Accella AI

Three Reasons Why You Need a Digital Twin of Your Factory

Photo by Andy Kelly on Unsplash

Change is constant everywhere including manufacturing and to remain competitive manufacturers have to adopt new technologies. The Internet of Things (IoT) and its industrial strength relative, aptly named the Industrial Internet of Things (IIoT), cloud computing and artificial intelligence, specifically machine learning, are innovations that can help manufacturers to enhance efficiency, decrease risk and ultimately reduce cost.

In this world of change, agility, the ability to quickly adapt to changing circumstances, is critical. Restrictions and changes to standard process due to the COVID-19 pandemic is just the latest, extreme and hopefully rare example of a situation where practically overnight fundamental changes hit manufacturers with force. Increasing personalization of products resulting in smaller and more frequently changing production runs is a second force that fuels the need for agility.

Then there is the elephant in the room: stopping or reversing the loss of manufacturing jobs. The US alone is said to have lost 5 million manufacturing jobs to low wage countries, specifically China. In addition to the loss of jobs, the pandemic clearly showed another potentially fatal flaw of outsourcing all of our manufacturing to other countries: the complete dependence on these manufacturers for critical products, such as PPE. The need to quickly adjust to such situations and domestically manufacture needed goods has been made clear to us in a dramatic way over the last year.

Agility in manufacturing using digital twins

There is never just one silver bullet to solve complex problems like the ones outlined above, but modern technology can go a long way. A particularly powerful way of increasing agility, optimizing products and/or reducing cost is to deploy a digital twin.

A digital twin is a virtual replica of a factory environment which allows the user to simulate scenarios without real-life consequences. What differentiates digital twins from more traditional simulations is that data derived from smart devices provide real-life and near real-time inputs about critical variables. This allows for the development of an accurate virtual representation of the actual situation, including possible fluctuations, deviations and variables that are hard or impossible to control or predict, e.g. changes in light conditions or temperature on the shop floor due to time of day and/or weather.

Digital twins can be deployed in manufacturing to add not just flexibility and agility but also help reduce risk for routine operations.

Predictive analytics for product optimization and/or cost reduction

Once a digital twin is built based on inputs from different sensors, machine learning algorithms can be deployed to experiment with and analyze different scenarios without posing a risk to operations. Applications include the optimization of products and/or reduction of cost through modelling the effect of changing input parameters, such as type and amount of input materials used (see “Use case - optimizing viscosity of a component”).

As new production assets and/or new products are added digital twins can be used for optimization based on new variables, inputs and product specifications.

Capturing knowledge about the production process therefore allows you to run optimizations with the goal to:

- Reduce cost of input components, e.g. by identifying cheaper alternatives that have no or a negligibly small negative effect on the quality of the product.
- Improve the quality of product, e.g. by identifying the best input materials from a variety of vendors.

In short, the use of digital twins allows for value engineering of products by determining the sweet spot between cost and quality. Using a digital twin this can be done completely risk-free and with no impact on ongoing operations.

Use Case - Optimizing Product Characteristics

Accella AI is working with a global manufacturing company on optimizing the viscosity of a critical component in one of their products. Even slight variations of the relative abundance of individual ingredients can lead to noticeable, even drastic differences in product performance.

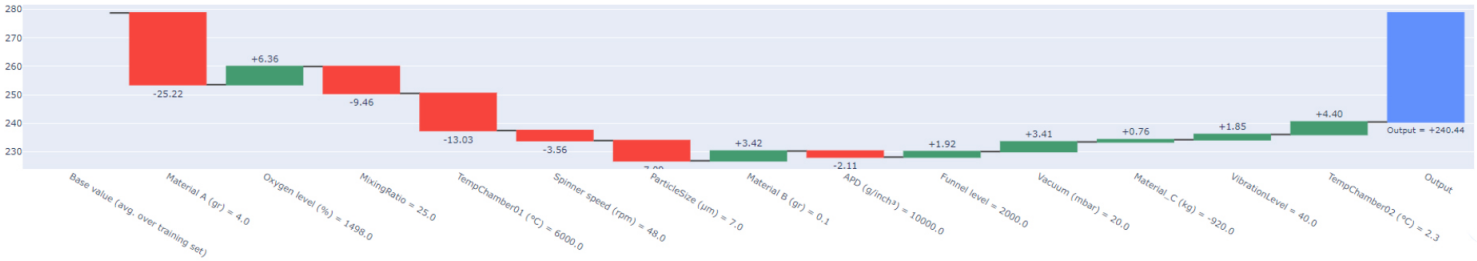
Traditionally the company’s R&D team optimized the formulation and tested its characteristics on a trial production line before implementing any changes. This process is time consuming and therefore severely limits the number of permutations that can be tested.

