



Optimizing Manufacturing Systems with Simulation

PLM World 2006, Long Beach

Stefan Linner, UGS



1

Tecnomatix Portfolio

2

Tecnomatix Simulation Applications

3

Integrated Planning + Simulation



UGS – Solutions for Product Lifecycle Management





Tecnomatix Simulation Portfolio



Geometry oriented Sequence oriented

Factory
Cell
Process

3D-Layout-planning

NC-Simulation

Pressline-simulation

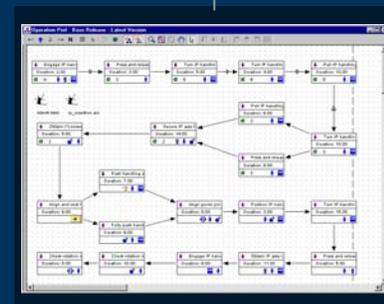
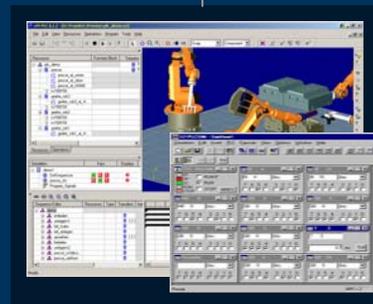
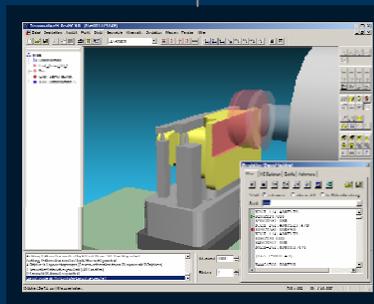
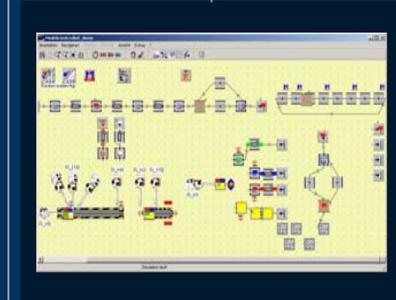
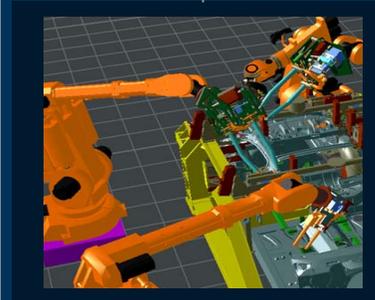
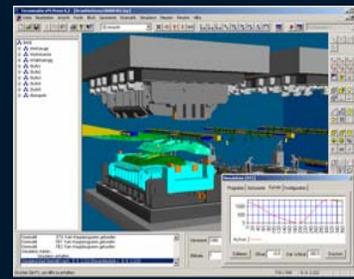
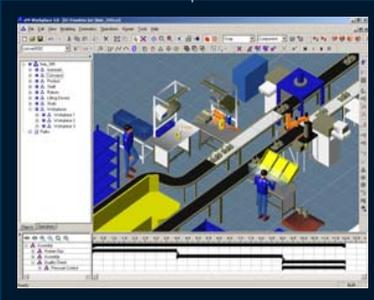
Workplace design

Robotic-simulation

PLC-Simulation

Discrete event simulation

Process-Planning





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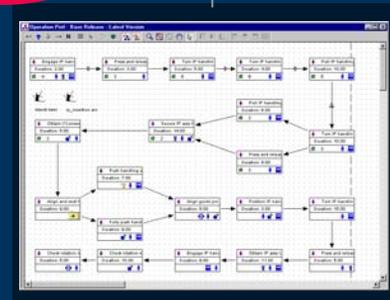
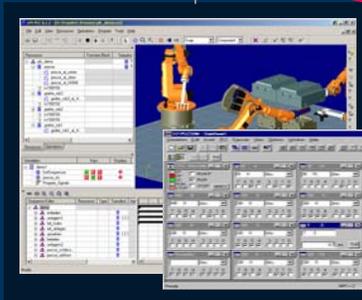
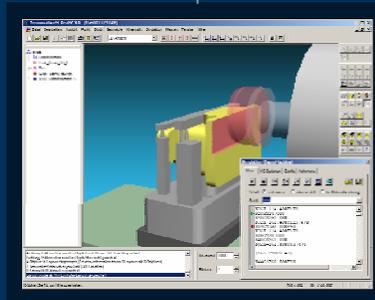
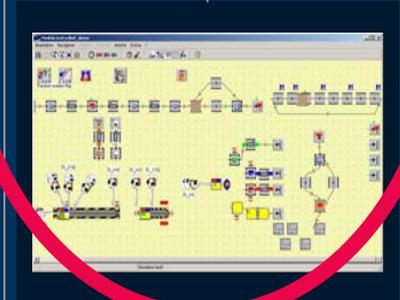
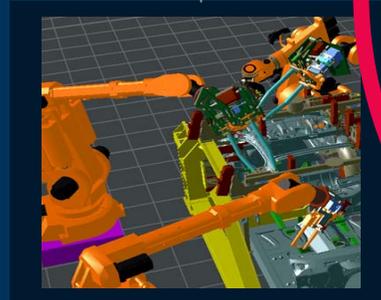
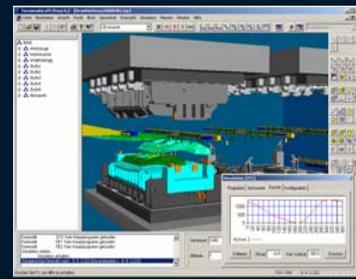
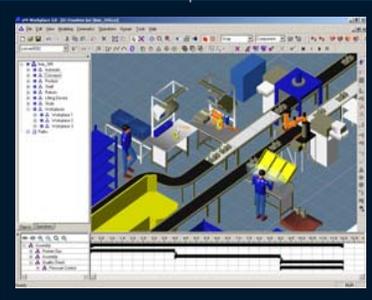
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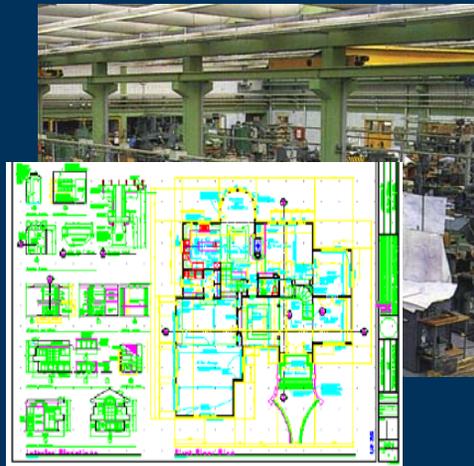
- ▶ Tecnomatix Plant Simulation allows for creating a **dynamic** computer model of a **complex system** (e.g. production) to explore its characteristics and **optimize the performance** of the system.
- ▶ The computer model enables user to run experiments and what-if **scenarios** without disturbing an existing production or – used in the planning process – long before the real system is installed.





