Proceedings of the 2016 Winter Simulation Conference
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AUTOMATICALLY GENERATING FLOW SHOP SIMULATION MODELS FROM SAP DATA

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ABSTRACT

Automatic model generation, the consequential reduction of problem solving cycles and the need for a higher degree of data integration have long been characterized as significant challenges in the field of simulation of manufacturing systems. Especially operationally used manufacturing simulation models require a high degree of modeling detail and thus depend on a significant amount of input data. In many cases, the time and effort required to manually build such a detailed model and keeping it up-to-date are prohibitive. This paper describes a practical case in which entire simulation models of a complex and large scale automotive flow shop production were automatically created from an automotive company's SAP and MES systems in order to support operational planning purposes and reduce operational logistical risks, such as production disruptions caused by stock-out situations at the manufacturing line.

1 INTRODUCTION

Fowler and Rose (2004) state that an order-of-magnitude reduction of problem solving time and the lack of a real-time problem solving capability are among the greatest challenges in modeling and simulation of manufacturing systems. According to them, the time to design a simulation model, collect data, build and execute the model, and interpret the results is too long, especially for the operational use of simulation. Furthermore, they state that the automatic and on-demand generation of entire simulation models from company data sources would significantly increase the applicability of simulation for operational planning purposes.

In line with these findings, this paper describes a practical case in which entire simulation models of complex and large scale automotive flow shop production lines were automatically created from the company's SAP and MES systems in order to provide operational planning support. For that purpose, not only the required master data (e.g. bills of materials, routings etc.) and the latest transactional data (e.g. order data) were loaded into a predefined simulation model template but additionally structural information (e.g. workstations, links etc.) was automatically retrieved from the company's IT systems and used to automatically generate the simulation model.

2 SIMULATION MODEL SCOPE AND REQUIREMENTS

In the automotive industry lean production principles are widely implemented, obliging companies to balance cost saving inventory reduction activities and operational risks, such as stock-out situations at the manufacturing line. The purpose of the described simulation model is to act as an early-warning-system and detect potential stock-out situations before they occur so that counter-measures can be assessed and initiated. Therefore, the scope of the model covers the entire in-house logistics processes of the company from the parts retrieval in the warehouse to the consumption at the manufacturing line.

The requirement of operational planning support using simulation derives from the complexity of the planning process and the high number of system parameters that need to be controlled by a limited number of planning personnel on a daily basis. Because of frequent changes to both, master data and transactional data, and even structural changes of the line layout two technical requirements existed. First, the model should be ready to use within a very short period of time while still containing the latest data. Second, the process of incorporating the company's data and creating the model should not involve manual tasks causing potential errors, time delays and inefficiency.

3 TECHNICAL APPROACH

In order to fulfill the aforementioned requirements, a generic flow shop simulation model template capturing the company's specifics was developed using SIMIO. Following the object-oriented modeling approach of SIMIO, simulation model objects, representing specific elements of the real system, were created. The specific instances of the modeling elements were then placed into a blank model on an on-demand basis using a custom built extension to SIMIO. This extension allows to generate entire flow shop models by automatically placing, connecting and parameterizing these predefined model objects into a simulation model. The data required to generate the model was extracted from the company's SAP and MES system using a custom built data extractor software which directly retrieves the relevant data from the respective system's databases. The SAP system provides the information to model the manufacturing line, such as details about workstations, routings, bills of materials, shift plans, manufacturing orders, stock levels, material master data etc. The MES system provides detailed information about production sequences and the current and planned production progress per workstation and manufacturing order.

Figure 1 describes four stages of data integration of simulation applications. The chosen approach represents the fourth stage of data integration.

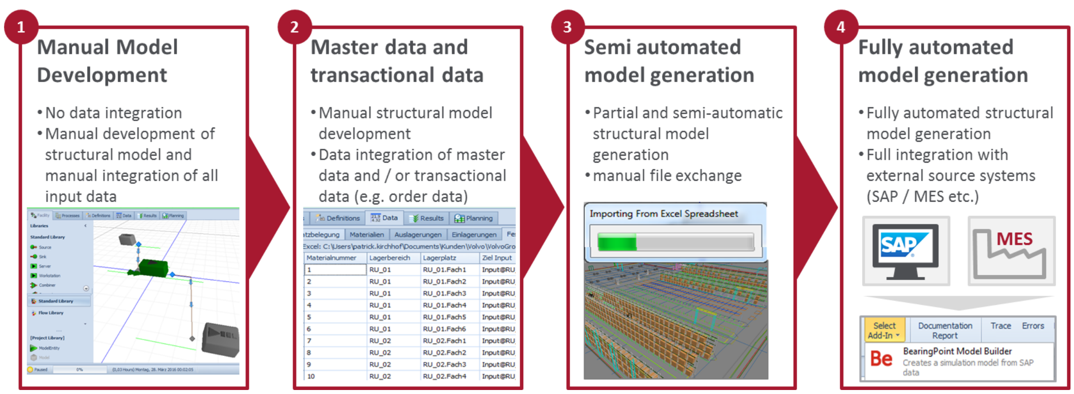

Figure 1: Data integration stages of simulation applications.

4 RESULTS AND BENEFITS

Following the described approach led to a simulation solution that was fully integrated into the operational planning process and the IT architecture of the company. It helped the planning personnel of the company to prevent logistical problems and production disruptions. The simulation results were displayed in such a way that operational risks were highlighted and the problems could be easily identified by the planning personnel. During the course of a single structural change project more than a hundred critical issues were identified and preventatively corrected and thereby helped to significantly reduce production disruptions. Because of the automation of the model generation, the problem solving cycle is significantly reduced compared to the manual creation of simulation models. Furthermore, the approach is suitable for large-scale models with a high degree of modeling detail which are required for operational planning support.

REFERENCES

Fowler, J., O. Rose. 2004. "Grand Challenges in Modeling and Simulation of Complex Manufacturing Systems". *SIMULATION* 80 (9): 469–476.