SIEMENS

AEROSPACE AND DEFENSE

GKN Aerospace

GKN Aerospace uses Tecnomatix Plant Simulation to optimize production processes

Product

Tecnomatix

Business challenges

Identify production bottlenecks

Test between improvement approaches

Show complex and dependent improvement areas

Keys to success

Evaluate and verify the applicability of Tecnomatix Plant Simulation at GKN Aerospace

Identify improvement activities in the volume ramp up of the turbine exhaust case/turbine rear frame (TEC/TRF) value streams in the Kongsberg plant

Produce a simulation template for engines' value streams to be used for future value stream analysis at all engine sites

Results

Optimized production processes

Increased production capacity

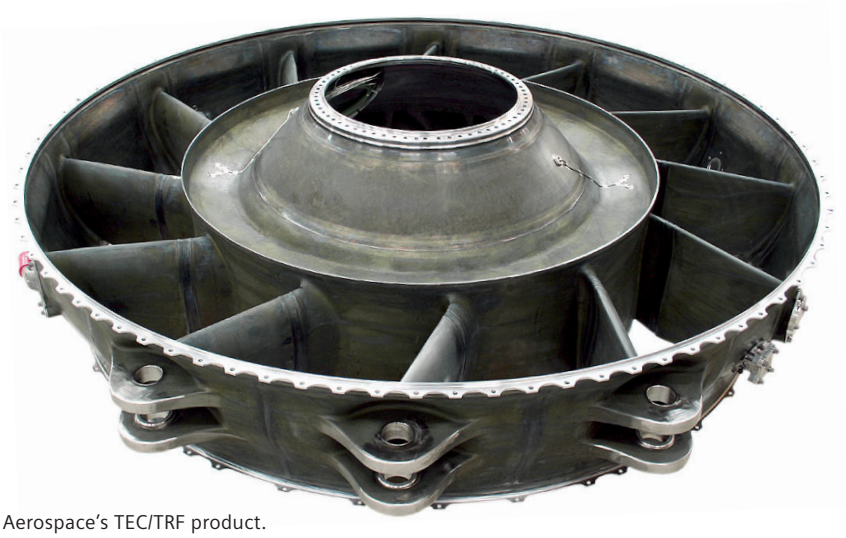
Reduced production lead-time

Reduced work-in-process (WIP) level at production sites and lowered costs

Global aerospace engine supplier deploys Siemens solution to identify production bottlenecks and lower costs

GKN Aerospace Engines, a business line of GKN Aerospace, needed a better tool to plan and optimize their production process and production equipment investment, a tool that would aid in strategic planning, and handle real life complexity to accurately predict lead times and consider variation. GKN Aerospace needed a new avenue to meet customer delivery expectations and identify any existing problems that could be solved before they became unmanageable. In addition, some value streams share production resources between different products, which cause crossing material flows. The production complexity and the daily base decision making, impact the lead time, and created an opportunity for a simulation-based approach, to support a continuous improvement. This led GKN Aerospace to believe that discrete event simulation would perfectly support the company's different initiatives.

Recognizing a clear need to make their current processes more efficient, while also considering expected future production volume increases, GKN Aerospace decided to conduct a pilot program using Plant Simulation in the Tecnomatix® portfolio. Plant Simulation enables users to define a virtual model of a production plant, with all its characteristics and inter-dependencies, and use it to

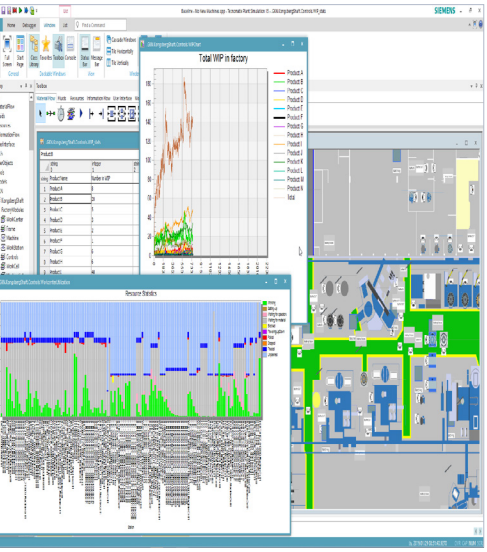


GKN Aerospace's TEC/TRF product.

"Following the comprehensive Plant Simulation pilot we have conducted in our Kongsberg plant in Norway, we were convinced that Plant Simulation can be used to create a simulation model of our aerospace engines production processes."