Principles of material flow simulation

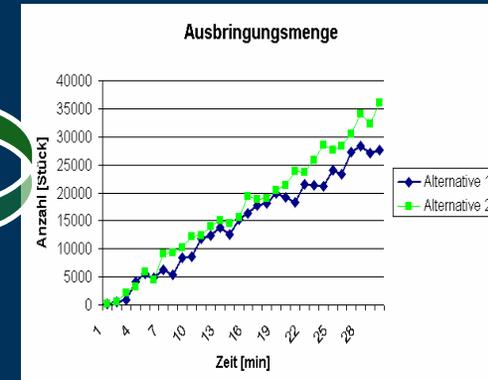
Real System / Plan



Simulation-Model



Simulation result



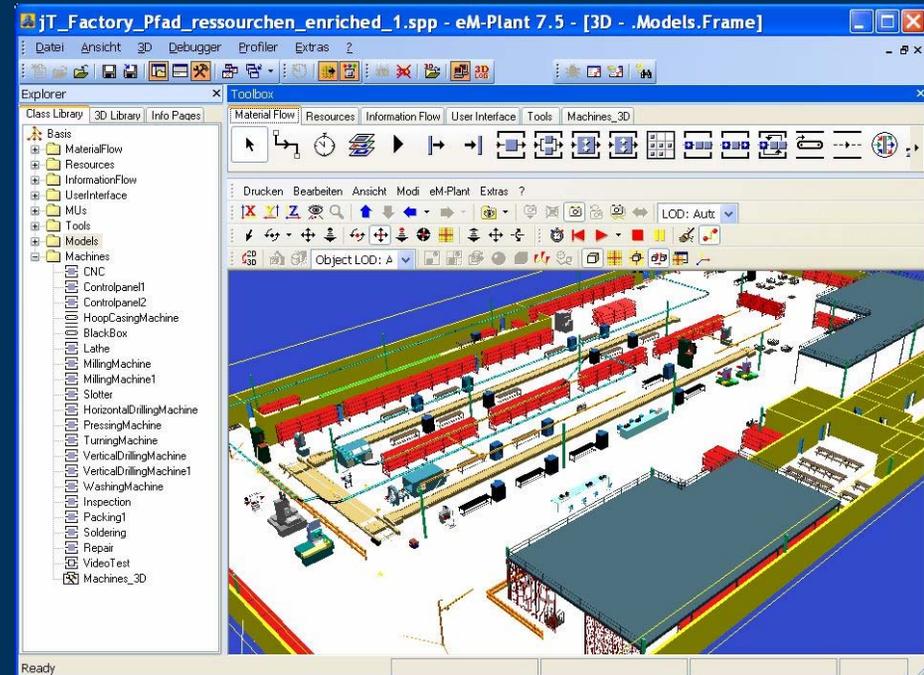
- ▶ **Transparent** analysis of complex systems
- ▶ Calculation and comparison of **real numbers**
- ▶ **Computer supported** investment decisions



Benefits of simulation



- ▶ Detect and **eliminate problems** that otherwise would have required cost and time consuming correction measures during the production ramp-up
- ▶ **Minimize the invest cost** for production lines without jeopardizing the required output
- ▶ **Optimize the performance of complex production systems** with many variants



- ▶ **3 - 6 % savings on investment**
(VDI, Association of German Engineers)
 - ▶ **15 - 20 % productivity increase** of existing systems
 - ▶ **5 - 20 % reduced cost** of new systems
 - ▶ **20 - 60 % decreased throughput time** and inventory
- Average savings found in European market survey



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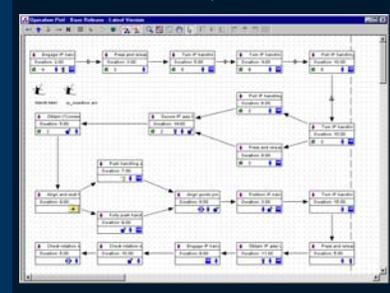
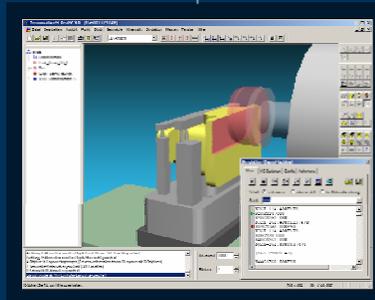
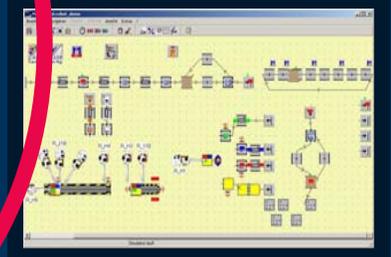
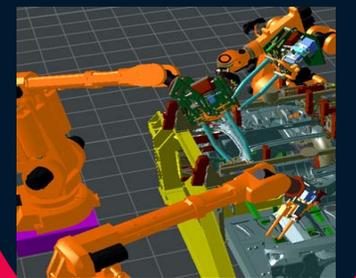
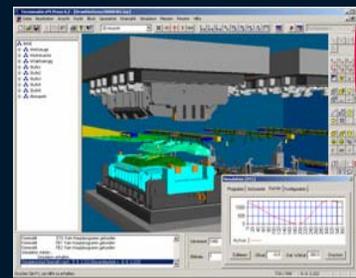
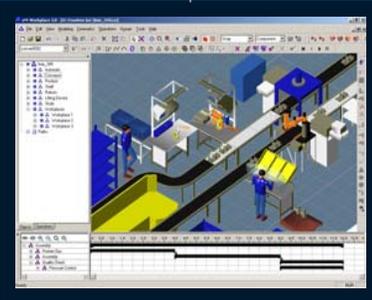
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Robotics Applications

