



**CHALMERS**  
UNIVERSITY OF TECHNOLOGY



UNIVERSITY OF GOTHENBURG

# Engineering of Systems of Systems (SWESoS)

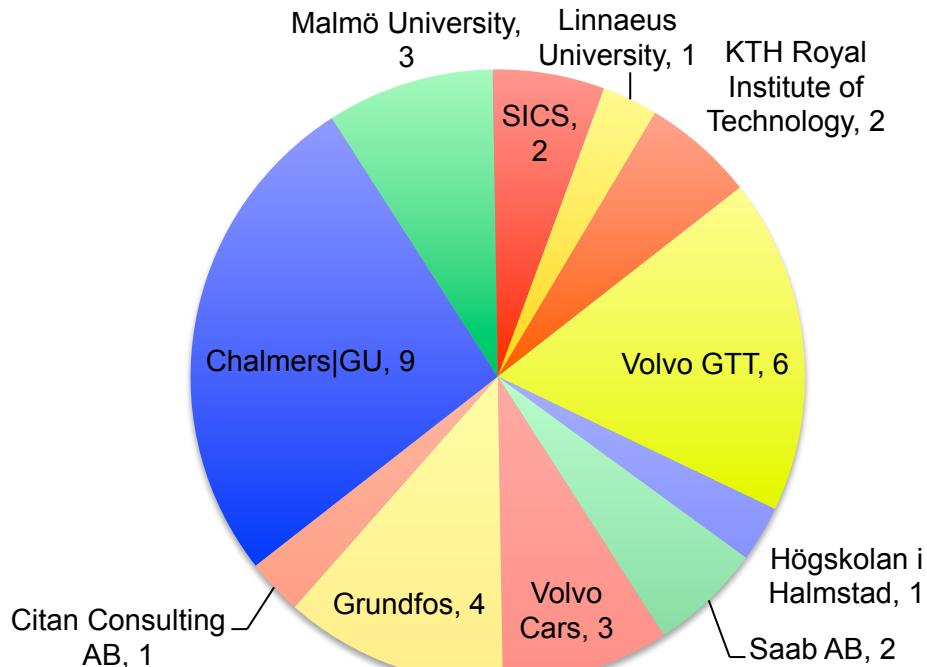
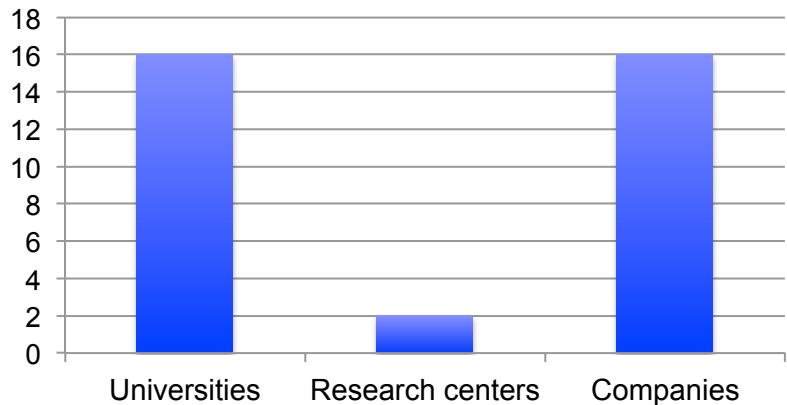
Swedish Workshop - Gothenburg, September 9, 2016



## Registered participants

34 people registered!

- 6 Universities
- 1 research center
- 5 companies



# Main goals in participating to SWESoS



Inform Gain useful finding opportunities discussing ideas industrial architecture view smart applications ongoing challenges people Learn research mix development problems community potential feedback intermediate Listen broad innovation automation Electrical activities work Familiarize Present results truck Increase Aligning exchange enjoy within

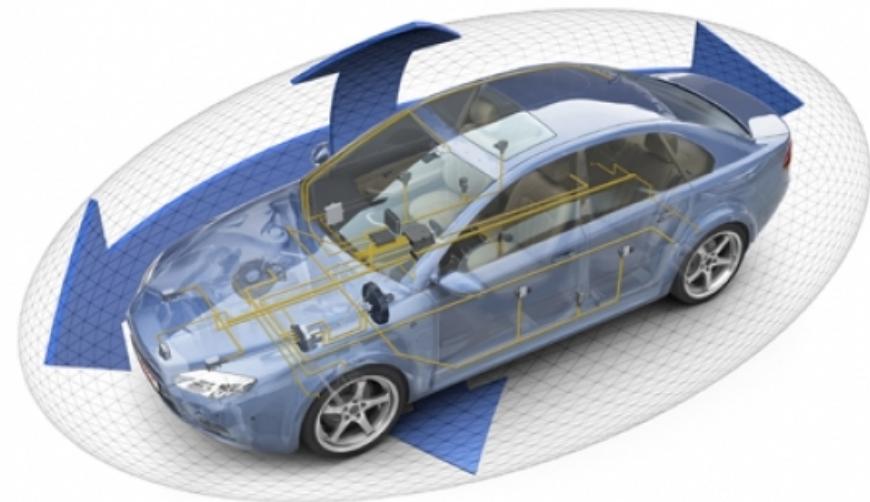
knowledge interesting networking new inspiration novel IoT-based presentations perspectives Next sharing Sweden keeping trends interesting Concepts Knowledge Security Generation Trends

# Systems of Systems (SoS)

- Collection of independent, often pre-existing and/or independently owned and managed systems that collectively offer a service that emerges from their collaboration
- The units that compose a SoS are systems themselves and are called *constituents*
  - Constituents might need to sacrifice part of their functionalities in order to meet the requirements for joining the SoS
  - Constituents have operational independence
  - Constituents might be independently owned and managed

