COMPARISON OF HYBRID PRODUCTION CONTROL POLICIES BY MULTI-CRITERIA ANALYSIS

Research goals

Most manufacturing industries plan and control their production using classical methods such as inventory control, Material Requirement Planning (MRP) or Just-In-Time (JIT). Due to increasingly high customer expectations and highly competitive environment, new techniques of planning and control of the production have emerged in order to achieve better performance.

The main objective is to compare the performances of DSSPL (Double Speed Single Production Line) with other hybrid production control policies such as CONWIP and POLCA. There are many performances one should consider, including quantitative factors such as service level or work in process, and qualitative factors such as simplicity, flexibility or ease of implementation. In the presence of multiple performance measures, a multi-criteria analysis is implemented to derive a global evaluation and rank the different alternatives.

Modeling and simulation

A four-stage production line is modeled to serve as a benchmark. The hybrid production strategies are tested under the same assumptions and in the same environment of demand. The production line is subject to two types of demand: customer orders for A-items and for B-items. For each production strategy, the number of cards per loop is the only internal parameter to adjust. The models are tested for various number of cards per loop, the lower limit being the number of cards for which the model is saturated and the upper limit the number of cards for which the performance measures do not improve.

The main performance measures are the delivery lead time, the work in process (WIP), the throughput and the machine utilization. Performance measures are collected according several experimental designs: deterministic/stochastic service, variation of the workload or A/B volume ratio and change in the variability of demand for A-products. For each criteria, average and standard deviation performance are considered.

Application of AHP

Criteria weights are evaluated by pair-wise comparisons using judgments. A variant of AHP with its fuzzy extension is also proposed. The use of fuzzy numbers instead of exact values can integrate the uncertainties and vagueness in the judgment process.

A combined AHP and TOPSIS approach

The proposed methodology is to apply the Analytic Hierarchy Process (AHP) to determine the importance weights of the criteria which are then employed in TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) to evaluate and rank the hybrid production strategies.

Application of TOPSIS

Once the criteria weights are calculated by AHP, then TOPSIS is used to evaluate and rank the alternatives. The basic principle of TOPSIS is that the chosen alternative should have the shortest distance from the ideal solution and the farthest distance from the negative ideal solution. The ideal alternative has the best value for all criteria, whereas the negative ideal has the worst value for all criteria.

In the studied configuration, the overall rankings of alternatives show that DSSPL is the most preferred strategy, followed by CONWIP and POLCA which are relatively close.

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