Increasing Production by Operationalizing Model-Based Manufacturing & MRO Simulations

James W. Hill, Aging Aircraft Solutions

Presenters Bio

James Hill
Aging Aircraft Solutions

- Aerospace & Defense Executive with 20+ years experience
- Research & Development of new solutions for defense
- Leading model-based MRO initiatives for 5 years
- Focused on commercialization of technology

Education:
B.Sc. Biochemistry, Georgetown University
M.B.A., Goizueta Business School, Emory University

U.S. Air Force – Warner Robins Air Logistics Complex

The Air Force Material Command (AFMC) exists to deliver integrated material capabilities to the Warfighter!

The Warner Robins Air Logistics Complex (WR-ALC) is one of three Complexes assigned to the Air Force Sustainment Center (AFSC).

Mission: "Deliver Air Power and Combat Readiness for Our Nation!"

Delivering a Quality Product is obviously one of the team's top goals. Falling short of this goal is directly related to aircraft performance and can result in loss of life.

- Aircraft Maintenance (F-15, C-5, C-17, C-130)
- Commodities Maintenance
- Electronics Maintenance
- Software Maintenance

Critical Situation - U.S. Air Force

- **2017 C-130 prop blade failure event caused loss of life & aircraft**
- **Grounded C-130 fleet**
- **Prop blade repair was halted during investigation**
- **Engineering waivers required to fly**
- **Repair process redesigned for enhanced safety**
- **High demand for refurbished blades**

Challenges - Warner Robins Air Logistics Complex

- **Increasing Throughput to Meet Customer Demand**
  - Repair process had been redesigned with increased number of inspections to meet safety requirements; this had reduced throughput
  - Running scenarios to determine what changes would increase overall throughput
  - Create Business Case for Change: Documenting expected benefits so the change could be justified to engineering and management
- **Forecast Production Outcomes**
  - Limited engineering resources, but high demand for production forecasts
  - Optimize production to increase throughput

Doing More Under Pressure

- **Background:** Limited resources, complex process, basic toolset, limited budget – can we do more with less? Can we establish some leverage?

- **Experience:** We have been working with manufacturing and MRO simulations for years and had established relationships with them.
  - How to use the model to improve production process design
  - How to use the model to improve day-to-day decision making

Goals:

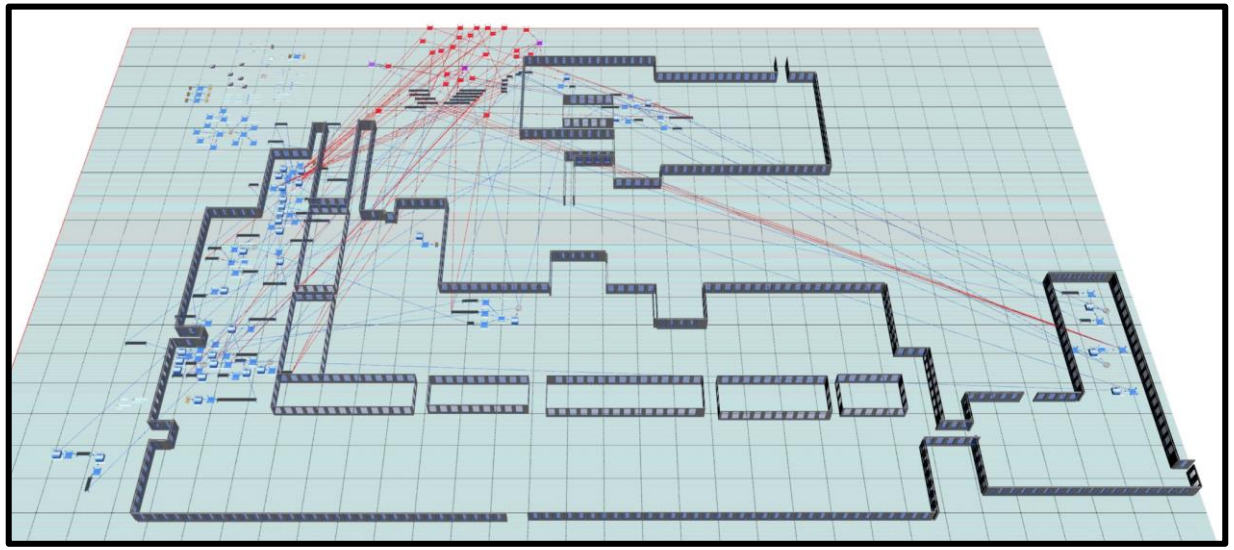
- **Primary:** Increase throughput to meet operational fleet demand without adding human resources or machines.
- **Secondary:** Lower unit cost

