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C. Laroque, J. Himmelspach, R. Pasupathy, O. Rose, and A.M. Uhrmacher, eds

MATERIAL FLOW SIMULATION FOR PROCESS DEVELOPMENT AT A TELECOMMUNICATION'S FACTORY IN THE AMAZON REGION

Dalton Soares

Nokia
Av. Torquato Tapajós, 7200 km 12
Manaus, AM 69093-415, BRAZIL

Eduardo J. Quaglia

Nokia Institute of Technology – INdT
Av. Torquato Tapajós, 7200 km 12
Manaus, AM 69093-415, BRAZIL

Hélido Montenegro

Nokia
Av. Torquato Tapajós, 7200 km 12
Manaus, AM 69093-415, BRAZIL

ABSTRACT

This paper describes how a telecommunication company applies simulation modeling to develop a factory internal material flow Kanban process in the Manaus free trade zone, Amazon region, Brazil. Simulation and Process Development working together to identify bottlenecks and define proper resources for material replenishment on production lines fulfillment based on resources availability just like orders timeline, manpower, machinery capability and process cycle time, preventing risks to the factory. The main goal is a solution that provides production expected output keeping 42 assembly cells running in an optimized way. The model parameters for experimentation include quantities of resources for 6 different areas, ordering and kit request time schedule, following restriction from incoming warehouse, becoming a complex risk prevention exercise on material flow process. The model uses primarily statistical distributions for the conceptual phase, waiting for real data from the fully implemented system to improve the statistics.

SUMMARY

This paper presents a material flow (Wagner & Enzler, 2005) process simulation model developed for the Kanban material replenishment system applied to production lines fulfillment of a telecommunication factory restricted by borders of Manaus free trade zone, in Amazon region, Brazil. A case of success where simulation provided support for the Process Development area of the factory company (Kühn, 2006).

The system comprehends a supermarket which receives replenishment material from a warehouse, performs a kitting process and provides the kits for 3 hours provision to a production cell. Each kitting is started by a Kanban order and is performed in trolleys which, when completed, go to an audit area for quality assurance (to guarantee correct material and quantities for the kits). After the audit phase the trolley stays in a chessboard waiting for the correspondent production cell to be released for fulfillment.

The supermarket comprehends 4 replenishment areas with specific type of material handling (for instance, memories, box forming, accessories, etc.) and its respective groups of resources for fulfillment. It has dedicated resources for auditing and also for line feeding to cover 42 cells, which are split in three groups by level of output.

The simulation model uses statistical distribution for each replenishment area, the audit process, the line feeding and production cell tasks, mostly of them considering the production order size. Also, the

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model was implemented over the factory CAD layout to properly consider the distances traveled by the trolleys and other resources.

In order to minimize the chessboard and line feeding lead-time, also maximize the production cells run rate and output, the main goal of the simulation is to find reasonable numbers in terms of:

- employees
  - each of the 4 replenishment areas,
  - audit,
  - line feeding,
- cycle time
  - new order trigger,
  - chessboard out trigger.

The model was implemented using Simio (Kelton, Sturrock, & Smith, 2010). It became a heavy model mainly due to the number of path and node entities necessary for the flow between the supermarket and the production cells. The size of the model impacted the experiments performance requiring long time for running, database support for results treatment and timesheet for final analysis and presentation.

Simio has presented some limitation like: it is not possible using Simio standard library to have an operator riding a trolley to pick and deliver a kit to its cell, where the operator is a “worker” in the Simio nomenclature, the trolley is a “transporter” and the kit a “model entity” (necessary due to limited number of transporters and workers). Since there was not enough time for development of a specialized library, a satisfactory workaround using “resource” was developed.

The experiments followed two approaches:

- First approach tested a range of numbers for employees and cycle times to figure out: i) the minimum quantity for a good level of resources performance and ii) the most reasonable range of “new order trigger” and “chessboard out trigger” cycle times.
- Second approach made refining tests providing graphs (Figure 1) as a supporting tool for production to show the relation among new order trigger, chessboard trigger, production output and chessboard waiting time.

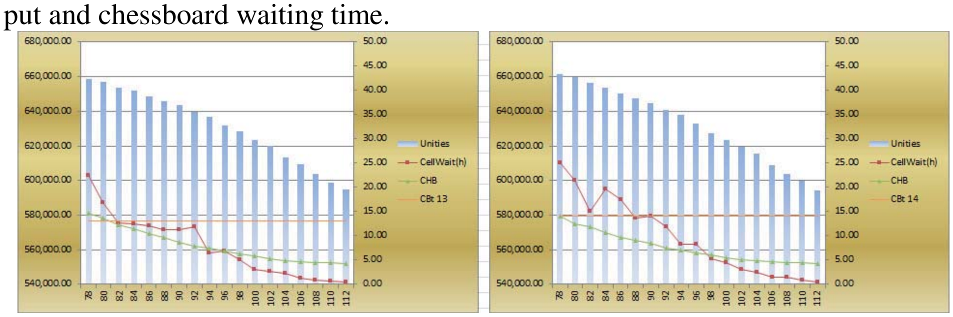

Figure 1: Tool for decision support.

The statistical distributions used were mostly triangular distributions, based either on a relatively poor set of data or from specialists guessing when there were not ways of measuring. Since the system shall be fully implemented in a few months, the customer intends to update the simulation model with data closer to reality and improve the model results analysis and benefit later factory adaptations.

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