Application of Simulation Technologies in an Ice Cold Merchandisers Manufacturing Case

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Frigoglass is a Hellenic-based global corporation, specializing in the design, manufacture and marketing of ice cold merchandisers (ICMs) and the production of glass containers. Frigoglass has more than 15 production facilities in 19 countries, customers (Coca-Cola, Pepsi, Nestle, etc.) in more than 100 countries and invests substantially in research and development.

Manufacturing scenario description

Frigoglass produces more than ten different models of ICMs using a batch manufacturing technique. The main types of manufacturing processes used for ICMs are: steel sheet forming, painting and assembly operations. The aforementioned types are further specified in seven manufacturing operations including, forming, subassembly, insulation, cooling mechanism subassembly, electrical mechanism subassembly, door's subassembly and final assembly. After the raw materials and components are delivered by the suppliers to Frigoglass, each ICM model undergoes though a sequence of these series of manufacturing operations assigned to a limited number of production resources, following varied process plans according to its particularities. The lot sizes are in most cases fluctuating and fast decisions are of crucial importance.

Production planning for such complex manufacturing environment is indeed considered a core activity for profitable and sustainable operation of the company. Until recently however, Frigoglass carried out the detailed scheduling of the shop floor activities for over 15 production facilities using Excel based Gantt charts. The charts were "optimized" using previous experience of production managers and rules of thumb. The deriving solutions were sub-optimal, hard to maintain, difficult to interpret and in many cases even non-feasible due to violation of pre and post production constraints and miscalculated time slots.

Approach and results with simulation technologies

Towards that end, the Lab for Manufacturing Systems and Automation (LMS) from University of Patras in cooperation with the Production Planning department of Frigoglass developed, tested and applied intelligent short-term scheduling simulation software for supporting the daily production design and planning needs of the company.

The simulation tool generates detailed production scheduling alternatives, evaluates them based on multiple performance indicators and visualizes the optimal results. Moreover, the tool has enabled the immediate redesign and simulation of the production line following different setups, such as cellular manufacturing and classical work-center structures. In addition, the experimentation with different dispatch policies is also enabled for the company. More than ten search heuristics have been implemented and can be selected for evaluating different production scenarios together with an intelligent scheduling method that provides high quality schedules requiring minimal computation resources.

The developed simulation tool is nowadays integrated in the daily design and planning activities of the company and has vastly improved its operational performance. This is demonstrated by the improvement of Key Performance Indicators (KPIs) of the company, such as increase of machine utilization, reduction in production flow time and makes span. The improvements reached ~70% in some cases as visualized in the diagram. The following dispatch policies were used for simulating diversified company objectives: FIFO (First in First Out), LIFO (Last in First Out), SPT (Shortest Processing Time) and ISA (Intelligent Search Algorithm).

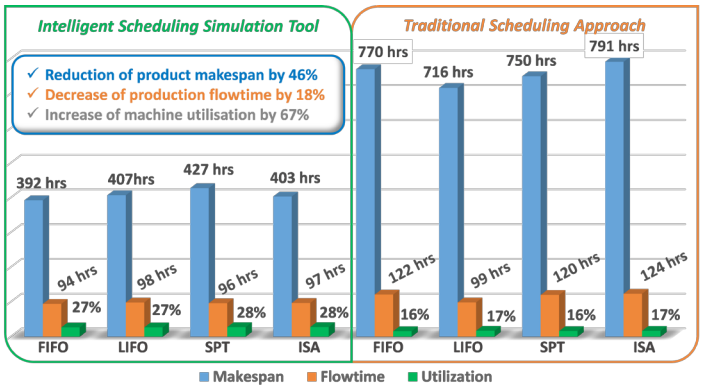

Fig. 1. Improvement in KPIs after the utilisation of the Intelligent Scheduling Simulation Tool

Benefits for the Company

- Substantial improvement in KPIs and intuitive results visualization
- Reduction in the manpower required for data entry, manipulation and processing
- Decrease in human-introduced errors and enabled trial and error experiments

Key Success Factors

- Utilization of Real-life Data for the development, testing and optimization of the software
- Commitment of both developers and end-users of the tool and good collaboration
- Ease of use, extensibility, scalability, integration / interfacing capabilities of the software