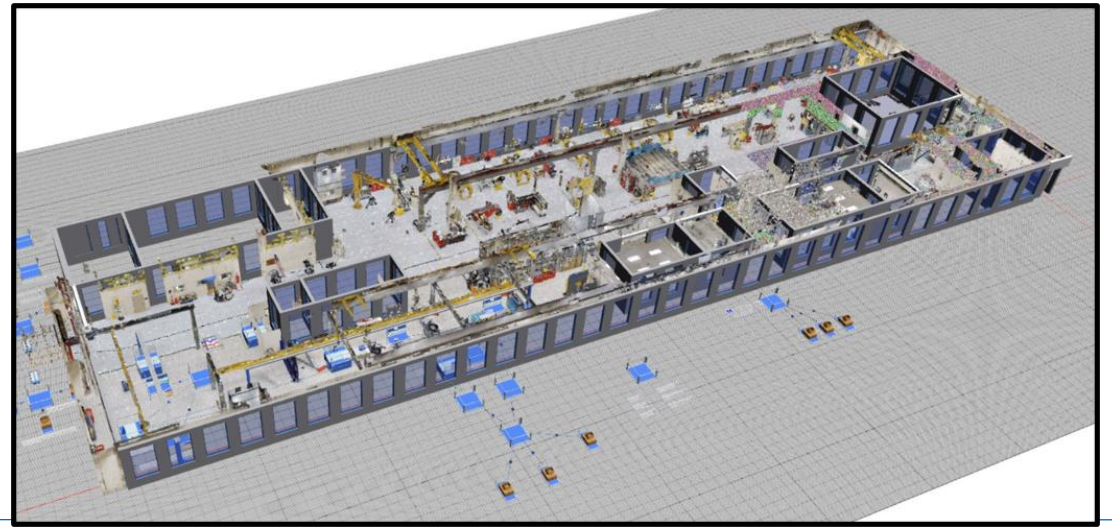
The Plan: Model-Based Production Management with an MRO Digital Twin

- **Define the problem to be solved**
- **Define the tools**
  - **Model-based MRO Production Management**
  - **Discrete event simulation of production process**
  - **Software: Tecnomatix Plant Simulation**
- **Define the data inputs available (statistics)**
  - **Bill of Process definition documents – Work control documents**
  - **Historical production data and statistics**
  - **Interviews with process experts**
- **Define the relevant scenarios and hypotheses of where value could be created**
- **Create the simulation model**
- **Validate (statistically) the simulation model against historical production data**
  - **Verify the defined problem is evident in the initial model**

Call to Action

- **Model the digital twin of the propeller assembly repair line in Tecnomatix Plant Simulation, with focus on the propeller blade repair line**
- **Define the benefit of bringing forward blade inspections earlier in the overhaul process (reconfiguring the process)**
  - **Identify condemned blades earlier in the overhaul process**
  - **Reduce value added process time on blades that would be condemned (cost savings)**
  - **Utilize increased capacity for blades that would be sold (increase throughput and revenue)**





Success

- **Using the process simulation digital twin, Warner Robins Air Logistics Complex production managers quantified the benefit of this change to the production line and to the 402d CMXG**
- **Estimated Cost Savings: $3,064,000 per year**
- **Estimated Additional Revenue: $9,600,000 per year**

- Production managers presented the proposed change to process engineering and product engineering backed by data
- The process change was approved and implemented

