Overview
An Artificial Intelligence (AI) enabled digital twin is a state-of-the-art simulation of a complex real-world system, enhanced with predictive AI. It has the capability to tap into a data stream, learn, and run “alongside and ahead of” increasingly complex highly interconnected real-world manufacturing and asset management system and provide the ability to identify areas for improvement, model improvement scenarios, provide tactical decision support for unexpected challenges, as well as model and optimize systems during design to avoid costly changes later during implementation.

Digital twins continue to evolve quickly and gain traction as an important problem-solving tool in life sciences driven by advances in AI, cloud computing, Internet of things, and simulation by blending the relative strengths of these component technologies. Digital twins have found application in life sciences research & development (R&D), process, manufacturing, supply chain, intelligent medical devices, advanced diagnosis and therapy, business and new product introduction modeling, and logistics.

<table>
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<tr>
<th>Capability</th>
<th>Output</th>
<th>Business value</th>
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<tbody>
<tr>
<td>Situational awareness</td>
<td>Current status of the manufacturing work in progress</td>
<td>Support warning of potential schedule and process issues</td>
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<td>Root cause analysis</td>
<td>Process outcome leading indicators analysis</td>
<td>Support identification of actionable process levers for improvements</td>
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<td>Retrospective “what if” A/B real-world data experiments</td>
<td>Help understand impact of proposed levers to intelligent guide improvement strategies</td>
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<td>Process drift and trending</td>
<td>Support early warning of processes drift and potential outcome impact</td>
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<td>Probabilistic scheduling analysis</td>
<td>Probability of in-process schedule attainment</td>
<td>Support identification of emergent schedule risks sooner for proactive mitigation and loss avoidance</td>
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<td>Explore more efficient baseline scheduling</td>
<td>Support evaluation of proposed improvements in terms of output and quality to reduce lead time, waste and rejected product.</td>
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<td>Identify bottlenecks</td>
<td>Support schedule modifications and process flow design to overcome bottlenecks</td>
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<td>Dynamic rescheduling</td>
<td>Provide recommended adjustment to schedule when unexpected events occur</td>
<td>Support reduction of impact of unexpected downtime for lost work product and sales</td>
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<td>Schedule optimization</td>
<td>Adjust baseline schedule to improve overall schedule attainment while optimizing output</td>
<td>Support improved ROI on CAPEX by optimizing infrastructure and accurately evaluating ROI on proposed investments</td>
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Client challenge
A leading global bio pharma company was experiencing challenges meeting demand for one of their mainstay products, which was impacting commitments as a trusted supplier for their providers and patients that counted on them, as well as their financial performance. Many difficult-to-model factors were potentially affecting the steps in the supply chain, ranging from environmental, to labor and biochemical, and they were struggling to understand, prioritize, and operationalize avenues for performance improvement in the areas of lead times, service levels and cost-to-produce.

Challenges/Pain points:
— Schedule variations
— Yield and quality variations
— Inability to realize full value from sunk infrastructure costs

Approach and outcome
KPMG worked with the client to rapidly identify and organize acquired key data sources for planning, execution, and quality; built multistep predictive models using advanced machine learning algorithms; and combined them into a multistage discrete event digital twin. The digital twin was a key first step in moving from a reactive to more proactive execution model by providing intuitive, easy-to-use problem-solving tools focused on identifying key factors influencing target performance variation, expected improvements, evaluating potential improvement scenarios, and providing tactical decision support when unexpected events happened during the production cycle.

Benefits
Obtain outcome predictions for duration, yield and rejection, and key influential factors to effect improvement. Reduced step predicted duration uncertainty by > 40%.
Run realistic what-if experiments for proposed schedules, and evaluate risk/benefit of systemic changes to baseline schedules.
Dynamically recommend adjustments to production schedules to reduce overall end-to-end schedule time impact when unexpected events occur.

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