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VIRTUAL FACTORY FOR CORN SEED MANUFACTURING FACILITIES

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ABSTRACT

This case study presents an overview of the Virtual Factory developed for North America Corn Manufacturing Facilities at Bayer Crop Sciences. In this talk, we will cover: process complexity of corn manufacturing, input data analysis (equipment data from OEE, MES, & data historian and production plans), output analysis, and an overview of various business scenarios. We will conclude our talk by providing our perspectives on the various challenges and opportunities from a practitioner's viewpoint.

1 INTRODUCTION

After corn is harvested in the field, it is transported to the manufacturing facilities by trucks for processing and packaging. Corn manufacturing facility can be divided into four major areas based on the various operations: receiving (husking & sorting), drying & shelling, conditioning (cleaning and sizing), and finishing (treating & packaging). Along the process, there are several inventory buffers between the operations to store the work-in-process inventory. The finished goods inventory is stored in the warehouse after the packaging operation is complete. The scope of this virtual factory includes the conditioning and finishing operations.

2 PROCESS OVERVIEW

A few process complexities in corn seed manufacturing include: series of continuous flow and batching operations, change in units of measure (bushels to pound to seed count), complex push – pull system, product characterization and product family categorization, parallel unidentical machines, varying processing rate based on seed size and treatment type (or packaging type) at treaters (and packaging line), sequence dependent set up, reentrant product flow, among several others were all considerations and captured in the virtual factory implementation.

3 VIRTUAL FACTORY ARCHITECURE

3.1 Scenario Engine

Scenario Engine was created to automatically generate business scenarios based on several strategic business questions. The initial questions were mainly around estimating the operational capabilities to make capital decisions around equipment purchase.

3.2 Virtual Factory Development

We used several platforms including AnyLogic (simulation model development), Domino Datalabs (simulation runs on the cloud), R-Studio (statistical and predictive modeling), and IBM-CPLEX (running optimization routines within simulations).

3.3 Design of Experiments and Input & Output Data Analysis

Input analysis and distribution fitting for historical processing and equipment downtimes were estimated based on OEE & MES data. Based on the business scenarios we designed several experiments considering factors such as: treater and packaging line processing times based on seed size, treatments, and packaging type; run order of production orders; sequencing rules at treaters and packaging lines; equipment setup times; policies on using inventory buffers among others. Output reports from these experiments were analyzed and transformed in a way interpretable by business leaders.

4 DISCUSSION

During the development of the virtual factory, one of the major challenges we faced was around integrity and quality of various data elements, however, this also presented an opportunity to enhance the coverage of the existing sensors. Virtual factory provided valuable business insights regarding manufacturing capabilities to several organizations across Product Supply. Along with guiding key strategic capital purchase decisions, this work is now viewed as an enabler platform for identification of future innovations, inventions, and process improvements.