Karl-David Pettersson
SVP Engineering & Technology
GKN Aerospace Engines
Business Line

Welding of a turbine rear frame in GKN Aerospace's Kongsberg plant.



A Plant Simulation model created by GKN Aerospace with material flow and charts, such as machines utilization statistics, dynamically created during the simulation run.

simulate actual production. Tecnomatix is a part of the Siemens Xcelerator business platform of software, hardware and services.

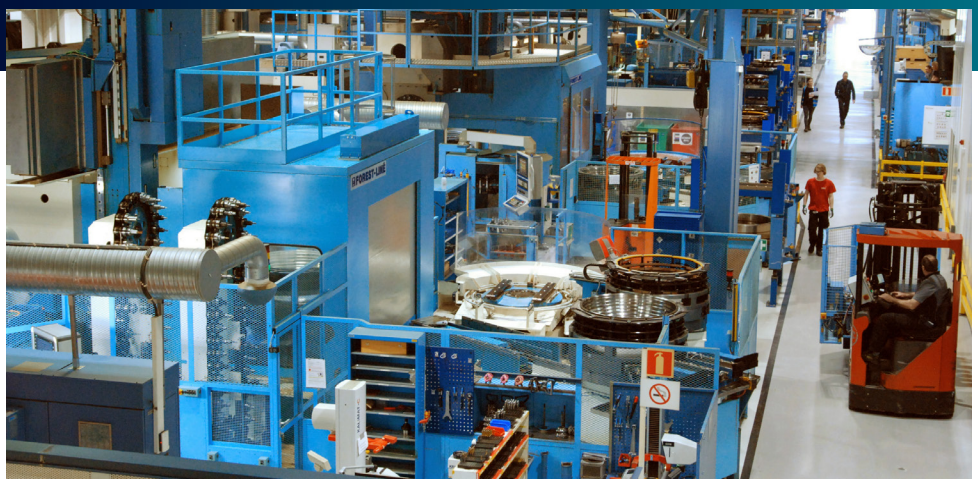
"We started to use Plant Simulation as we needed a better strategic planning tool to analyze and plan production capacity," says Alexander Hall, MOM-MES Architect, GKN Aerospace Engines Business Line, TI-IS. "Given the combination of increased forecasted production volumes and the complexity of our production process, we have realized that the static capacity analysis tools we were using were not accurate enough."

Pilot project takes flight

The Plant Simulation pilot project was conducted at GKN Aerospace's plant in Kongsberg, Norway. This plant was selected for the pilot, as production volumes of their TEC/TRF product family were expected to grow significantly, creating the need to conduct a production analysis and adjust the product system to the new expected volume. The engineers in the Kongsberg plant possessed basic experience with discrete event simulation tools before starting the Plant Simulation project. One of their main goals in this virtual production project was to analyze value streams (value stream is GKN Aerospace's terminology for a product family and its production process) and identify potential problem areas (bottlenecks, which machines are not being properly utilized, etc.) for improvement.

"We found the capacity and utilization results obtained with Plant Simulation were 30 percent more accurate than our previous methods."

Ragnhild Hansen
Project Engineer
Kongsberg site
GKN Aerospace Engines Business Line



GKN Aerospace's Kongsberg plant production floor.

"We started to use Plant Simulation as we needed a better strategic planning tool to analyze and plan production capacity."

Alexander Hall
MOM-MES Architect
GKN Aerospace Engines
Business Line, TI-IS

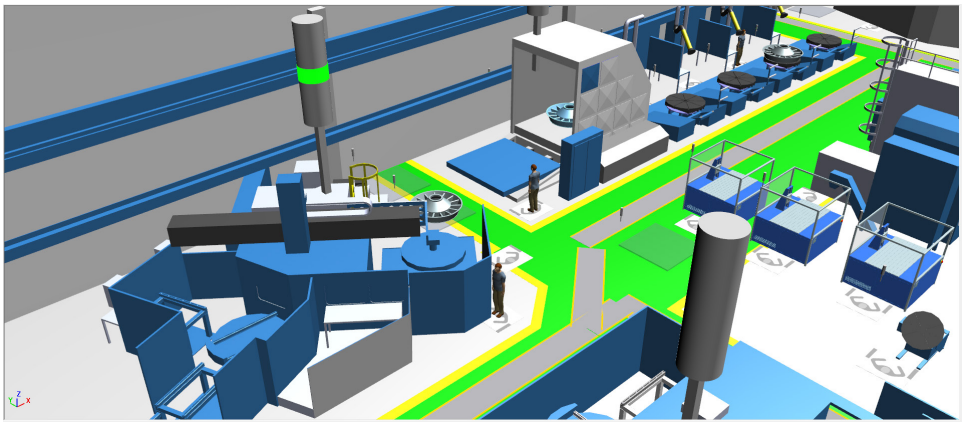
Production simulation with Plant Simulation can consider the effect of variability, an important factor that strongly impacts plant performance. In Kongsberg they have planned and unplanned variability. Examples of unplanned variability include machine failures, lack of material from suppliers, and non-conformance. In an environment with a lot of uncertainties, the simulation is a robust production digital twin that takes into account these issues and, in turn, improves decision making in the areas of machine investment and process improvement. Simulation is also a major component of GKN Aerospace's digitalization initiative.