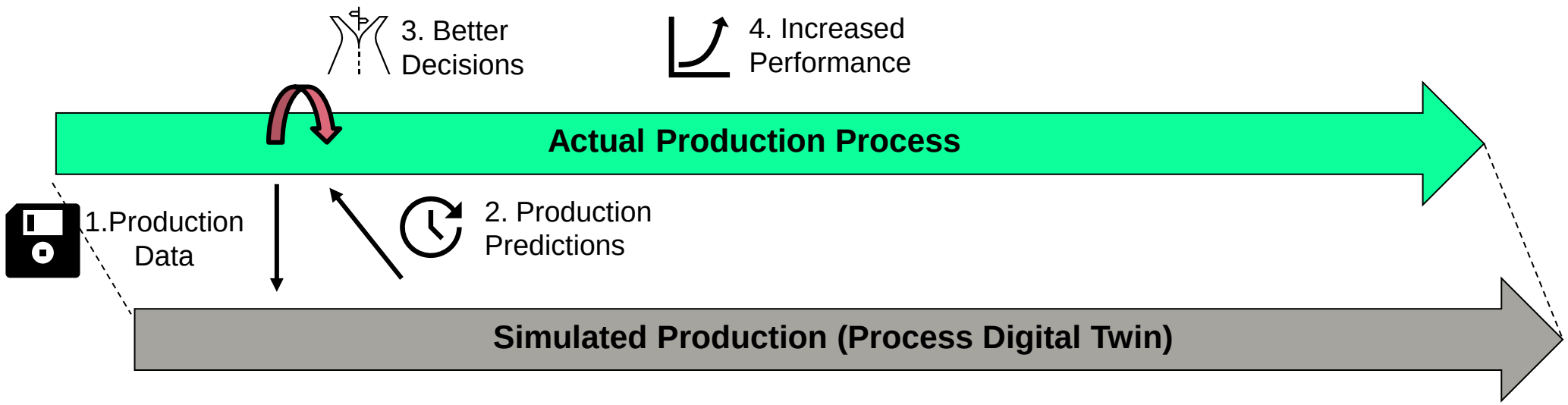
↓ Lower Unit Cost

↗ Increased Throughput (Revenue)

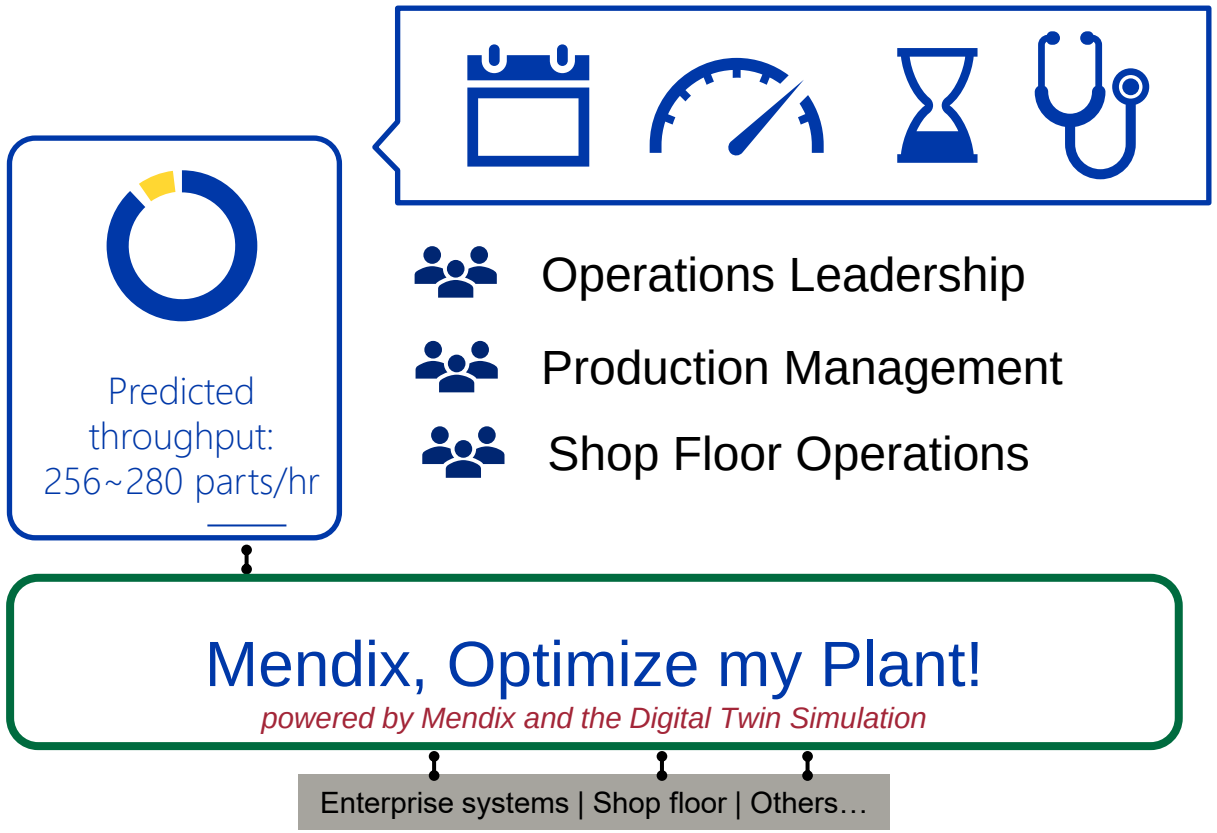
- Simulations are managed by process engineers or third-party contractors
- No process was in place to “request” simulation analysis
- Limited process engineering resources
- No scenarios were defined for different stakeholders
- Constantly changing environment
- Complexity of overhaul processes