# Point of view of a constituent of a SoS

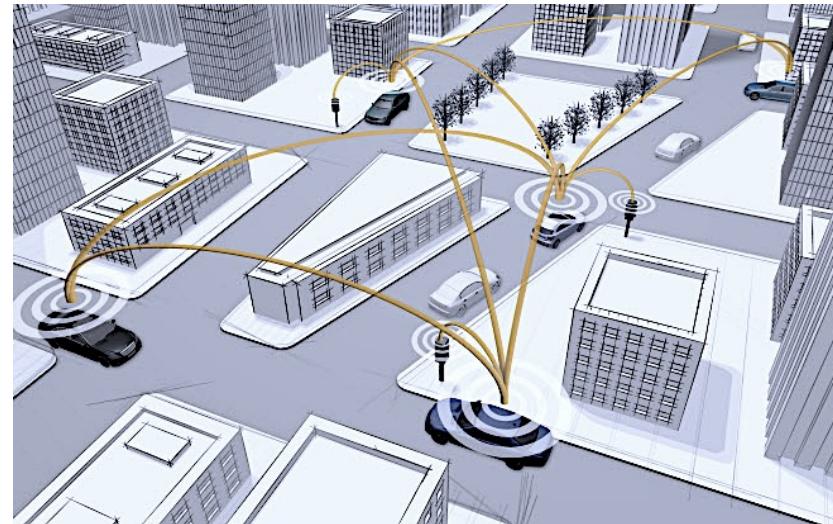
*How to engineer a system so to  
be part of a system of systems?*



# Point of view of the overall SoS

*How to engineer the SoS so that the collaboration among various constituent systems will achieve the SoS goal?*

- Constituents have their own goals
- Constituents have operational independence
- Constituents might be independently owned and managed



# Business Ecosystem

Economic community supported by a foundation of interacting organizations and individuals, which can also be perceived as organisms of the business world (Moore, 1993).

1. Symbiotic relationship
2. Co-evolution
3. Platform: tools, services and technology used in ecosystem to enhance performance

# Ecosystem Stakeholders



# Software Ecosystems

- ◊ Here's a try: A business ecosystem consisting of a platform, a set of internal and external developers and a community of domain experts in service to a community of users that compose relevant solution elements to satisfy their needs.
- ◊ Some more detail:
  - ◊ **platform:** A hierarchical set of shared components providing functionality that is required and common for the developers constructing solutions on top of the platform.
  - ◊ **Evolution:** Over time, the functionality in the ecosystem commoditizes and flows from unique solutions to the platform.
  - ◊ **Developers:** Although internal and external developers use the platform differently, the platform often allows developers to build on top of each other's results.
  - ◊ **Composition:** Users are able to compose their own solutions by selecting various elements into a configuration that suits their needs optimally.

# Ecosystems and Systems of Systems

- **Different perspectives on a similar concept**
- **Important to understand the business, architecture, process and organizational implications**

# Agenda

- ⌚ 10:15-11:00 Industry talks
  - ⌚ 10:15-10:30 Steen K. Hansen (GRUNDFOS Holding A/S). Systems of Systems, Obstacles and opportunities
  - ⌚ 10:30-10:45 Katrin Sjoberg (Volvo Group Trucks Technology).
  - ⌚ 10:45-11:00 Anders Lindeborg (Volvo cars). Overview of the Next Generation Electrical Architecture (NGEA) project
- ⌚ 11:00-11:30 Coffee break
- ⌚ 11:30-12:30 Systems of Systems in the Automotive domain
  - ⌚ 11:30-11:50 Eilert Johansson, Tony Larsson, Maytheewat Aramrattana, Patrizio Pelliccione, Magnus Ågren, Göran Jonsson, Rogardt Heldal. NGEA project - Systems of Systems Concepts for Cars
  - ⌚ 11:50-12:10 Avenir Kobetski and Jakob Axelsson. System-based Safety Analysis of Automotive SoS Applications (15 min presentation + 5 min questions)
  - ⌚ 12:10-12:30 Dejiu Chen. A Model-based Development, Execution, and Evolution Platform for Dependable Cyber-Physical System-of-Systems

# Agenda

- ✿ 12:30-13:30 Lunch
- ✿ 13:30-14:50 Sociotechnical aspects of Systems of Systems
  - ✿ 13:30-13:50 Jan Bosch. Ecosystems and Systems of Systems (15 min presentation + 5 min questions)
  - ✿ 13:50-14:10 Helena Holmström Olsson and Jan Bosch. Collaborative Innovation In Business Ecosystems: A Strategy Selection Framework (15 min presentation + 5 min questions)
  - ✿ 14:10-14:30 Jesper Andersson and Mauro Caporuscio. Aligning Architectures for Sustainability
  - ✿ 14:30-14:50 Helena Holmström Olsson and Jan Bosch. Self-Learning, Self-Actuation and Decentralized Control: How Emergent System Capabilities Change Software Development

# Agenda

- ⌚ 14:50-15:50 Systems of systems (SoS) for energy, defence, security, and everyday life scenarios
  - ⌚ 14:50-15:10 Fahed Alkhabbas, Romina Spalazzese and Paul Davidsson. IoT-based Systems of Systems
  - ⌚ 15:10-15:30 Patrizio Pelliccione. Collaborative mobile multi-robots
  - ⌚ 15:30-15:50 Bengt A Mölleryd. Frameworks for innovation
- ⌚ 15:50-16:10 Coffee break
- ⌚ 16:10-16:40 Working/Discussion session
- ⌚ 16:40-17:00 Wrap up and plan next steps



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