GKN Aerospace created a simulation model with Plant Simulation, simulated real-life historical production scenarios to validate the model accuracy, and used the model to test future production volume increase scenarios and options. In addition, the capability of Plant Simulation to visualize the production process in a dynamic 3D environment was powerful as it helped GKN Aerospace's employees to better understand the layout, production process and material flow.

The Plant Simulation pilot project had three main targets: evaluate the applicability of Plant Simulation for GKN Aerospace, produce a simulation template that will ease the use of the simulation tool in other production sites and analyze the expected volume increase in one of the plant product families (or value streams). All three targets were met successfully with Plant Simulation.

Another, somewhat unplanned benefit, obtained from the Plant Simulation pilot was that it gave GKN Aerospace a better understanding of how production related data is handled within the company, allowing them to identify several potential areas of important improvements in systems integration and data flows.

Finally, all the insights obtained with Plant Simulation were gained through the creation of a realistic production digital twin model without interfering with the actual production.



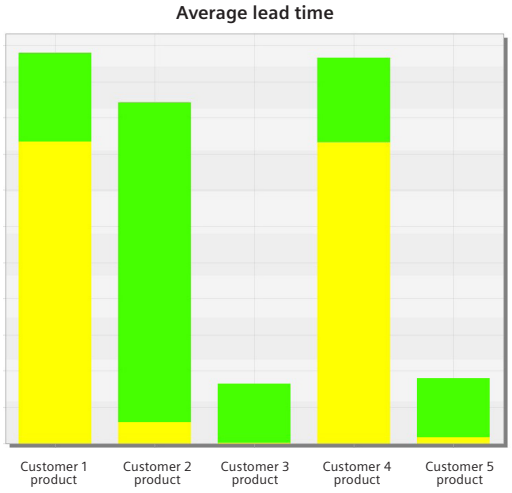
Dynamic 3D plant visualization with Plant Simulation.

"We have a lot of planned and unplanned variability in our plant," says Ragnhild Hansen, technology/project engineer, GKN Aerospace Kongsberg site. "For example, handling non-conformance is an unplanned activity that has a strong impact on our production performance. Plant Simulation helps us analyze the impact of variability on the plant performance, as otherwise it's almost impossible."

Martin Asp, MOM-MES Architect, GKN Aerospace Engines Business Line, TI-IS says that GKN Aerospace's production system is very complex and includes variability in both volume and product mix. "It's a system within a system , with a lot of interdependencies, which makes it challenging to analyze without a suitable tool," he says. "As such, we have found Plant Simulation is a tool that can handle this complexity and highlight beneficial insights."

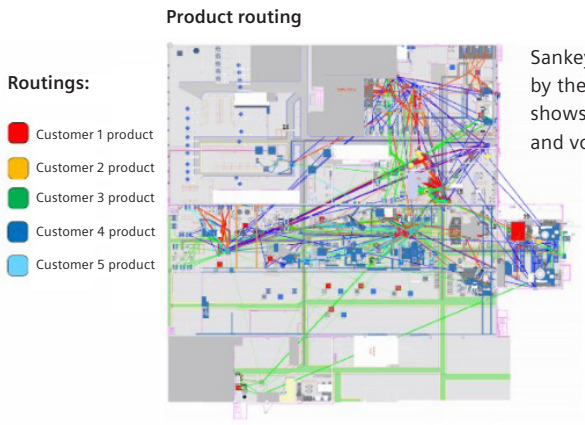
GKN Aerospace also used the unique capability Plant Simulation possesses to represent material flow paths and volume with the Sankey Diagram to help demonstrate to their management team the complexity and many interdependencies of GKN Aerospace's production and material flow. In a Sankey Diagram, the width of a line represents the volume (material or technicians) flowing or moving in this route (a similar concept is common in train or subway maps). An example for the importance of material flow paths analysis is the single heat treatment work cell, which supports several value streams.

