Heavy Equipment: Integrated Engineering and Manufacturing

Rahul Garg, Sr. Director, Industrial Machinery & Heavy Equipment Industry
Agenda

- The Industry Challenge
- Siemens Business Value Proposition
- Why Siemens?
- Solution Areas and benefits
- References
Implications

Product Complexity

Process Complexity
Global Manufacturing Challenges

Manage complexity
- Global engineering and production
- Process variants
- Flexibility requirements

Decrease manufacturing costs
- Automation and labor mix

Reduce time-to-market
- Faster ramp-up
- Market change adaptation

Improve Quality
- Continuous improvement

Late Product Changes
Complexity is the Challenge: Confidence before Start of Build

Design intent not well understood by manufacturing

Outstanding change orders not taken into consideration

Out-of-date safety directives have been applied

Bought in parts found to be not to specification

Missing or incorrect NC program files

Difficulties incorporating new, untried technology – impact not foreseen

Cannot deliver full range of variants with usual manufacturing approach

Cannot achieve quality targets at multiple manufacturing locations

Causes of quality defects not understood

Do late changes during manufacturing delay delivery and erode profit margins?
Underlying Cause: Lack of Functional Integration

Departmental boundaries impede information sharing and visibility, leading to poorly informed decisions, and a high risk of mistakes.

Inadequate information

Problems & questions

Design

Planning

Shop Floor
Lack of Integration: the Consequences

At the point of production:

- **Quality escapes** at the shop floor

  - Late changes consume time and cost up to **30-50 hours per change**

  - Product introduction is **delayed** & delivery **target dates missed**

- **Warranty** issues and penalties
Cost of Lack of Integration

High level of design resource to support planning due to poor information hand-off.

Planning effort is protracted while issues are resolved.

Long product introduction lead-time due to problems and late changes.

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The Manufacturing Engineering Challenge: bridging the gaps between design, manufacturing, production
PLM for Manufacturing Planning
Leading Practice - Shift Left

- Concept
- Design
- Plan
- Validate
- Build
- Launch

- Design for manufacturing
- Early manufacturing planning
- Detailed planning
- Evaluate impact of change
- Continuous improvement

GOAL: SHIFT LEFT
Perform manufacturing planning activities earlier

- Cost of change
- Ability to change

- Cost
- Investment
Productivity Improvements

- Significant reduction ~50% in change cycle time
- Less support for manufacturing with better quality information hand-off
- Planning effort is reduced through clearer requirements and fewer issues
- New product introduction lead time significantly reduced

Lead time improvement vs. Time

Design Process Planing

Hours
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"Digital Factory": Shaping the future of manufacturing in design, production and maintenance services

Merging the virtual and real worlds

End-to-end view of product development and production process

Drive the paradigm shifts

Increase efficiency
-40% energy
+14% output

Shorten time-to-market
-40% in PLM

Enhance flexibility
Shenyang: 3 models on 1 line
Unique Solutions differentiators

Offline simulation and optimization of manufacturing planning

Integrated engineering and manufacturing

Shop floor visibility and manufacturing excellence
Solution Areas

Assembly Manufacturing Solutions

Part Manufacturing Solutions

Quality Management Solutions
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Typical Business Systems Environment

PLM
- Requirements
- Product development
- Release management
- Product configuration
- Variant control
- Engineering bill of material
- Engineering change management
- Simulation
- Digital manufacturing
- Production information repository
- Collaboration backbone between disciplines

ERP
- Finance, HR and procurement
- Order management processes
- Forecasting and planning process
- Logistics and inventory management

MES
- Orders Management
- WIP Monitoring
- Defect Tracking & Non-Conformance
- As-Built Documentation

Sales

Tecnology

Manufacturing

Service
Controlled Business Systems Environment

PLM
- Requirements
- Product development
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TEAMCENTER

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Sales

Technology

Manufacturing

Service

- Manufacturing bill of material
- Bill of processes
- Manufacturing processes
- Service bill of material

- CNC
- Controls
- Hazard material
- Work instructions
- Safety instructions
- Detailed line design
- Tool & fixture design

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MBOM in Teamcenter

Reasons for managing the MBOM in Teamcenter & Synchronizing with ERP

- eBOM to mBOM alignment, easier to manage the engineering changes
- Global where-used search on parts to which products which plants
- Cost roll-ups of complete products
- Use in manufacturing planning (BOP) & eBOP
- mBOM can be created with visuals
- Enriched work instruction for shop floor users
- Use MBOM to capture as-Build & drive spare part catalogue and service BOM
Solution Areas

- Assembly Manufacturing Solutions
- Part Manufacturing Solutions
- Quality Management Solutions
Assembly Manufacturing Solutions

Planning
- BOM Management
- Process Definition
- Equipment Selection
- Equipment Costing

Design & Validation
- Throughput Validation
- Process Validation
- Layout Design
- Tool & Fixture Design

Production Support
- Shop Floor Documentation
- Manufacturing Operations Management

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Part Manufacturing Solution

Planning
- Manufacturability Analysis
- Process Planning
- Tool & Fixture Selection

Design & Validation
- Tool & Fixture Design
- NC Programming

Production Support
- Tool Management
- Direct Numerical Control
Quality Lifecycle management solution

Planning
- PMI
- GD&T Validate
- VSA
- Template Reports

Design & Validation
- CMM Programming

Production Support
- DPV RTA Flow Data
- DPV CAPA
- CMM Execute
- DPV-Compare
Assembly Manufacturing - Summary

Customer Challenges

- Extensive manual work to create and maintain MBOM
- Mixed/global production planning
- Latest changes not captured

Key Points

- Improved BOM accuracy
- “Best Practices” and Templates for knowledge capture and re-use
- Controlled updates
- Faster change reconciliation
Siemens Rail Systems
Digital manufacturing strengthens organic growth

Complete Manufacturing Lifecycle

“We perceive the digital manufacturing project deployment…to be a key element in our ability to deliver trains to customers on time and according to quality requirements”

Ulrich Semsek
Krefeld Plant Manager
Siemens Rail Systems
Summary

Collaborative Manufacturing to drive

- Greater efficiency
- Improved Flexibility
- Increased Productivity

- Driven through proven solutions for
  - Offline Simulation
  - Integrated Engineering and Manufacturing
  - Shop floor visibility