Using process and material data collected via smart devices, Accella AI developed an AI-based model and generated a digital twin that allowed the customer to virtually model different formulations and assess their product characteristics virtually.

Outcomes for the customer:

- Faster time to market for new and improved products
- Reduced waste due to virtual nature of the trial runs
- Larger number of different formulations could be tested at very low/no marginal costs
- Increased understanding of the chemistry underlying the product, e.g. a component believed to be necessary could be eliminated without negative consequences.
- Model can be used as a preproduction gate, determining whether variable factors, e.g. higher ambient temperature, require adjustment of the formulation. This makes it possible to pre-actively adjust production parameters, e.g. during a heat wave.
- Material from two different vendors were found to cause significant variance in product quality despite having the same product specs.

Model Prediction for Viscosity



Predictive analytics in equipment maintenance

Predictive maintenance is one of the most frequently cited use cases for deploying smart devices and machine learning algorithms.

Predictive maintenance means applying the power of predictive analytics to forecasting likely equipment failure by using smart devices that continuously monitor the environment on the floor (e.g. ambient temperature, humidity, etc.) and of the manufacturing assets (e.g. pump pressure, temperature). Based on the sensor data ML algorithms are deployed that learn to detect patterns associated with likely asset failure, e.g. a pump clogging or breaking, and alert the maintenance crew so they can fix or replace the almost failing component.

Therefore the digital twin allows predictions about when failure might occur based on ever-changing variables and make it possible to interfere before failure happens.

Predictive maintenance can therefore replace scheduled maintenance and avoid:

- Cost associated with the scheduled but premature replacement of a parts. Extending the life cycle of parts can save significant amounts of money, esp. in cases where the parts are expensive or replacement is difficult, time-consuming and/or requires temporary shut-down of operations.
- (Catastrophic) failure of a part that leads to unscheduled shut down of operations or even damage to production assets, e.g. failure of a turbine or metal press.
- Cost associated with spoiled or wasted products and/or contaminated equipment. This is especially relevant for manufacturers perishable goods.

Optimizing maintenance cycles using digital twins therefore is a powerful way of reducing ongoing maintenance cost and managing risk associated with equipment failure.

Process documentation using digital twins

Digital twins can also be used for comprehensive process documentation. Process documentation has always been a challenge for manufacturers but with a digital twin all changes and adjustments are automatically captured in the model and are readily available.

Having comprehensive process documentation available addresses a number of other issues:

- No knowledge is lost when key personnel leaves the company
- Facilitates onboarding and training of new team members
- Makes proving compliance with applicable regulations easier.

Summary

Digital twins build based on input from smart sensors and ever more powerful machine learning algorithms are here to stay. Manufacturers adopting the technology now gain agility and can optimize products and/or reduce costs.

Building a digital twin, while it might sound intimidating, can be done in a step-by-step process with manageable cost and no interruption to operations. At Accella AI we have experience setting up digital twins for our customers and can help you to implement a digital twin in your plant.

Contact us to start the conversation.

If you have any questions or would like to discuss your quality inspection needs, please contact us at info@accella.ai

Accella AI develops tools that enable the rapid implementation and easy management of artificial intelligence models for manufacturing applications. Our mission is to make AI-empowered solutions in quality control and predictive maintenance economical for manufacturers.

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