Plant Simulation showed GKN Aerospace's production team that facility equipment breakdown and maintenance was impacting production of their leading turbine rear frame product by only four percent, which contradicted their original projections. On the other hand, Plant Simulation revealed that manual production impacts 72 percent of the lead time, clearly showing where optimization can be most impactful for GKN Aerospace.

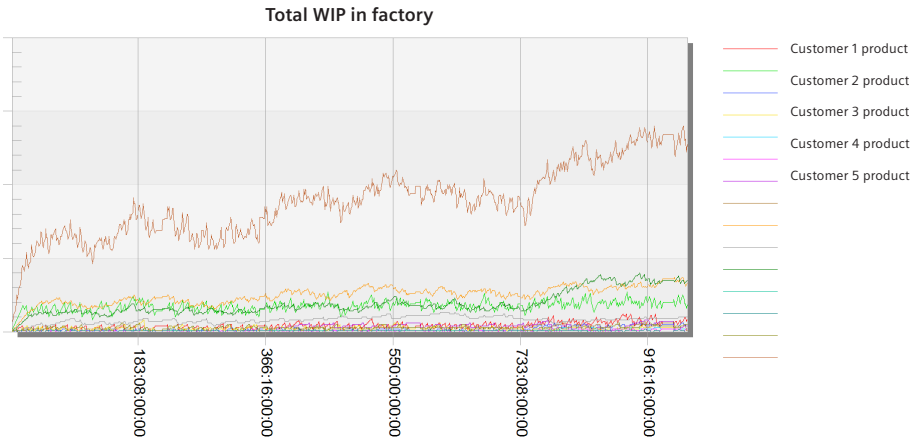


Analysis chart created by the simulation for the rework impact on lead time.

"We realized we needed to change the static production analysis we were doing to a dynamic one, so we started to use Plant Simulation," says Mikael Carlsson, MOM-MES Manager, GKN Aerospace Engines Business Line, TI-IS. "We decided to include non-conformance processes in our simulation model. Predicting lead times for rework orders is a challenge for our business. Using different scenarios in Plant Simulation we can see the impact on lead time of different types of rework. By using Plant simulation we were able to identify a bottleneck caused by rework in combination with main production flow. We resolved this by adding a new workstation." With Plant Simulation, GKN Aerospace can simulate an entire production line and come up with concrete conclusions to potential performance improvements. Such a dynamic simulation considers production and material flow dependencies between machines and production cells.



Sankey Diagram created by the simulation that shows material flow paths and volume.



WIP analysis chart for different product families, created by the simulation.

"We found the capacity and utilization results obtained with Plant Simulation were 30 percent more accurate than our previous methods," says Hansen.

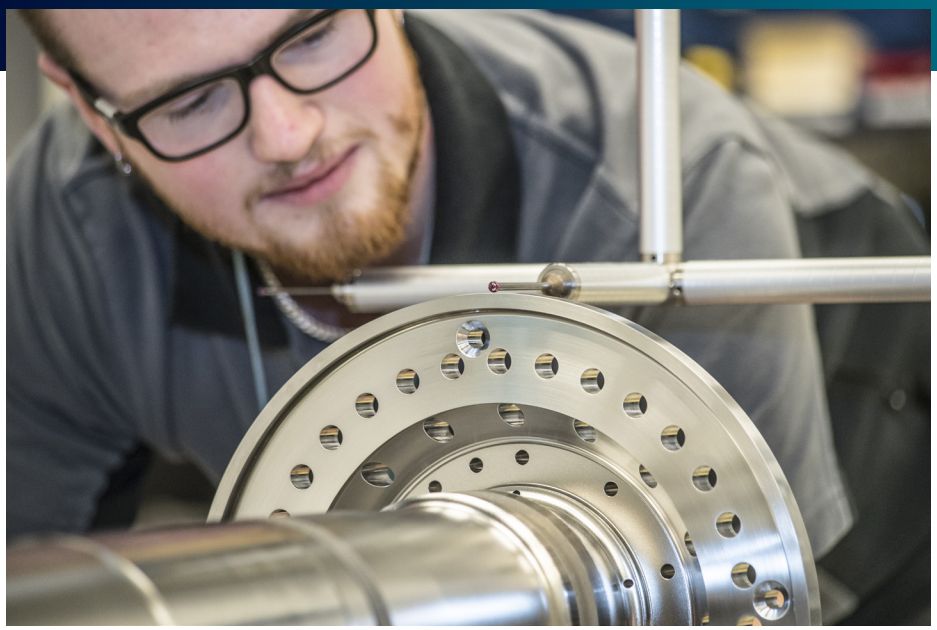
Positive early returns

The Plant Simulation pilot project provided GKN Aerospace with a software tool that can handle its strategic target to reduce production lead time with the expectation it will ultimately result in a competitive advantage since Plant Simulation assists with testing and validating production scenarios, saving time and money.