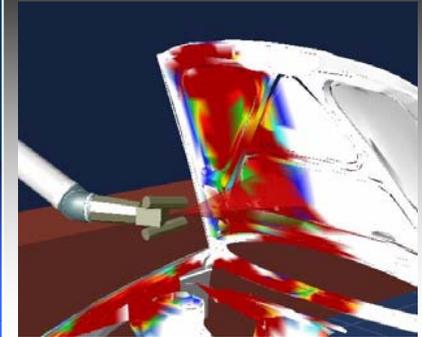
Arc Welding



Spot Welding

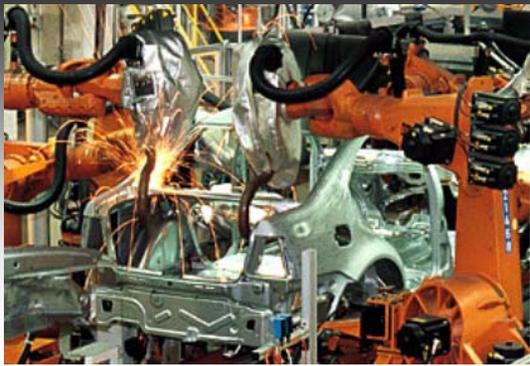


Paint



*Off-Line
Programming*

Laser



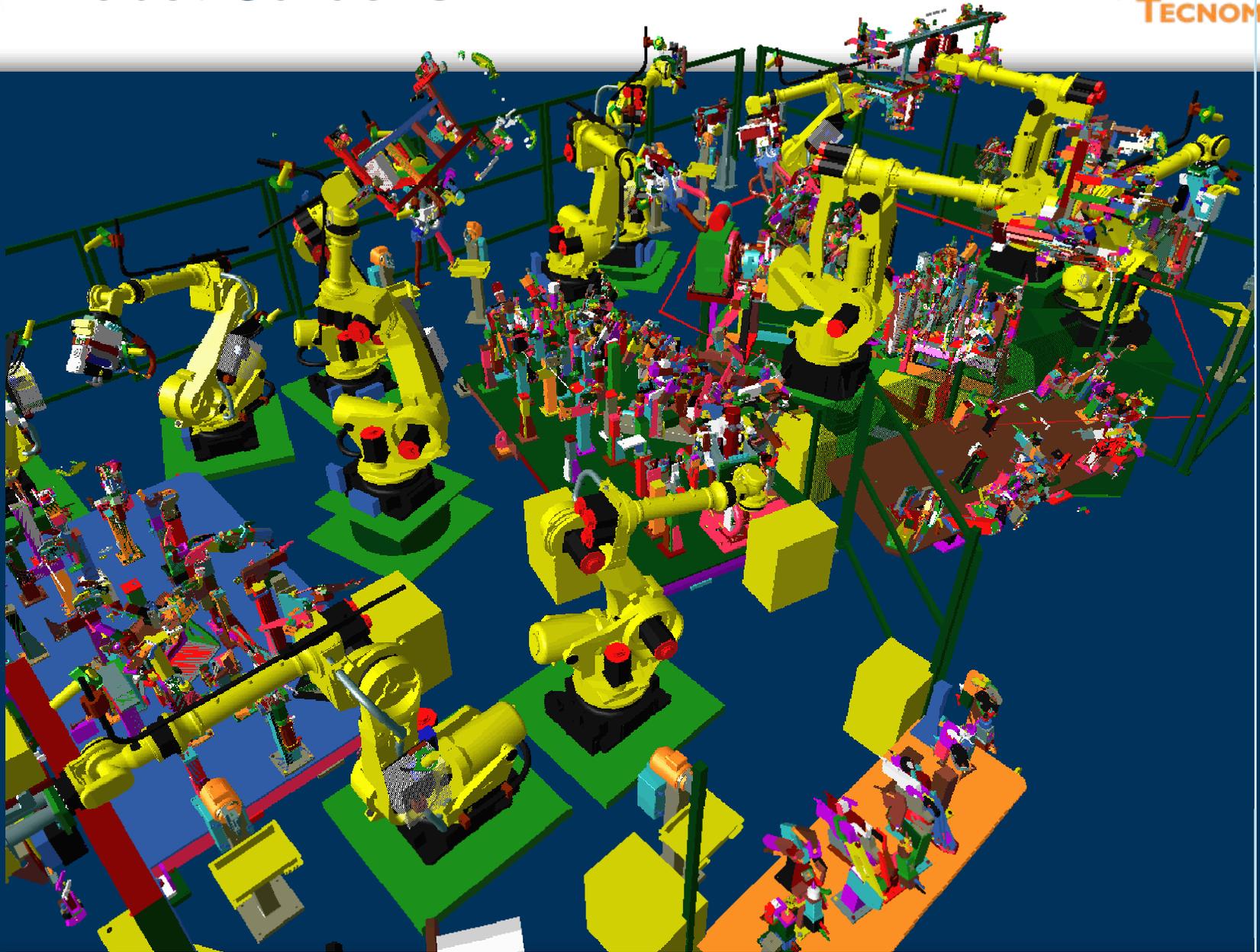
Planning

Handling



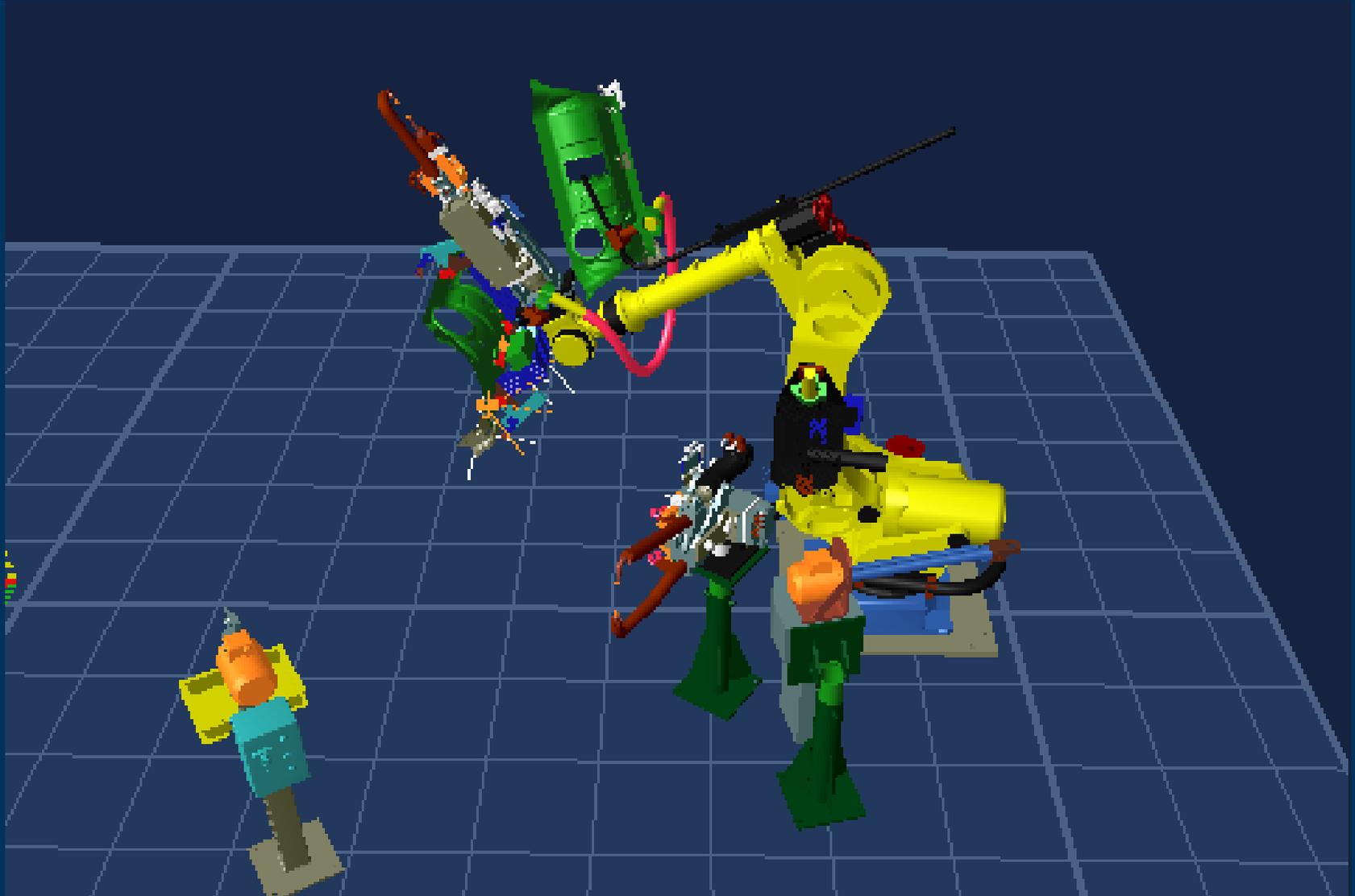


Robot Gardens





Cable Simulation





