Comparing Entropy Weighting Method and AHP for JIT implementation in a Manufacturing System

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Abstract:

Although some important criteria, such as work in process (WIP) and inventory, are recognized to have an impact on Just-in-Time (JIT) implementations, the exact weights of these criteria for different systems are not known. Consequently, the decision maker will not be able to predict the size of change in the system when implementing his JIT strategy. On the other hand, different weighting methods result in different weight values which makes it more confusing for the decision maker. We therefore consider entropy weighting method and Analytic Hierarchy Process (AHP) to compute the weights of the selected criteria. A case study is also discussed to demonstrate the differences between these two weighting methods. Simulation modeling is used to validate and compare the results.

Keywords: : Simulation Modeling, Just-in-Time Philosophy, Entropy Weighting Method, Analytic Hierarchy Process

We extracted four main strategies from several articles which were exploring the factors and elements influencing JIT implementations [1-4]. In the first strategy, raw material storage replenishment rate is changed. In the second strategy, several inventory buffers are placed between stations. In the third strategy, the quality of the products are increased to reduce reworking and lead time. Finally, in the fourth strategy, emergency maintenance of machines and tools is decreased to decrease the lead time.

The entropy method is an object empowerment approach, in which the weight values of individual indicators are determined by calculating the entropy and entropy weight. The greater the entropy is, the smaller the corresponding entropy weight will be. If the entropy weight is zero, it provides no useful information to the decision-maker, and this indicator may be removed [5]. On the other hand, AHP is a structured technique for organizing and analyzing complex decisions, based on mathematics and attitude. Quantitative methods are used to rank decision alternatives and select the best one given multiple criteria. These decision alternatives are

evaluated by numerical scores based on how well each alternative meets the decision maker's criteria [6].

We consider a case study representing a small part of a production line in a manufacturing company. Inventory, WIP, lead time, utilization, and output quantity are identified as indicators in this model. The system is simulated for 250 working days. We weigh these indicators using both entropy and AHP weighting methods in all predefined strategies. An average weight of all strategies is calculated for each indicator. The analysis carried out shows that inventory in production line is the most important factor (64%), while the second important factor identified as WIP (27%). Although researchers claimed the significance of lead time, output quantity, and utilization of resources, this study revealed that these indicators are not critical and their importance is very low (3%, 2.6%, and 2.6% respectively) to be effective on JIT implementation.

These initial results from AHP method displayed a distinct outcome from entropy method. AHP results indicate the importance of each indicator as follow: 30.9 % for inventory, 29.8% for WIP, 22.3% for lead time, 11.7% for utilization, and 5% for output quantity. This comparison demonstrates experts' points of view are different with entropy results. Future research would explore more the criteria which are effective in JIT implementation throughout the supply chain system. Other weighting methods could be considered to improve the comparisons analyses. Working on mathematical and heuristic decision making methods to discover the best mixed strategy in JIT implementation is another research direction we will explore.

References:

1. Benton, W.C., Hojung, S., *Manufacturing planning and control: The evolution of MRP and JIT integration* European Journal of Operational Research, 1998. **110**: p. 30.
2. Gonzalez-Benito, J., Suarez-Gonzalez, I. , *Effect of organizational variables in JIT purchasing implementation.* International Journal of Production Research, 2001. **39**(10): p. 20.
3. Meybodi, M.Z., *Benchmarking performance measures in traditional and just-in-time companies.* Benchmarking: An International Journal, 2009. **16**(1): p. 15.
4. Inmana, R.A., Saleb, R.S., Green, K.W., Whitten, D. , *Agile manufacturing: Relation to JIT, operational performance and firm performance.* Journal of Operations Management 2011. **29** p. 13.
5. Liping, J., M.K. Ng, and J.Z. Huang, *An Entropy Weighting k-Means Algorithm for Subspace Clustering of High-Dimensional Sparse Data.* Knowledge and Data Engineering, IEEE Transactions on, 2007. **19**(8): p. 1026-1041.
6. Russell, R.S.a.T.I., Bernard W. , *Operations Management*, ed. t. edition. 2003, Upper Saddle river, New Jersey: Prentice Hall.