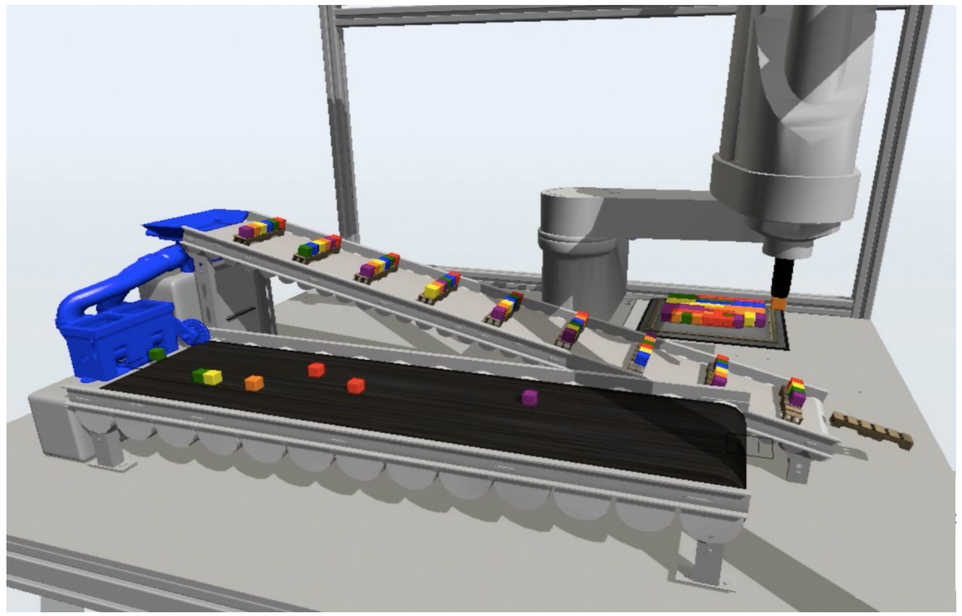
BYU
BRIGHAM YOUNG
UNIVERSITY

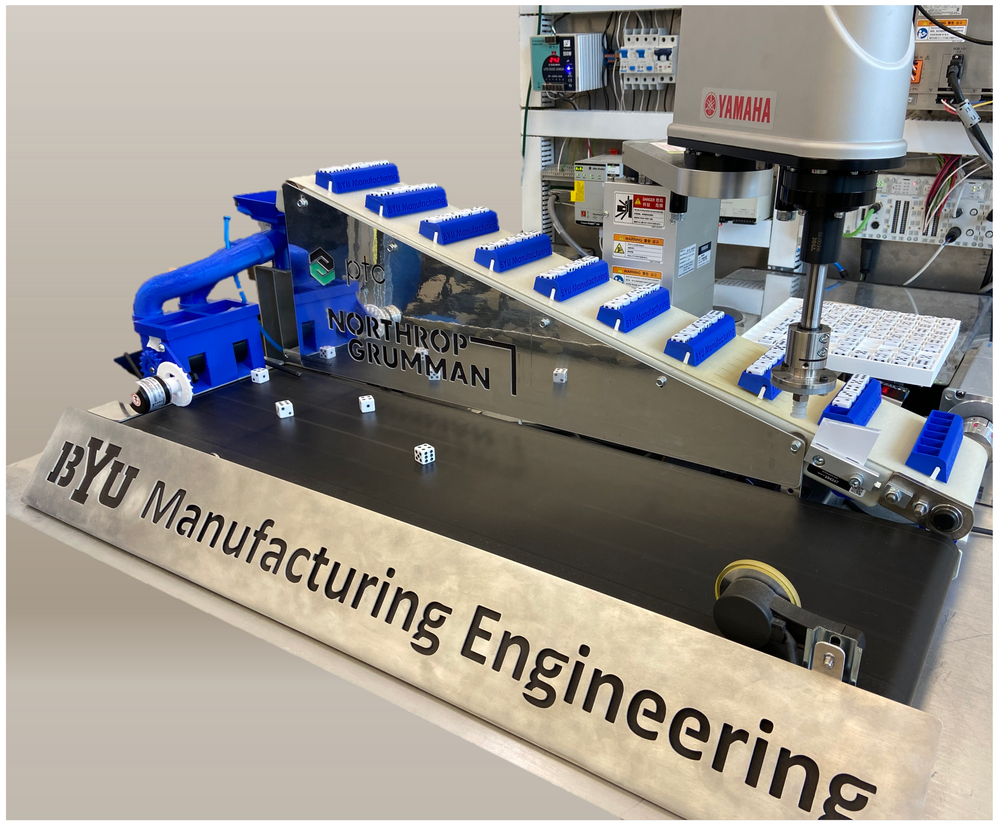
Analysis of a Closed-Loop Digital Twin

Project Background:

The evolution of smart manufacturing presents opportunities to implement digital twins (DTs) for factories and processes.

BYU has a demonstration factory that can implement smart technologies, particularly the DT. Although our factory produces dice, the insights learned from this smart factory can be applied across a wide spectrum of manufacturing enterprises.





A. Eyring, R. Domike, Y. Hovanski, Analysis of a Closed-Loop Digital Twin Using Discrete Event Simulation, Journal of Manufacturing Systems (2021) - Under Review

The Problem:

Traditionally, DTs look at historical data of a process to create a digital representation of reality. However, historical data isn't always present and agile factories make a single static model unrealistic.

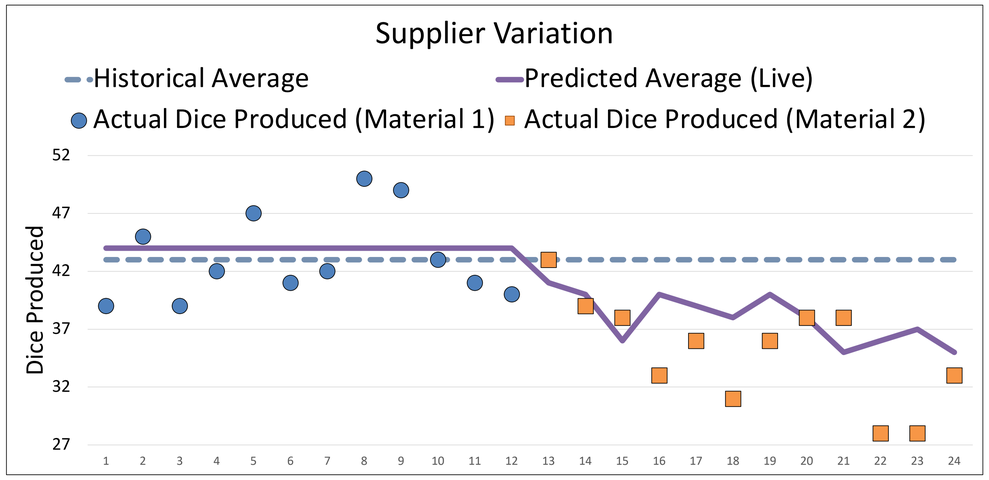
If DTs were to be fully integrated and become bi-directionally connected to the physical system, DTs could more quickly adapt and identify problems, make more accurate analysis, and automate these solutions. However, the difficulty of analyzing and quantifying these claims on a large implementation of a closed loop system is complicated and largely unvalidated.

Proposed Solution:

Using Discrete Event Simulation, we built a DT of our factory and then connected that same DT to live data using PTC's Kepware, which allows for bi-directional data transfer. This meant that not only could problems be identified before they occurred, but the DT could even manipulate production and alert operators if needed. A comparison of traditional DTs and connected DTs was evaluated to quantify the benefits of converting from an unconnected DT to a connected DT.

Test Results:

The unconnected DT was able to accurately predict production when it had historical data on a certain material. When a new material was introduced, the DT could not adjust, and its predictions were impaired. However, the connected DT identified the change and within minutes had adjusted the model to make accurate predictions. Problems, otherwise unforeseen, were identified.



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PTC Digital Transformation in Education Summit 2021