

# Modernizing Model-Based System Engineering For A North American Machinery Manufacturing Firm

## ABOUT CLIENT

- A legacy industrial machinery manufacturer in North America with over \$2.5B in annual revenue.
- Specializing in precision equipment for aerospace, automotive, and heavy engineering industries, the company has a strong foundation with trusted clientele across the globe.

## PROBLEM STATEMENT

During our initial meetings with the client, they shared 4 Major key challenges that were affecting their business:

**Disconnected Models & Factory Data:** MBSE tools like Siemens Teamcenter and IBM Rhapsody weren't connected to real-time manufacturing data, making it hard to validate designs against actual shop floor performance.

**Fragmented Systems & Siloed Data:** Key information was scattered across CAD, PLM, ERP, MES, SCADA, and IoT platforms, creating gaps in the digital thread and limiting cross-functional visibility.

**Slow Design Iterations:** Without real-time feedback, design teams had to rely on delayed or incomplete insights, slowing down prototyping and production tweaks.

**Compliance & Traceability Gaps:** Manual reporting processes made audit preparation time-consuming and error-prone, especially with no automated traceability from design to delivery.

## SOLUTION

The project involved designing and implementing a scalable Azure architecture to create an end-to-end digital thread between MBSE models and real-world operations. In the process, our experts with their internal tech team established:

### Data Integration & Storage

- Our team used Azure Data Factory to pull in data from a variety of engineering and manufacturing systems—including MBSE tools, CAD files, PLM, ERP, MES, SCADA, and IoT sensors—into a unified pipeline.
- We centralized all structured and unstructured data into Azure Data Lake Storage Gen2, creating a scalable and secure repository. Real-time equipment data was captured using Azure IoT Hub and Event Hubs, enabling continuous factory-floor visibility.

### Data Processing & Engineering Analytics

- We built powerful data transformation and analysis workflows using Azure Synapse Analytics, allowing engineers to validate MBSE models against real-world production data.
- For deeper insights, we used Databricks to run AI/ML models that could compare simulated system behaviors with actual performance metrics.

### Dashboards & Visualization (Power BI)

To ensure data-driven action across teams, we created interactive Power BI dashboards:

- Designed dashboards to track iteration cycles, validation outcomes, and failure patterns.
- Manufacturing dashboards were implemented to monitor machine health, defect rates, and production cycles.
- Compliance dashboards were created to automate traceability reports and track regulatory metrics in real time.

### AI-Driven MBSE Optimization

- Using Azure Machine Learning, we implemented predictive models that helped in forecasting system failures, optimizing performance, and identifying design bottlenecks early.
- We also used Azure Cognitive Services to automate compliance documentation, saving time and reducing manual errors.

Manufacturing & Industrial Engineering

Artificial Intelligence (AI) | Azure Data Engineering | Data Analytics | Data Governance | Data Warehousing | Machine Learning | Power BI

North America

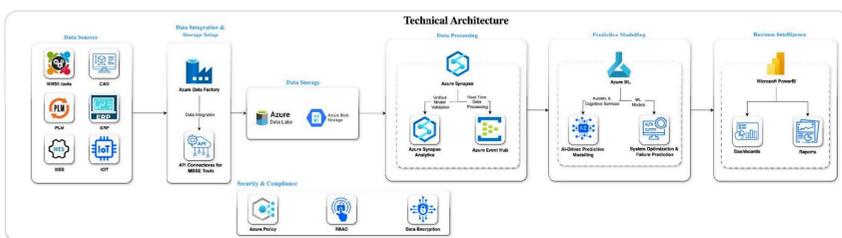
IT and Technology Support, Legal and Compliance

End to End Project Lifecycle Management

## TECHNICAL IMPLEMENTATION

- **Data Integration:** Connected MBSE tools, CAD, PLM, ERP, MES, and IoT systems using Azure Data Factory and APIs for streamlined ingestion.
- **Storage:** Used Azure Data Lake Gen2 and Blob Storage to store and manage structured/unstructured data securely and at scale.
- **Real-Time Pipeline:** Built a model validation framework with Azure Synapse Analytics and Event Hubs for real-time data processing.
- **AI-Powered Modeling:** Deployed Azure ML, AutoML, and Cognitive Services to optimize systems and predict failures.
- **Dashboards:** Created interactive Power BI reports for engineering, operations, and compliance teams to support decision-making.
- **Security & Compliance:** Applied Azure Policy, RBAC, and data encryption to maintain compliance and safeguard all data.

## TECHNICAL ARCHITECTURE



## BUSINESS IMPACT

**Design Validation Time Cut by Half:** Reduced design validation cycles from 6–8 days to just 3–4 days, enabling faster product iterations and quicker time-to-market.

**Downtime Reduced by 3 Hours Monthly:** Predictive analytics brought down unplanned equipment downtime from 10 hours/month to 7 hours/month, directly improving production output.

**MBSE Insights in Minutes, Not Days:** Engineering teams now get model-to-factory insights within 2–3 hours, compared to the earlier 2-day wait, accelerating design and production alignment.

**Compliance Made Click-Simple:** Replaced manual report compilation with automated audit trails, cutting 90% of manual work and achieving full traceability for regulatory audits.

By bringing together Azure's data engineering, AI/ML, and Power BI tools, our team at DataToBiz helped the client build a real-time, MBSE-backed digital twin. This shift not only made their product development faster and smarter but also improved system reliability and simplified compliance.