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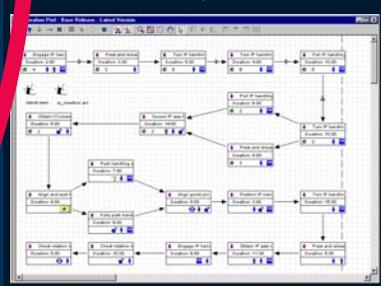
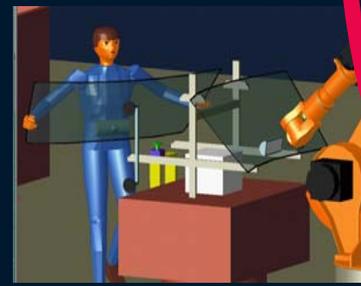
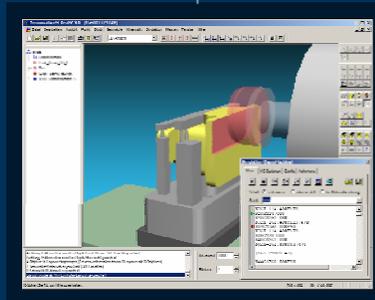
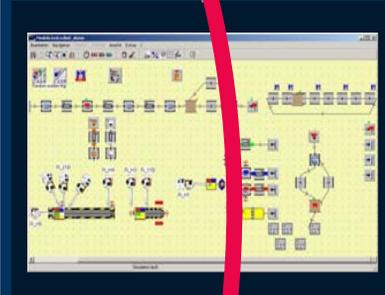
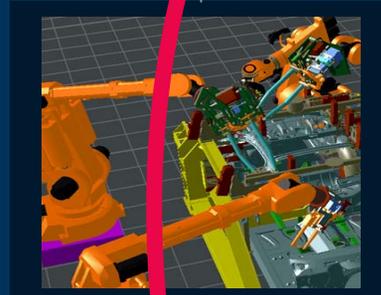
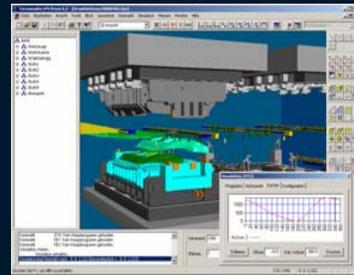