GKN Aerospace also used Plant Simulation to calculate production capacity and visualize the material flow. The simulation also helped easily identify bottlenecks as GKN Aerospace can run Plant Simulation for any production period (for example, one week). Plant Simulation also helped GKN Aerospace plan production shifts and answer operational questions. "Following the comprehensive Plant Simulation pilot we have conducted in our Kongsberg plant in Norway, we were convinced that Plant Simulation can be used to create a simulation model of our aerospace engines production processes," says Karl-David Pettersson, SVP Engineering & Technology, GKN Aerospace Business Line. "It helps us optimize production processes, better utilize our production assets, validate the material flow, reduce WIP and determine when we have to purchase new production equipment to increase production capacity."

The project was carried out with the support of Siemens consultants, which helped GKN Aerospace to ramp up with Plant Simulation. At some point, a simulation need arose from their U.S. production site as GKN Aerospace was planning to change the product flow and wanted to understand the impact on the delivery to customers. GKN Aerospace engineers built a simulation model to support this, on their own, without the help of the Siemens consultants, which was a good sign for the GKN Aerospace ramp up with simulation skills.

Jonas Steen, Director of Technology Insertion Information Systems, GKN Aerospace Engines Business Line, concludes, "GKN Aerospace Engines Business Line produces complex products with exceptionally high quality requirements in a low volume, using very expensive equipment, which is sometimes used for various products. The combination of all this creates a very complex production scenario, such that only an advanced simulation tool like Plant Simulation can handle this complexity."



Inspection of an engine shaft produced in the shaft value stream.

To have a more successful buy in of the innovative methodology Plant Simulation offers, the project team made sure to involve the plant production people in the activity. Such an example is the involvement of Daniel Bryn, a shaft value stream manager in the plant, who believes Plant Simulation is an essential means to reduce production lead time, which is a strong initiative. An example of an important simulation need that came from his value stream is the analysis of the paint shop area. As the paint process includes a lot of diversified production processes, it's not completely straightforward to understand the flow and dynamics within this area, and there was a feeling that only the people that worked there can really understand and optimize it. He asked to analyze how to increase the rate of shafts processed in this area, without increasing the manpower, and indeed, such a simulation was done, revealing promising insights. In another simulation project for this value stream, they evaluated the introduction of an entire automated cell for shafts (robotics material handling, automated turning milling machine, etc.). Plant Simulation helped analyze how the new machines would impact the production sequence, helped compare it to performances of similar machines they already had, and showed how this would impact the existing machines in the line. This activity also proved that GKN Aerospace can reuse a simulation model from one value stream to another.

Plant Simulation also provides value with customer-related scenarios, allowing GKN Aerospace to showcase their innovative production process.

"Plant Simulation can be used to show the customer an active production line or a planned concept of a production line in a very dynamic and visualized manner that highlights GKN Aerospace's innovation," says Bryn.

As a result of this pilot project, GKN Aerospace can use Plant Simulation in various areas, such as supporting lean manufacturing. Plant Simulation helps GKN Aerospace better understand their value streams and the vast amounts of data the company isn't fully utilizing. The pilot project also offered GKN Aerospace significant transparency into their production

Solutions/Services

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Customer's primary business

GKN Aerospace is a global aerospace innovator with 48 facilities in 14 countries worldwide. GKN Aerospace's technologies have inspired and industrialized the industry by combining engineering excellence with technology leadership.
www.gknaerospace.com

Customer location

Trollhättan
Sweden

facility and allowed them to better understand their processes. Plant Simulation is used both for completely new processes and value streams (greenfield areas), but also to support (continued) improvement of existing production processes. In addition, a few new potential simulation initiatives with Plant Simulation were identified, such as shop floor production space analysis, operational process planning, supporting bid processes and others.

GKN Aerospace also has some thoughts on how they can use Plant Simulation to cope with the new challenges the COVID-19 pandemic presented. For example, the production digital twin created with the simulation can be used for a lot of virtual reviews and reduce face-to-face interaction of employees. Also, the visualization and simulation of a production line helps to understand the production flow, almost as if you've visited the line.

"We have learned that Plant Simulation is a great simulation tool that supports our expected production volume change," says Pettersson. "It certainly proved its value."

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>
> Mikael Carlsson
> MOM-MES Manager
> GKN Aerospace Engines Business Line, TI-IS

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