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Abstract

In this paper a new heuristic algorithm based on the GTBM (Global Throughput Buffer Management) method is proposed questioning the Theory of Constraints which was originally published in the early 90's and also the method of dominant throughput applied in environments with shared resources and bottlenecks with variable location. It has been based on the typical configuration of discrete flow processes with parallel activities unbalanced and I made a simulation for comparative information. The effectiveness of 70.88% that is associated with PMA/GTBM algorithm versus TOC classic method is not negligible and after 1000 iterations random is possible to obtain sufficient confidence that there is no doubt to be taken into account. However, it remains a heuristic algorithm and, as such, is not 100% conclusive. Yet 29% of TOC classic method iterations allows a better solution. I saw that the new algorithm can overcome the traditional way of resolving the mix of product-service in terms of higher gross contribution margin and also could identify possible future research such as the application of variable transfer batches in order to increase the output rate without changing the productive resources.

Introduction

The production mix analysis about finished goods and services is a classic research problem of interest to industry, especially when Lean Thinking organizations pretend to improve the economic value of their processes.

GTBM (Global Throughput Buffer Management) is a theoretical model that considers these potential losses and to calculate more realistically the actual economic throughput of a value stream [1]. From a quasi-experimental simulation of discrete event, in this article a heuristic procedure is supported to determine the production mix that achieves maximum ROI in environments with shared resources and no fixed bottle necks.

In the first part of this paper, a literature review is prepared and then a critique of traditional models that solve this problem is presented.

Subsequently, the approach of a new algorithm is presented and then the results of a discrete event simulation are analyzed, in which changes are evident in the mixed solution that provides higher gross profit. Finally the findings are discussed to make conclusions and recommendations.

Literature Review

The optimization of the production mix that responds to a product-service mix in any company has been studied for many decades, because the profit must always be related to the installed capacity and gross margin generated by the products-services sold [1].

In the 50's, after World War II, there was a growth of mathematical models based on linear algebra that took force in quantitative methods of capacity analysis [3]. Since then, linear programming, integer programming, dynamic programming and transport models are widely spread, however, their deterministic rigidity and assumptions about the space of possible solutions were taken to explore other heuristic and stochastic approaches (given the nature of geometric growth of the possibilities of solution especially when it comes to many product lines-services and many sources of variability in productive resources) [2].

Global Throughput Buffer Management (GTBM) is an analytical perspective of economic throughput that questions the traditional way of calculating this indicator by the classical theory of constraints, that is, from the output of the bottleneck of a supply system. GTBM, in contrast, argues that must be calculated from the exit of the value stream according to the output rate of the products calculated as the inverse of takt time [1]. For a supply system, which typically has shared resources and productivity rates are subject to variability, global economic throughput can be recalculated under the GTBM perspective and consider the analysis of the overall weighted average of throughput for a production mix as follows:

Calculating the root mean square of the variation between the production rate of the value stream.

Calculate the weighted average throughput with respect to the proportional value of the amount allocated by each production mix being analyzed.

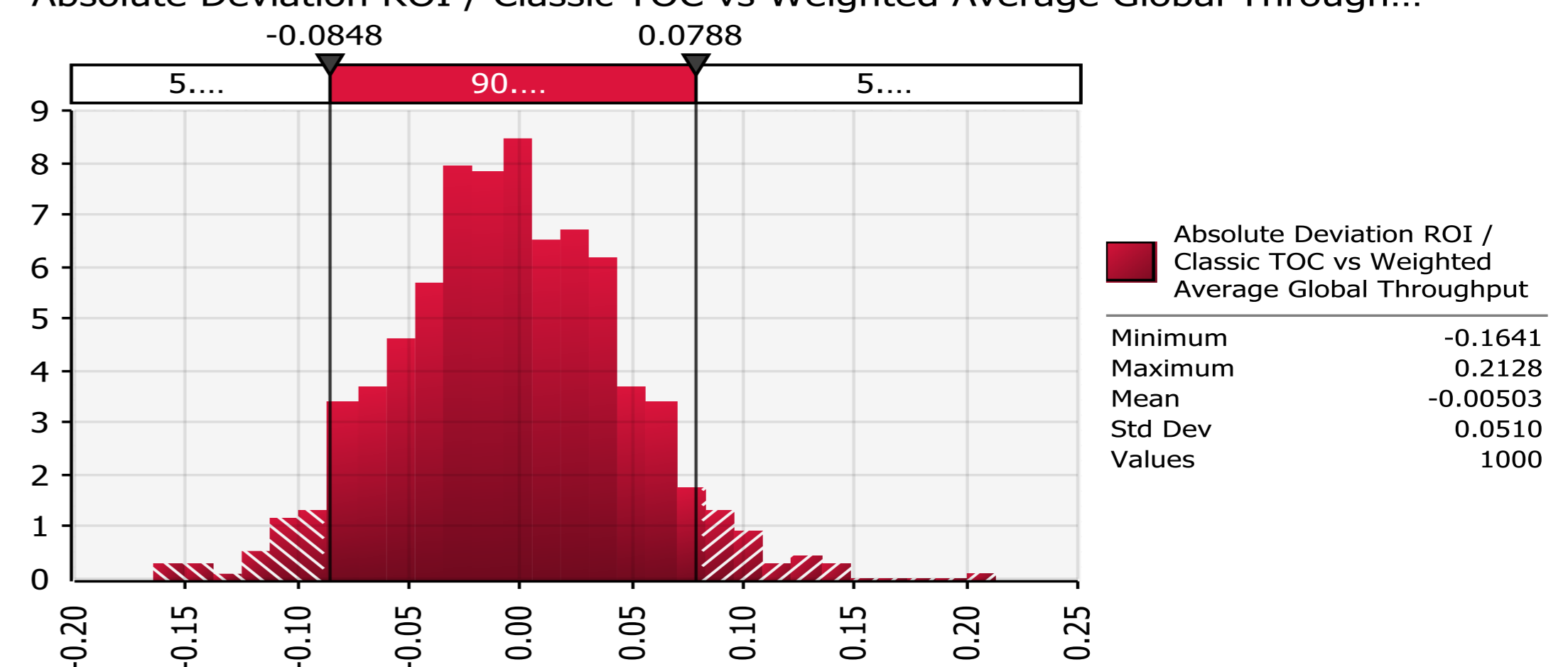
Results

The company has been selected as a case study is dedicated to the production of electronic devices with total assets reaching 125 million USD\$.

In Figure 1, the stochastic results are presented. It can be seen that the total gross margin contribution is higher for classical TOC solution versus the weighted method and this is associated with a higher ROI expected; in this case, about 0.5% which suggests a virtual tie (although it can be higher up 21.3%).

after 1000 iterations (finding that production times fit well with Weibull and lognormal distributions and levels of Scrap fit well with normal distributions) remains a tie between ROI indicators achieved with the two methods. When making an Anderson-Darling test for the results of the 1000 iterations can be inferred that these differences are distributed according to a normal function with a reliability of 95% (p -value > 0.15) and the probability that the TOC classic method to obtain a higher ROI is 50%.

Absolute Deviation ROI / Classic TOC vs Weighted Average Global Through...



Conclusions

The quasi-experimental simulation conducted for a production process of electronic devices with shared resources, rework, variability in production mix, resource availability and production time leads to the conclusion that the proposed algorithm based on GTBM method provides a more realistic view of the expected ROI on a value stream and determine the most effective production mix in terms of profitability.

References

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