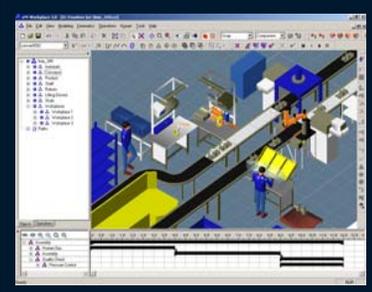
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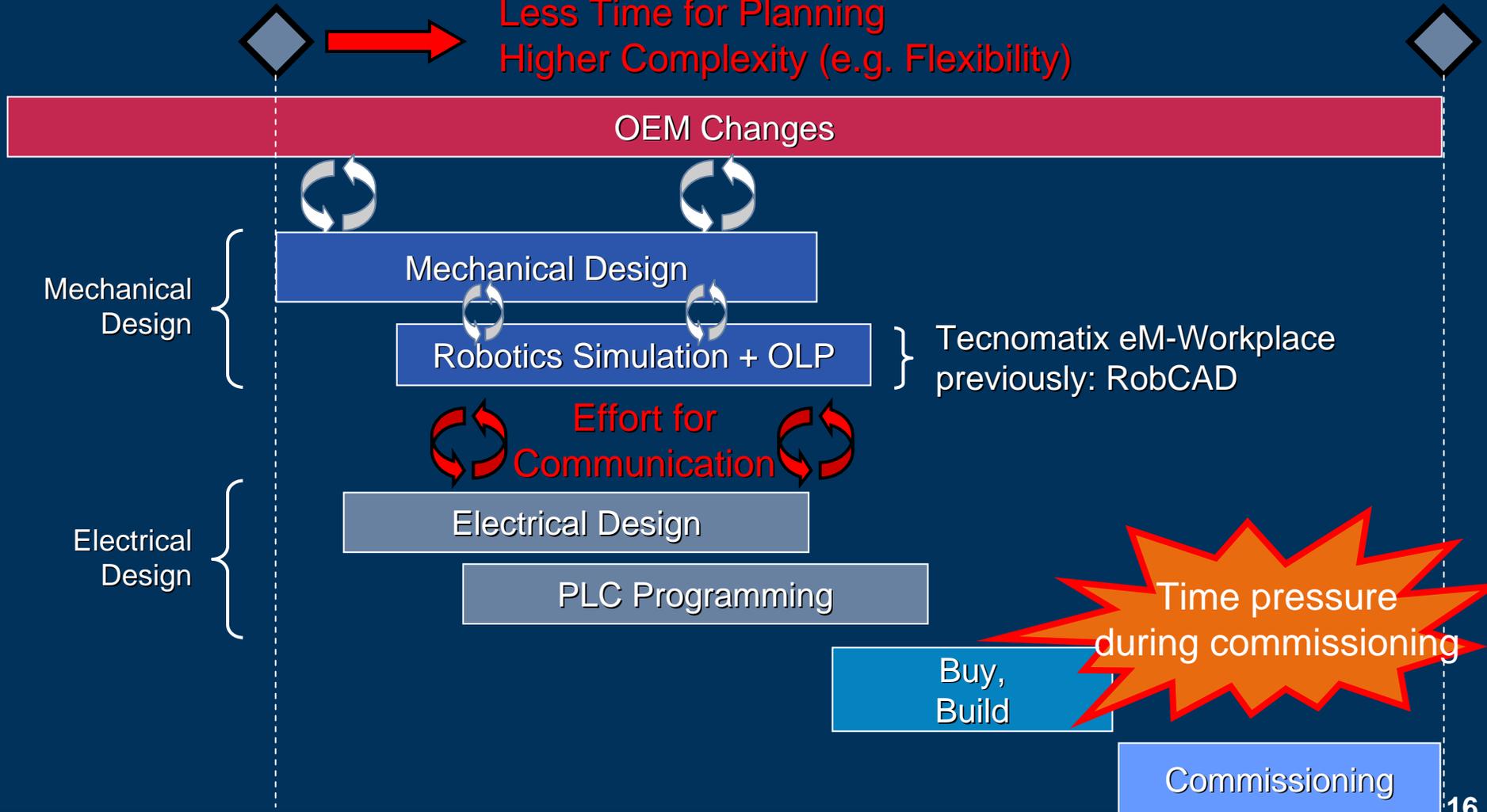
Today's situation



Signed OEM Contract

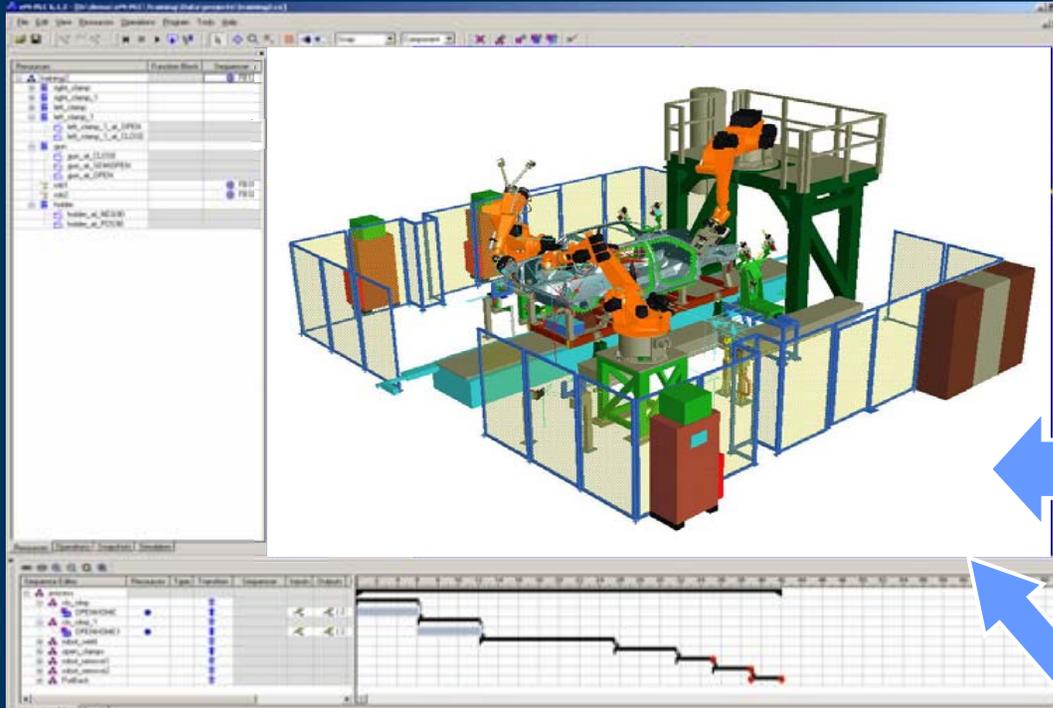
Fixed SOP
Fixed Throughput

Less Time for Planning
Higher Complexity (e.g. Flexibility)