Model-Based MRO/Manufacturing Production Management

How it works

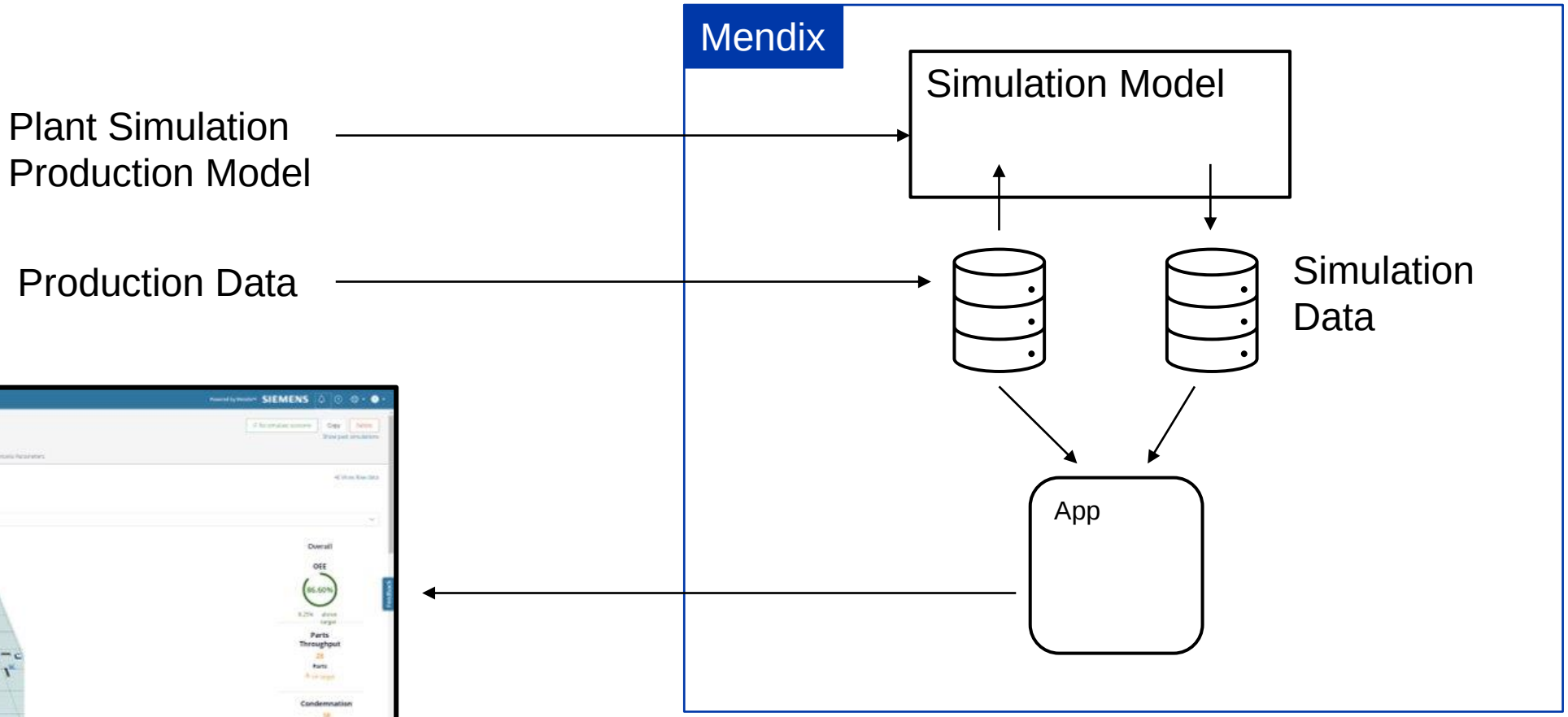


Mendix, Optimize My Plant

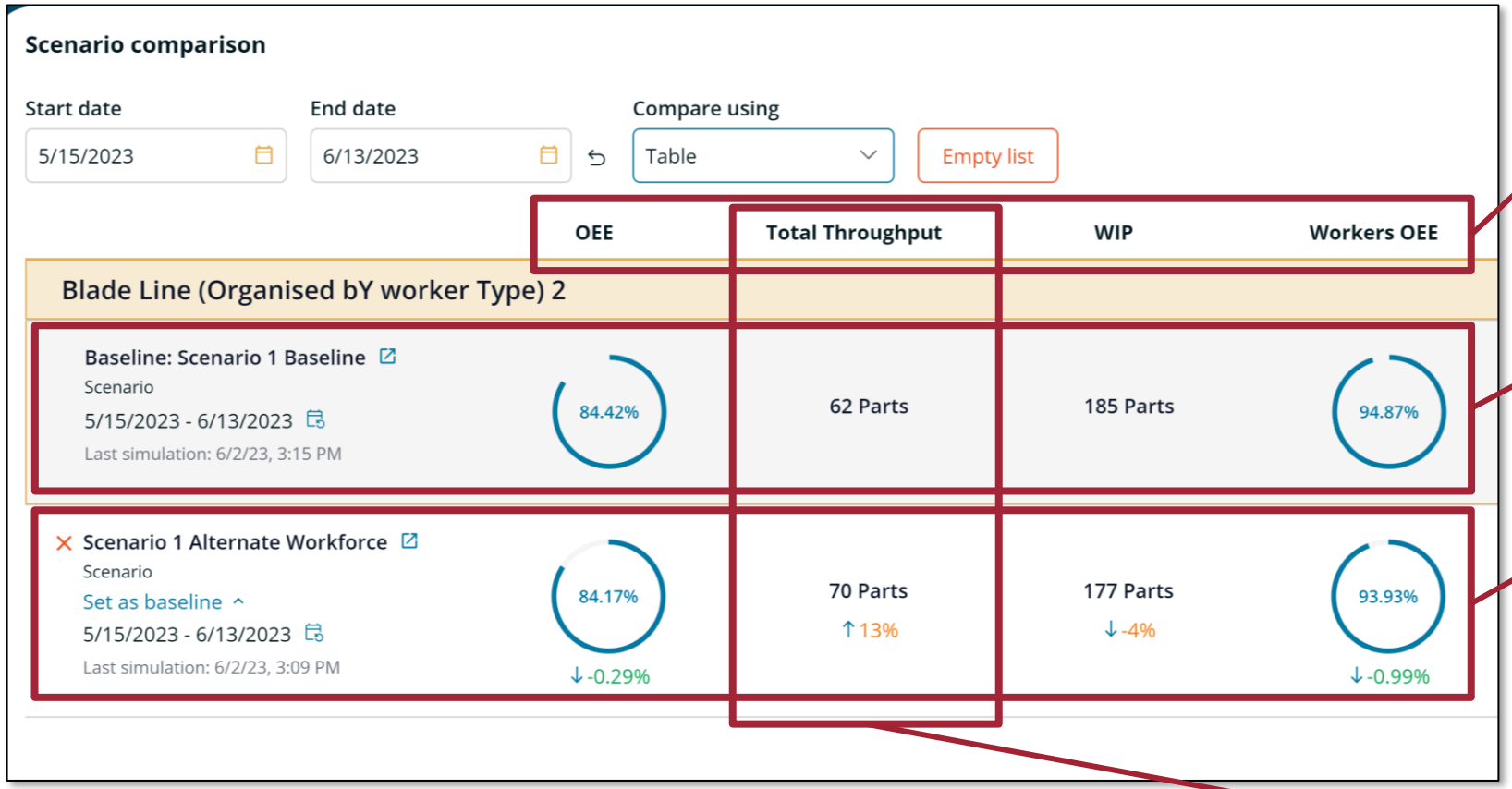


- New participants can run simulation scenarios on demand (broader user base)
- Mendix Application
  - Available - Mendix Marketplace
  - Ready to use modules
  - Plant Sim library
  - Data exchange between Mendix and Plant Sim

Solution: Tecnomatix Plant Simulation + Mendix, Optimize My Plant



Mendix Application Example



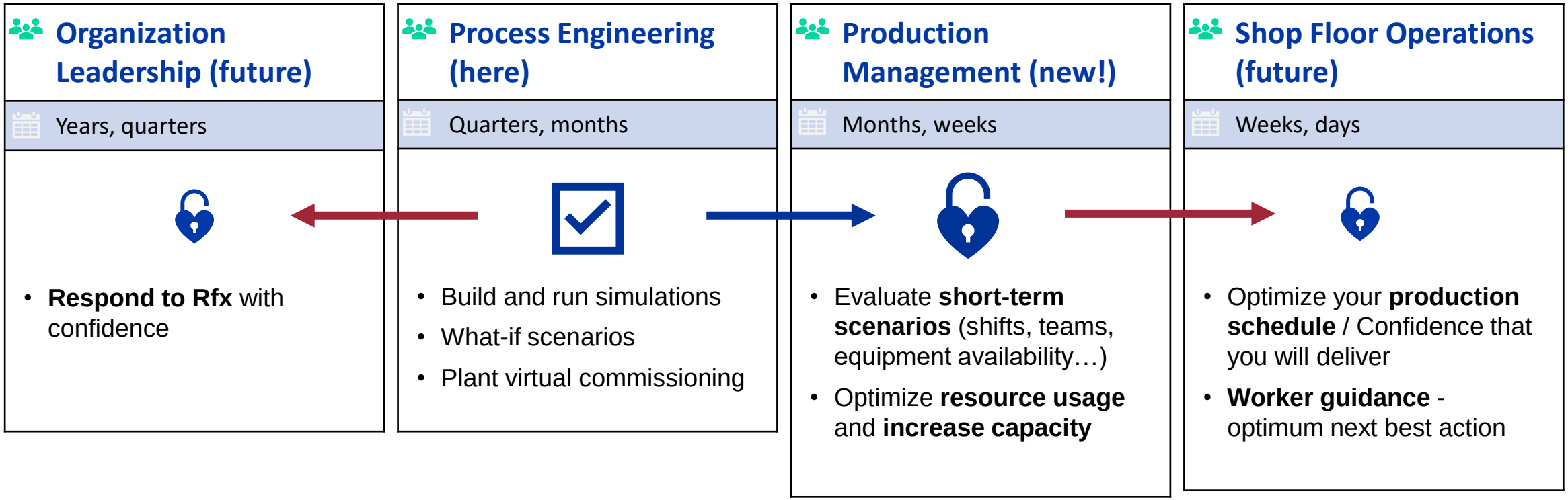
Scenario KPIs

Scenario 1 Baseline

Scenario 1 Alternate

Scenario Analysis Results:
Increased throughput

Expanding the Use of Simulations Across Up and Down the Organization



- **Scale the simulation across the organization to production managers & produce on-demand scenario results**
- **Integrate the simulation forecasts into daily, weekly and monthly decision-making process**
- **Forecast KPIs**

Increase Throughput with Model-Based Simulations

Explore outcomes of various scenarios rapidly and at low cost utilizing the process digital twin. Identify unexpected outcomes or side affects before they happen. Quantify the benefits and what it will cost to achieve the desired outcomes.

Operationalize Model-Based Simulations for Managers

Scale simulation to more users. Managers can make better decisions if they have a forecast of the expected outcomes. However, manufacturing and MRO systems are complex.

Empower Managers with Performance Predictions

Give production managers the information they need to make decisions that can dramatically increase performance.