Virtual Tire Manufacturing Plants: the Future is Now
Agenda

- Introduction
- Tire manufacturing dynamics
- Digital Manufacturing
- Simulation
- Experiences and results
- Conclusions and outlook
Speaker’s Biography

About the presenter:

• Dr. Gert Nomden
• Senior Consultant at cards PLM Solutions BV, The Netherlands
• Expert on Digital Manufacturing software (experience >15 years)
• Product Manager for Tecnomatix, Siemens’ Digital Manufacturing portfolio
• Active across many industries, recently focused on the rubber and tire industry
### cards PLM Solutions in Numbers

<table>
<thead>
<tr>
<th>Year</th>
<th>Established in Best</th>
<th>Loyal Customers</th>
<th>Global Footprint</th>
<th>Hardworking Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td></td>
<td>405</td>
<td>98</td>
<td>40</td>
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</tbody>
</table>

- **26 Professional Consultants**
- **21 Countries Active**
- **3x Platinum Siemens Partner**
- **3 Subsidiaries**
  - BEST (NL)
  - GENK (B)
  - STUTTGART (D)
Tire Manufacturing Process

Plant design goals
- Prediction of behavior, reliability
- Maximize system performance
- Minimize effort and investment
- Document and communicate

Plant level decisions
- Conflicting objectives
- Solution space
- Ambiguity
- Complexity
- Risks
- Project budgets

Tire manufacturing dynamics
- Seasonality of demand
- Product mix
- Variable equipment flow rates
- Product yield
- Perishability
- Product changeovers and maintenance
- Workers and shift models
- Equipment failures
- Buffering and storage

Source: ILO
Tire Plant Design Challenges

Tire manufacturing dynamics

Plant level decisions

Digital Manufacturing tools

Achievement of Plant design goals

Source: ILO
What is Digital Manufacturing?

Digital Manufacturing is a comprehensive set of software tools to:

- Define, simulate and optimize manufacturing, logistics and maintenance operations through virtual models.
- Capture and exchange information about those operations, both simulated and real-life, thereby closing the feedback-loop between planning and execution.
Principles of Digital Manufacturing

Existing or new system

Virtual model

Specifications, simulations, analyses, reports, communications

Ausbringungsmenge

Zeit [min]

Alternative 1

Alternative 2
Major Applications

Planning
• Support the preparation of the operations, defining basic information like recipes, routings, resources, control logic and work instructions.

Simulation
• Evaluate and optimize operations, from singular equipment or its components, production cells and lines, up to complete factories and even supply chains.

Execution
• Take the information generated by the planning and simulation tools to the shop floor.
• Information gathered during execution may also be relayed back to the planning and simulation tools.
<table>
<thead>
<tr>
<th>Simulation tool</th>
<th>Core application</th>
<th>Scope</th>
<th>Technology</th>
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<tbody>
<tr>
<td>Plant Simulation</td>
<td>Material flow analysis, resource utilization and energy consumption</td>
<td>•</td>
<td>Discrete-event simulation</td>
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<td>Process Simulate</td>
<td>Assembly and robot programming</td>
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<td>Kinematic models</td>
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<td>Jack</td>
<td>Human performance and ergonomics</td>
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<td>Multi-body physics</td>
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<tr>
<td>Mechatronics Concept</td>
<td>Interaction among physical components and controls</td>
<td>•</td>
<td>Multi-body physics</td>
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<tr>
<td>Designer</td>
<td>Program blocks and I/Os</td>
<td>•</td>
<td>Signal emulation</td>
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<tr>
<th>Supply-chain</th>
<th>Factory</th>
<th>Line</th>
<th>Cell</th>
<th>Equipment</th>
<th>Component</th>
<th>I/O signals</th>
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Plant Simulation at a Glance

**Modeling**
- Discrete and continuous products
- Resources (fixed and movable)
- Control strategies
- Dynamic and stochastic behavior
- 2D and 3D visualization

**Analysis**
- Integrated charting tools
- HTML Reports
- Open data architecture

**Optimization**
- BottleneckAnalyzer, Sankey diagram, EnergyAnalyzer
- ExperimentManager
- Genetic Algorithms
Tire Manufacturing Demonstration Models

Source: ILO

Take a look at our virtual tire manufacturing plant:
Siemens booth - 4014
Applications of Plant Simulation

**Concept design**
- Simulation of production concepts

**Detailed engineering**
- Optimize production line designs

**Ramp-up**
- Virtual commissioning

**Execution**
- Improvements, simulation-based planning

**Enterprise Information Systems**
- Product Data
- Process Data
- Resource Data
- Plant Data
Results

Benefits
- Enhance productivity of existing production facilities by as much as 15-20 %
- Reduce investment in planning new production facilities up to 20 %
- Cut inventory and throughput time by 20-60 %

Why it works
- Work in parallel, earlier feedback
- Improve quality of decisions through realistic models
- Optimized systems, due to more and more radical scenarios tested
- Better understanding and communication
Plant Simulation in Practice

Virtual tire plant

- Training
- Cost
- ROI
- Knowledge development
- Project team
- Roadmap
- Application areas
- Frequency of use
- Data management
- Object library

- Payback of investment during first project
- Self-supporting after 1 year
- Own library of building blocks
- Applied throughout organization
Conclusions and Outlook

Key points

• Tire manufacturing processes lend themselves very well to the application of Digital Manufacturing.

• Material flow simulation may be the most powerful tool: it offers a valuable, cost-efficient and risk-free test bed throughout the entire plant life cycle.

• The adoption of Digital Manufacturing in the tire industry is picking up, especially among equipment suppliers.

• Great opportunity for tire manufacturers, equipment suppliers and consultancy companies

Take a look at our virtual tire manufacturing plant:

Siemens booth - 4014
Contact

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