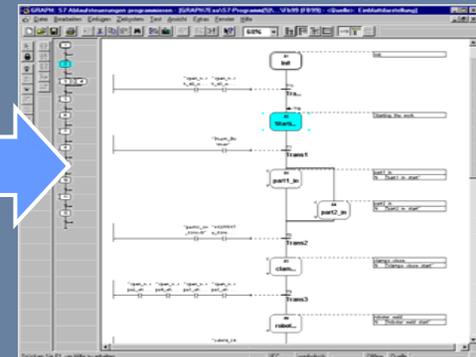


The Solution: Process Simulate Commissioning

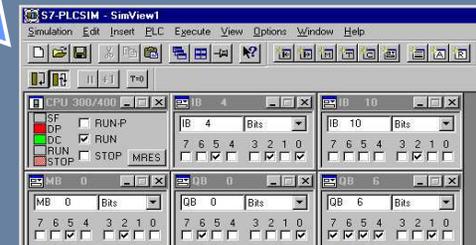


E-CAD
(e.g. E-Plan)

Step 7 Professional



- Programming
- Debugging



■ Virtual / Real PLC

①

- 3D Modeling
- Kinematics
- Layout
- Sequence (Simulation)

②

- Connecting the Signals (mapping)

③

- Virtual Test & Commissioning



- ▶ Commissioning
 - ▶ Identify problems before building the cell
 - ▶ Time- and Cost-Reductions due to:
 - ▶ Increased program-quality
 - ▶ Better preparation
 - ▶ Risk-reduction during the commissioning
 - ▶ Faster ramp-up
- ▶ Production
 - ▶ Training of shopfloor-personnel upfront using the virtual line
 - ▶ Planning of changes and maintenance work → shorter breakdown-times



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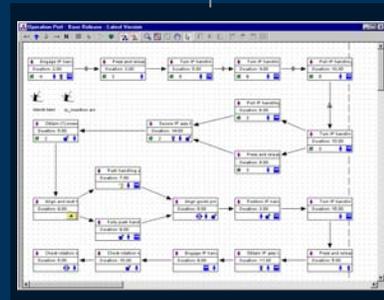
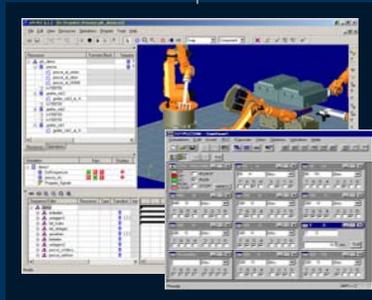
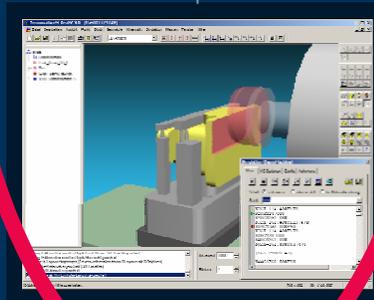
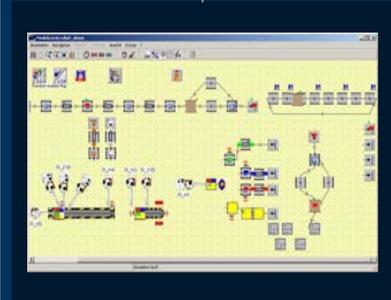
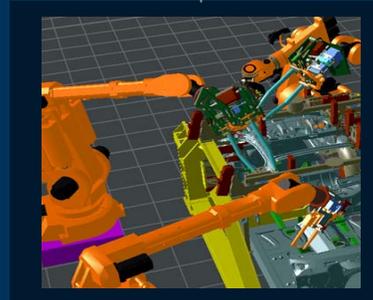
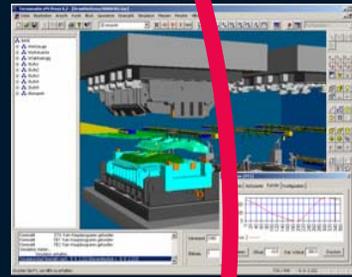
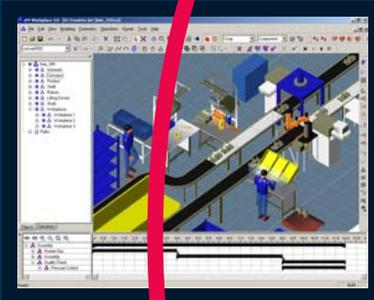
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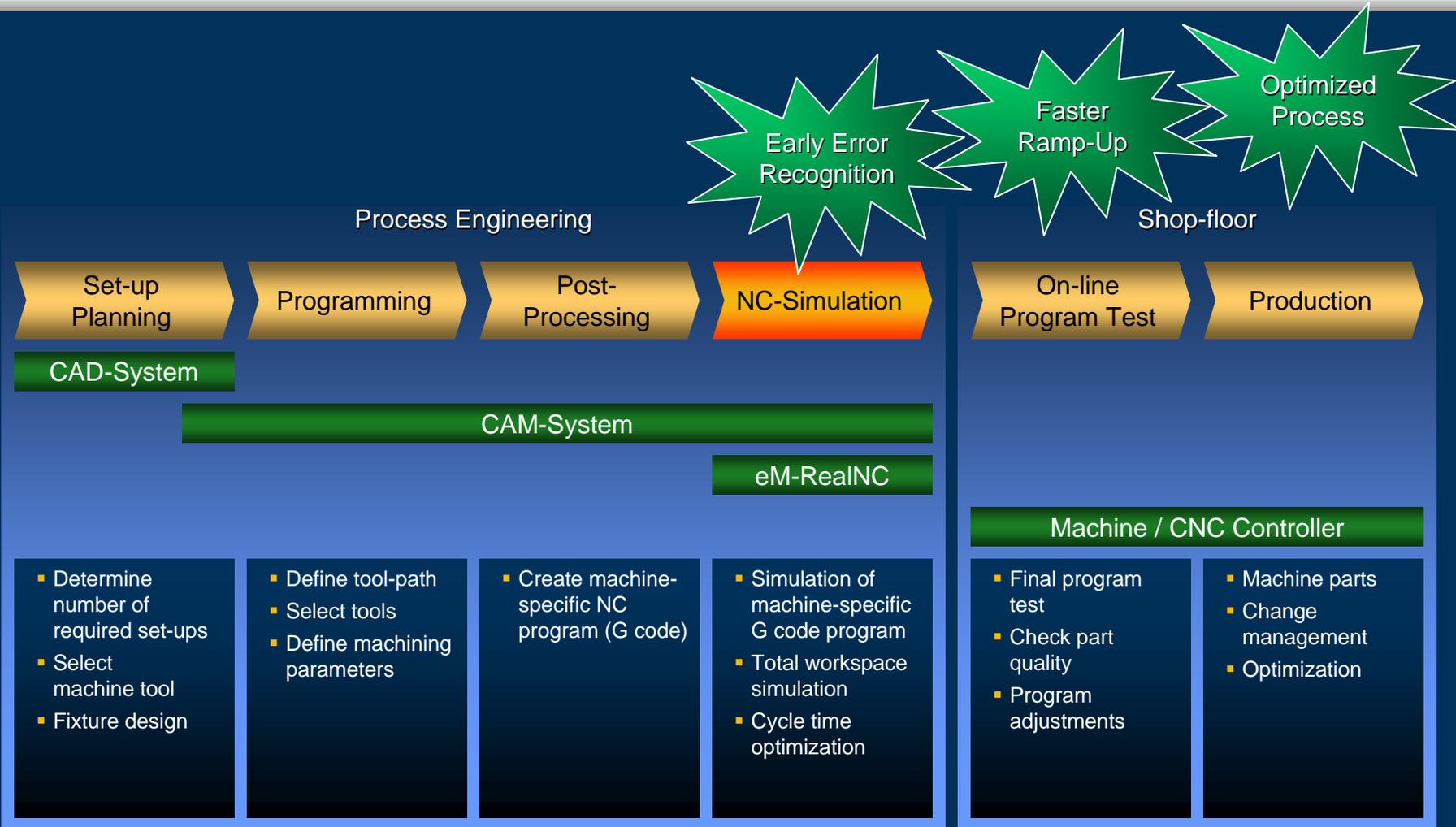
Discrete event simulation

