

Roadmap for Research in Model-Based SoS Engineering

Roadmap Presentation

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COMPASS in a nutshell

- Comprehensive Modelling for Advanced Systems of Systems
- EU Framework 7; October 2011 - October 2014
- Development of tools and techniques to support modelling of systems of systems
- COMPASS roadmap had very specific focus of M&S in SoS



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Recommendations for research priorities

1. Dealing with heterogeneous models & building tool interoperability
2. Improving accessibility of of formal verification methods
3. Developing tools to support verification of emergent behaviour in SoSs
4. Understanding SoS architectures
5. Developing standards and approaches for safeguarding emergent properties such as fault tolerance & security
6. Facilitating dependable dynamic reconfiguration
7. Coping with evolution

Main barriers identified

1. Lack of integrated tools/techniques crossing engineering disciplines or standardised/open architectures & data formats
2. Very little case study data is available about existing systems, for creating guidelines and learning best practice
3. High set-up costs assumed to accompany formalised modelling techniques discourages many firms
4. Valid societal concerns about security and privacy need addressing
5. Lack of personnel trained in modelling for multiple engineering disciplines
6. Lack of awareness of *SoS* as a term; many businesses don't self-identify as *SoS engineers*

Recommendations for CPS implementation

1. Develop ontologies crossing engineering disciplines
2. Develop tools & techniques to integrating formal techniques with systems engineering practices
3. Tools & techniques needed for collaborative design techniques, supporting design space exploration & providing early feedback on design choices
4. Techniques and patterns needed for identifying & analysing real-time properties & timing properties
5. Collect and publish real world case studies, to provide data on which to base recommendations for best practice

Strategic recommendations

COMPASS roadmap did not include strategic recommendations. However, here are our thoughts:

1. Improve recognition of the term „CPS“, for non-technical communities and engineering communities
2. Provide opportunities & platforms for SMEs to find business partners as well as collaborative tools
3. Develop and promote open architectures, ontologies & platforms to support collaborative modelling between independent partners
4. Develop and promote standards to address issues in security, privacy, dependability etc
5. Encourage a change in CPS engineering culture, so that it becomes normal practice to exchange models (with internal details hidden) with external collaborators
6. Encourage sharing of case study material

Unique findings in your roadmap and under-represented gaps

- Addressing accessibility of formal techniques drawn from computer science, and integrating them with tools used by other engineering disciplines
- Integrating a formal approach with semi-formal architectural modelling

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