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IMPLEMENTING DDMRP IN A BOTTLING PLANT USING SIMULATION

Chad Smith[1], Gerrit Zaayman[2], and Christine Watson[2]

[1]Demand Driven Institute (DDI), Seatle, WA, USA
[2]Simio LLC, Sewickley, PA, USA

ABSTRACT

This presentation will explain how bringing DDMRP together with a Simio Adaptive Process Digital Twin has resulted in a new and exciting development in the supply chain industry – and an ideal solution for the design, test, optimization, and execution of a Demand Driven Material Requirements Planning process. The presentation will cover the implementation of DDMRP for all relevant ranges to include the Demand Driven Operating Model (operational range), Demand Driven S&OP (tactical range) and Adaptive S&OP (strategical range) for a bottling supply chain.

1 INTRODUCTION

Simio has created an agile platform for developing Adaptive Process Digital Twins that can be deployed offline and/or online for both predictive and prescriptive applications to facilitate comprehensive digital transformation and process re-engineering initiatives. A Simio Adaptive Process Digital Twin is a data generated and driven, object oriented, 3D simulation model that accurately replicates the physical behavior of complex processes when run on Simio's discrete event simulation platform. The Simio Adaptive Process Digital Twin captures the current process in detail including all physical constraints, business rules, and detailed decision logic to serve as a process and operational knowledge base and reference model that can be used to evaluate all future changes and system performance. An Adaptive Process Digital Twin powered by Simio's discrete event simulation platform is an ideal solution for the design, test, optimization, and execution of DDMRP as a replenishment methodology to manage material flow that includes order generation for procurement, manufacturing orders, and stock transfers. This presentation will cover how to use the Simio Adaptive Process Digital Twin for the implementation, testing and execution of a DDMRP implementation for an end-to end bottling supply chain. It is applied to all three relevant planning ranges including the Demand Driven Operating Model for the short-term operational range, Demand Driven S&OP for the medium term or tactical range as well as Adaptive S&OP used for longer term strategical planning and decision support.

2 EXAMPLE CASE STUDY FOR A BOTTLING SUPPLY CHAIN

The Bottling supply chain consists of 2 suppliers providing bulk, colorants and bottles, a factory for mixing, filling and packing of the final SKUs, a factory warehouse for central storage and distribution of finished goods as well as 4 warehouses for final distribution to the regional markets served by each warehouse.

A data generated and data driven simulation model was developed using Simio's data tables. Resources in the factory, such as mixing tanks, storage tanks and filling machines are defined and generated using a Resources table that includes the custom Simio object type and X/Z/Yaw location in the Facility window. Employees and equipment such as trucks and AMRs are generated in a similar fashion. Material master data, as well as bill of materials, routings, and detailed information are stored in data tables. Both past and future demand for raw materials, component and finished goods, along with DDMRP master setting parameters, such as buffer profiles, decoupling points, lead times, MOQ and ADU calculation types, is used to calculate the Average Daily Usage, Decoupled Lead Times, Buffer Zone Sizes and Qualified Spike Demand data required by DDMRP. Simio includes a DDMRP ribbon with the calculators necessary to generate these values daily from the input data tables. During the simulation, these time-indexed tables are used with a daily review of the buffer zones for each material/site combination (inventory). Simio includes an Inventory Review Log that evaluates the net flow position of each inventory and determines the recommended order quantity if the on-hand inventory is below the top of the yellow zone. This log provides detailed simulation information such as quantity in stock, on order and backordered, as well as qualified spike demand and red/yellow/green zone sizes for each inventory daily. The On Replenishment Order Process for the replenishment policy is then used to detail the process logic required for generating orders.

Simio output tables are generated during the simulation that provide purchase orders, demand orders and stock transfer orders recommended by the DDMRP logic. For demand orders, based on the recommended order size and processing batch sizes, multiple filling orders and corresponding mixing orders are generated. As the simulation runs forward in time, all factory resources are scheduled based on material availability, employee certification and shift availability, and other constraints specified. For example, a Valid Resources table includes the material/resource combinations, cycle times and operating efficiency, as some finished good materials can only be processed on specific filling machines. This, along with changeover times for changing SKU, bottle size or formula are considered when dispatching filling orders to machines.

The simulation model can be used for decision making within the operational, tactical and strategic timelines. Users can evaluate the impact of preventive maintenance on resources or weather transfer times on trucks, utilizing the Planned Adjustment Factors table for zone or demand adjustments. Strategic evaluation of new products, or increased demand forecasts allow users to plan for factory and warehouse capacity constraints. Experimentation of multiple scenarios can be used to evaluate key system KPIs.

3 CONCLUSION

This example case study clearly demonstrates the Simio platform included features and functions specifically developed to support the accurate modeling of any DDMRP replenishment driven supply chain. DDMRP specific functionality includes the DDMRP replenishment method as part of the Simio inventory element, DDMRP specific calculators with associated data table schema/templates for inputs and outputs, and DDMRP specific dashboards. The Simio Adaptive Process Digital Twin is a key success component for supply chain design and planning going into the future. It provides both a system-wide aggregated view of the state of the system, as well as a means of predicting forward in time (crystal ball approach) to see the expected future state of the supply chain. Currently companies mostly rely on analysis of historical data and performance (rearview mirror approach) to help them decide what to adjust and do differently to improve the process going forward. When attempting to implement a new and innovative material management methodology such as DDMRP the ability to optimize the master setting of the demand driven operating model (DDOM) before putting it into actual operation is invaluable as it will prevent costly mistakes and avoid experimentation on the actual factory or supply chain.

REFERENCES

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