistic Performance (LP)", "Market Performance (MP)", "Internal Structure Performance (PIS)" and "Growth and Innovation Performance (PGI)", among which, the Strategic Performance (SP) and Return Performance (REP) are the most important and the least important constructs, respectively.

Conclusions

Based on the findings, the following practical recommendations are suggested to the companies:

- Enhancing the demand forecasts performance and utilizing more appropriate methods and software to improve forecasts in demand and order management areas.
- Improving the return management status by increased attention and more investment in return management processes.
- Effective investment in service development management to enhance the R&D services performance.
- Utilizing risk management approaches and methods to identify and take preventive actions on the risks in the companies' service supply chain.

Keywords: Product-service supply chain, Performance evaluation, Fuzzy neural network, Factor analysis, Home appliance industry

References

- Arnold, J.M., Javorcik, B.S., & Mattoo, A. (2011). "Does services liberalization benefit manufacturing firms? evidence from the Czech Republic". *Journal of International Economics*, 85(1), 136-146.
- Azar, A., Gholamzadeh, R., & Ghanavati, M. (2012). *Path-Structural Modeling in Management: SmartPLS Application*, Tehran: Publishing Knowledge Look.
- Rezaei Moghadam S., Yousefi, O., Karbaisan, M. and Khayambashi, B. (2018). "Integrated production-distribution planning in a reverse supply chain via multi-objective mathematical modeling; case study in a high-tech industry". *Production and Operations Management*, 9(2), 57-76.
- Zhou, H., & Benton, W. C. (2007). "Supply chain practice and information sharing". *Journal of Operations Management*, 25(6), 1348-1365.