LEAN / TOC AND SIMULATION AT HP

Nathan Guthrie & Jeff Buresh
Printing & Personal Systems
HP
1070 NE Circle Blvd
Corvallis, OR 97330, USA

ABSTRACT

Lean Methods and Theory of Constraints (TOC) are used in the Printing and Personal Systems group at HP to drive productivity improvements in existing and planned production lines through facilitated workshop events. Lean concepts are introduced to manufacturing teams, and are used to identify opportunities to increase efficiency. The teams are also educated on TOC as a method for managing the production line. Discrete Event Simulation (using WITNESS software) was added in order to increase the effectiveness of developing improvement plans during these workshop events. This presentation will discuss the added benefit of using DES analysis to refine and drive improvement activities, resulting in faster learning cycles, increased manufacturing output and ultimately increased revenue.

EXTENDED ABSTRACT

A few years ago, the Business Analysis & Modeling group in HP-Corvallis was asked to provide productivity improvement recommendations for an underperforming manufacturing line in HP's printing division, and to facilitate some Lean Manufacturing training sessions. As an outcome of this project, we developed a Lean & Theory of Constraints (TOC) initiative to help bring up new product manufacturing lines more efficiently and enable them to meet production goals. This initiative typically involves a production line evaluation (for existing manufacturing lines) and a training session to educate the manufacturing team on Lean and TOC concepts. We will then facilitate one or more workshops where the team will align on the biggest issues, generate ideas and develop an action plan for implementing improvements in order to meet business objectives. Lean concepts are taught in order to reduce waste and drive continuous improvement. TOC is used to provide line management focus on improving the right things (i.e. how does improvement "x" affect the line constraint?).

In the more complex segments of the production line, evaluation of line dynamics is slow and it is difficult to gauge how much (if any) improvement would be gained by some proposed improvement ideas given the complex interplay of machines, downtime, material changeovers, transportation devices, etc. This was a natural fit for DES, so we proposed a project to build a model of a production line and use the model in conjunction with the Lean & TOC workshop events.

A simulation model of a manufacturing line in HP's printing division was built using WITNESS software. The scope of the model covered the most complex portion of the manufacturing line, which consists of 28 process steps (including the line constraint) and uses multi-part shuttles on a track for the majority of the material handling between operations. Four operations use a consumable material that requires some machine downtime (based on usage) to change materials and to dial in the process. Unscheduled downtime was also modeled based on historical performance. The performance of this

section of the production line can be heavily influenced by a number of factors, including the number of shuttles, material changeover parameters, downtime interactions between machines, etc.

Lean/TOC workshop events were held with the objective to develop action plans for meeting production goals ahead of the product's manufacturing release date. The demand for this product was strong enough that any upside in production throughput would also translate directly into increased revenue for HP (if we could make it, we could sell it). The manufacturing team developed a long list of potential improvement projects during the first day of the workshop, using Lean concepts and TOC to guide and inspire ideas. The full factorial DOE of all applicable improvement ideas would entail about 4,000 simulation runs (about 300 hours), so a screening DOE was used to evaluate the first and second order effects. This reduced the total simulation run time to about 36 hours. Using the simulation analysis results, we were able to re-convene during the same event and develop a path forward to meet and exceed the throughput goal. Prior to the use of DES concurrent with these events, it took a couple of months to evaluate and develop an action plan for improvement ideas. As a result of using DES in conjunction with the Lean/TOC workshop events, the learning cycle was reduced from months to two days and throughput was increased by about 70%, delivering a significant amount of additional revenue to HP.