Process-Planning





Enhanced CAM Process Chain - NC-Simulation after Post-Processing





Virtual Controller NC-Simulation using Siemens 840D VNCK



- Machinemodel (geometric, kinematics)
- Simulation of all peripheral operations such as tool-changer, palet-changer, ...
- Visualization
- Material removal simulation
- Collision Detection
- Virtual Time Management
- Data Viewer VNCK



- Boot Controller with specific machine dataset (including canned cycles)
- Time discrete NC-program execution
- Transmit values to simulation (e.g. joint values)
- Support multi-channel applications



Example: Index Virtual Machine



Siemens 840D VNCK
with original HMI of the machine

Maschine REV1 AUTO VWKS.DIR\MESSE_1.WPD
1_0.MPF
Kanal unterbrochen Programm angehalten
Halt: NC - Stop aktiv

MKS	Position	Restweg	Masterspindel	S4
XM1	0.000 mm	0.000	Ist	999.578 U/min
YM1	0.000 mm	0.000	Soll	0.000 U/min
ZM1	893.300 mm	0.000	Pos	0 grad
+ CM4	136.315 grad	0.000	Leistung	100.0 %
BM1	0.000 grad	0.000		

Aktueller Satz CUSVL169.SPF
ALT_MAGAZIN_6:
GETD(UM5)
\$A_DBB[980]=6 MAG_ACHSE_ALT=(U5)
WZ_ALT_UMSETZEN=20 BERU_MAG_ALT=...

Vorschub [mm/U]
Ist 0.000 100.0 %
Soll 0.000

Werkzeug
T7/DREHEN_HINT
vorangewähltes Werkzeug:
DREHEN_HINTEN
G01 G40

Über-speichern DRF Ver-schiebung Programm Beeinfl. Satz-Suchlauf Handrad Programm Korrektur Programm Übersicht

eM-RealNC Simulation with machine-model

Tecnomatix eM-RealNC 7.2 - [Messe.LAY]
File Edit View Point Blocks Geometry Kinematics Simulation Measure Window Help
3D View

Interval: 54 [1/1000s]
Framerate: 1 [Interval/Update]

Press F1 for help 930 x 602 00:00:28.776



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Deliver Industry based solutions



