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A NOVEL APPROACH: SIMULATING EARLIER TO INCREASE BENEFITS

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ABSTRACT

Traditionally, warehouse automation systems are modeled once the system has been completely designed, approved, and a contract with the automation supplier has been decided. Digi-Key Electronics, "the world's largest selection of electronic components for immediate shipment", adopted a novel approach to simulation, where Digi-Key engineers started the simulation of concepts months before the system integrator is to be chosen. This approach allows Digi-Key to better understand the elements of the material handling design concepts that suit the changing business needs of the company, as well as providing insight into the business process requirements related to new concepts. Rather than wait for the system integrators to engineer and simulate the system, Digi-Key decided to simulate material handling system concepts required for concepts. This paper outlines aspects of Digi-Key's approach, and how Digi-Key and Diamond Head Associates worked together to achieve Digi-Key's goals for simulation.

1 INTRODUCTION

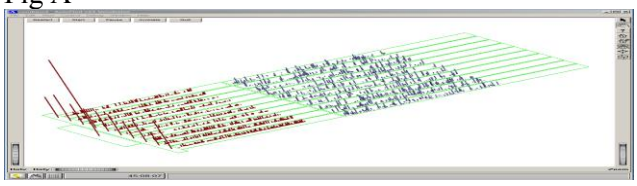
Digi-Key Electronics, is the fourth largest electronic component supplier in North America, and the fifth largest electronic component supplier in the world. The company was founded in 1972 by Ronald Stordahl, and the name Digi-Key comes from the "Digi-Keyer Kit" that Mr. Stordahl developed and marketed to amateur radio enthusiasts. A challenge that Digi-Key continually faces is having an adequate supply of labor for the Product Distribution Center. Digi-Key's goals and objectives are to augment PDC labor with automation.

2 MODEL DESCRIPTION

2.1 Abstract Model

An abstract process flow model was developed first, logic was defined and developed to model the flow of inventory to pick and pack stations, and then to a shipping area. The goal of the process flow model was to validate the process flow with actual order data prior to implementing material handling designs. The flow of product and station selection was controlled by model input settings so the team could test different schemes for product flow. The flow of product could be visualized with simulation to ensure that the model worked correctly. Fig A is a representation of the abstract model, showing the pick areas on the left (red) and the pack areas on the right (blue). Stacking in the Z dimension indicates how much activity is in the buffer for each station group.

Fig A



2.2 Material Handling Model

In parallel with the abstract model development, a model of the detailed conveyor design was built. This model included elements of detailed conveyor design like merges, diverts, lifts, and accumulating and non-accumulating conveyors. Model input settings were used to switch between the abstract model and detailed model when running scenarios. The detailed conveyor model was developed using AutoMod's sub-model feature so that the abstract model could be connected to the detailed conveyor model, and they could be developed in parallel.

2.3 Results and Analysis

While developing the model, understanding the results is important. Since there were many combinations of the input settings to compare, a matrix of scenarios with different settings was used. Using AutoStat, the project team automated a process to perform multiple scenarios and pull the output data back into Excel for analysis. The project team used a heat map to quickly sort and compare multiple columns of model outputs to determine the best possible combination. Fig B is a representation of the heat map, showing that scenario S208 is best when measured by Output 3. To protect Digi-Key's intellectual property, we have intentionally obscured the actual statistics.

Fig B

Scenario	Ouput 1	Ouput 2	Output 3
S208	1488.94	5.06	38975.01
S058	1489.21	5.06	39009.55
S059	1417.62	5.05	39020.26
S131	1489.42	5.07	39055.61
S207	1313.81	5.05	39064.99
S057	1512.56	5.06	39084.67
S209	1307.75	5.06	39212.70
S003	1387.83	5.06	39248.59
S039	1553.99	5.49	39314.86
	Seconds	Seconds	Seconds
MIN	1307.75	5.05	38975.01
MAX	1553.99	5.49	39314.86
DELTA	246.24	0.44	339.85

3 NEXT STEPS

The Digi-Key Simulation Group will continue to build out a model of concepts with alternate designs to help compare and determine the most cost effective and efficient automation design. The abstract model and associated logic will also be added to a model of our current system to help identify and drive process efficiency from Digi-Key's current material handling system. Abstract modeling will also be used to help identify and define test cases and criteria. This allows Quality Assurance more time to define test cases prior to the completion of construction and run tests to help determine expected results to compare against.

4 CONCLUSIONS

Digi-Key's modeling approach, combining an abstract model with material handling design model(s), enabled more informed decision making earlier in the design process. This allows management to visualize as well as understand the results of the design concepts. Digi-Key is currently evaluating two different design approaches using this model and the model will inform our design decisions in 2017. The abstract modeling approach and sub-models provided a framework for Digi-Key to perform parallel development of a large model, thus reducing model development time. The combination of improved model development time, and starting the modeling process earlier, helps Digi-Key leverage simulation results in their decision making.