MODELING AND SIMULATION OF EVOLVABLE PRODUCTION SYSTEMS USING SIMULINK / SIMEVENTS

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Presentation Overview

• Background
  • Challenges
  • Evolvable Production Systems (EPS)

• Industrial Test Case

• Conclusion
Background

Issues in Industry
- Global competition
- Unpredictable market conditions
- Diverse customer demands / mass customization
- High Investment costs leading to outsourcing

Major challenges
- Shorter lead times
- Reduction in downtimes
- Quick response to changes
- Adaption to market fluctuations
- Low investment costs
- Sustainable systems

Need for a change in conventional manufacturing approach!
Plug & Play
Plug & Produce
Evolvable Production System (EPS)

A process-oriented, modular, adaptable and intelligent production paradigm capable of handling emergence in production.

Business Model: Resource sharing

Reducing lead times and downtimes

Dynamic Scalability

Self-Managing
EPS: Control Architecture

References:
1) Colombo, 2005
2) Ribeiro, 2012
Emergence  Dynamic
Skills  Modular  ArtificialLife
Flexibility  Agility  MultiAgentSystems
Plug  Evolvability
Robust  DistributedControl
LowInvestments  AutonomicComputing
Product  Produce  SMEs  Scalability
ProcessOriented  SelfManagement  Adaptability
RealTimeModifications  SwarmIntelligence
A wide scale industrial acceptance of EPS requires further research in several directions!!
Requirements for Industrial Acceptance

• Development of a comprehensive methodology, well-integrated with the existing industrial standards.

• **Exploration and analysis of tools from other engineering domains for applicability in EPS.**

• Harmonization of existing EPS research activities such as, ontologies and resource allocation methods, visualization tool, business model, etc.

• **Effective Information Management Strategy**
Major Contributions of the Presented Work

- Evaluation of SimEvents as a tool for modeling EPS (Agent-based behavior)

- Provide guidelines for modeling an EPS in Simulink / SimEvents

- Choice of SimEvents is motivated by
  - A world wide usage of Simulink
  - Fulfillments of modeling and simulation requirements for EPS
  - Discrete event characteristics
Simulink / SimEvents as an Analysis Tool for EPS

Industrial Test Case:
EPS-based assembly prototype for Alcohol sensor

Implementation in SimEvents
Conclusion

• Combined usage of SimEvents and Simulink provides a multi-aspect analysis support.

• Increase in modeling effort with increase in complexity and number of agents

• Methodological improvements by
  • e.g. Automated generation of simulation model
Future Work

- A Comprehensive timing analysis by incorporating dynamic parameters of the resource agents

- Utilizing the Simulink-generated C/C++ code with suitable wrapper function for Java-based environment (e.g. JADE)

- Further exploration of the existing tools and methods from other domains for their compatibility with EPS approach, e.g.
  - Mapping formal models (e.g. UML) to SimEvents
  - Automatic generation of Simulink models from UML
Thank you!
Questions / Feedback?

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