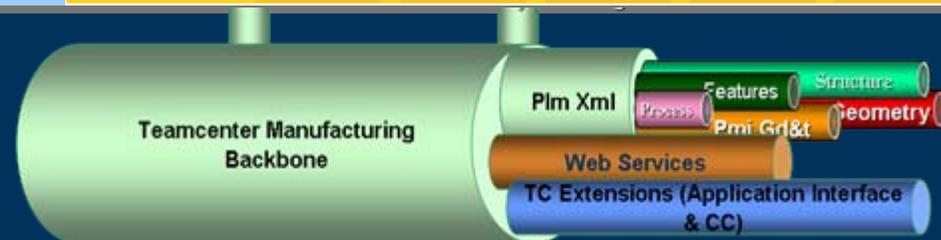
Value chain



Applications

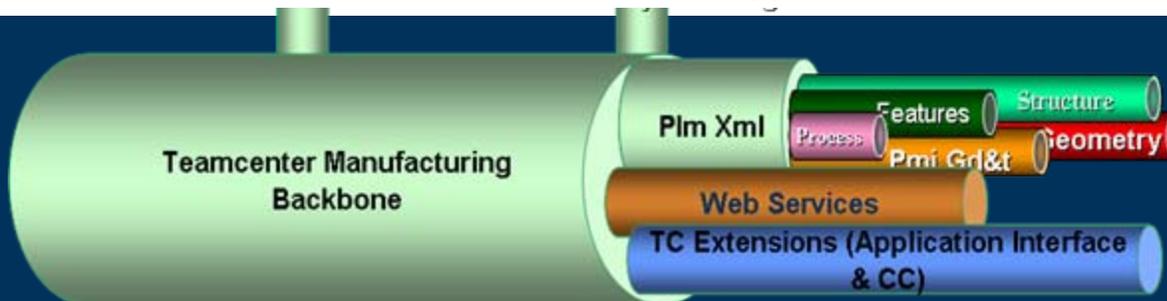
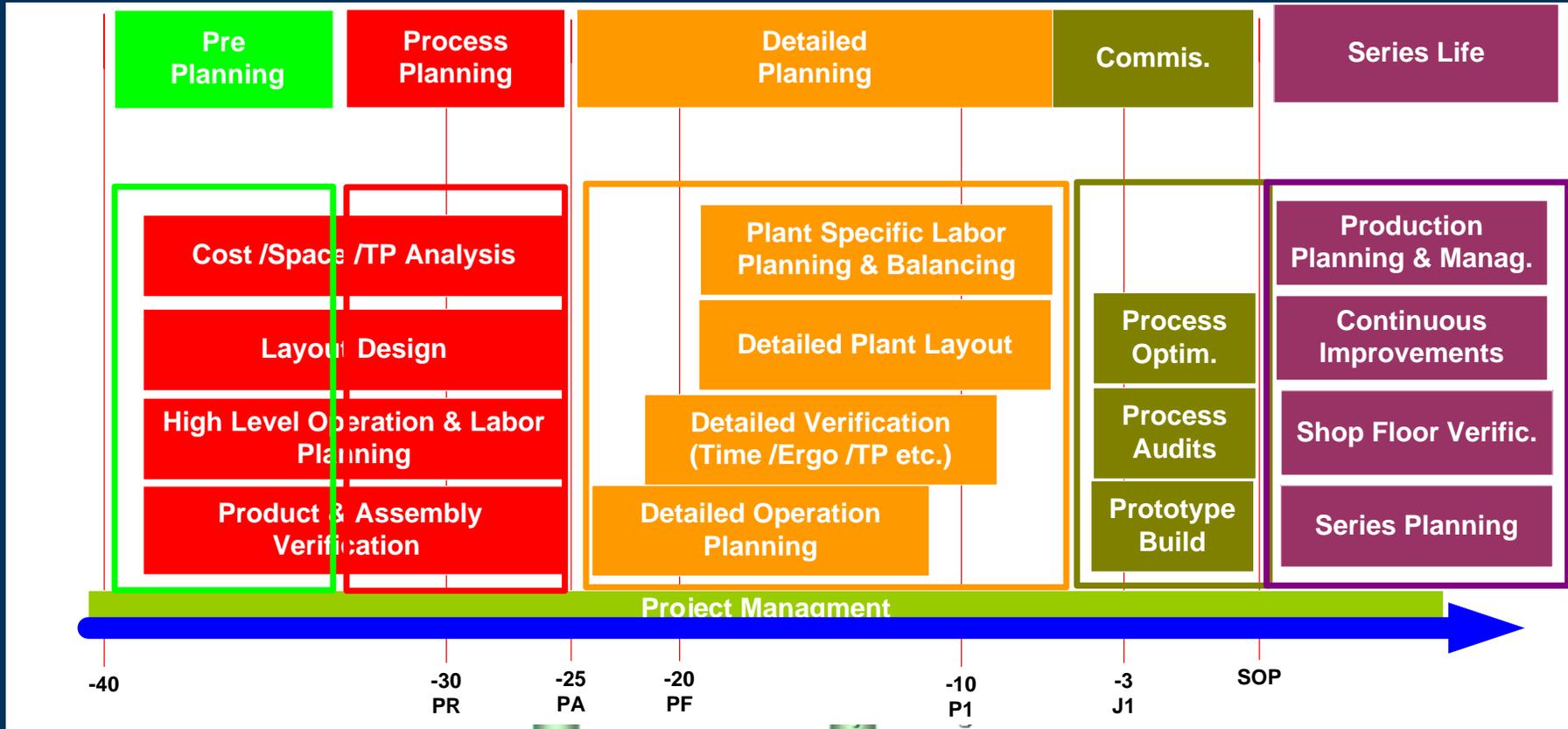
Industry focused solutions

	 Aerospace & Defense	 Automotive	 High Tech & Electronics	 Industrial Machinery	 CPG	
Digital Manufacturing Solutions	Part	✓	✓	-	✓	✓
	Assembly	✓	✓	✓	✓	✓
	Resource	✓	✓	✓	✓	✓
	Plant	✓	✓	✓	✓	✓
	Human	✓	✓	✓	✓	✓
	Quality	✓	✓	✓	✓	✓
	Production Management	✓	✓	✓	✓	✓





Assembly Planning Solution (Automotive, Aerospace, Heavy Industry)





- ▶ Simulation delivers strong and proven values.
- ▶ Simulation e. g. allows for
 - ▶ Verification of planning results.
 - ▶ Optimization of existing production lines.
 - ▶ Smoother ramp-up of production lines.
- ▶ Integration with planning applications and data management maximizes the value of Digital Manufacturing.



Thank you