30th Annual INCOSE international symposium

Virtual Event
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Towards an Ontology for Collaboration in System of Systems Context

Paper 52

www.incose.org/symp2020

Authors and acknowledgement

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Dov Dori. Dov Dori, is Fellow of IEEE, INCOSE, and IAPR, a Professor at the Technion, Israel. During 2020 he is Visiting Professor at the Aeronautics and Astronautics Department at MIT, where has intermittently been Visiting Professor at MIT since 1999. In 1993 he invented Object-Process Methodology (OPM ISO 19450:2015). He authored 380 publications, supervised over 50 graduate students, chaired nine international conferences, was Associate Editor of IEEE T-PAMI and Systems Engineering, and Co-Chair of the IEEE SMCS TC on MBSE. He received research and innovation awards and is a member of Omega Alpha Association - International Honor Society for Systems Engineering.

Yatin Jayawant. Yatin works as a Lead Engineer, Adv. Systems Engineering at John Deere India Private Limited. He received his Masters in Mechanical Engineering from the University of North Carolina at Charlotte. He is also a Trained Systems Engineer from Massachusetts Institute of Technology and Caltech. He has been engaged in research on systems engineering and design for environment.

Leonard Petnga. Dr Petnga is an Assistant Professor of Systems Engineering with the Industrial and Systems Engineering and Engineering Management (ISEEM) department. He holds a Masters in Systems Engineering and PhD in Civil Systems from the University of Maryland, College Park. He is a former Cyber-Physical Systems (CPS) Scholar at the US National Institute of Standards and Technology (NIST) and Postdoctoral Fellow at the US Army Research Laboratory (ARL) and the Institute for Systems Research (ISR) at the University of Maryland, College Park. His research focuses on knowledge structures for MBSE and integration of complex systems with an emphasis on CPS and System of Systems (SoS).

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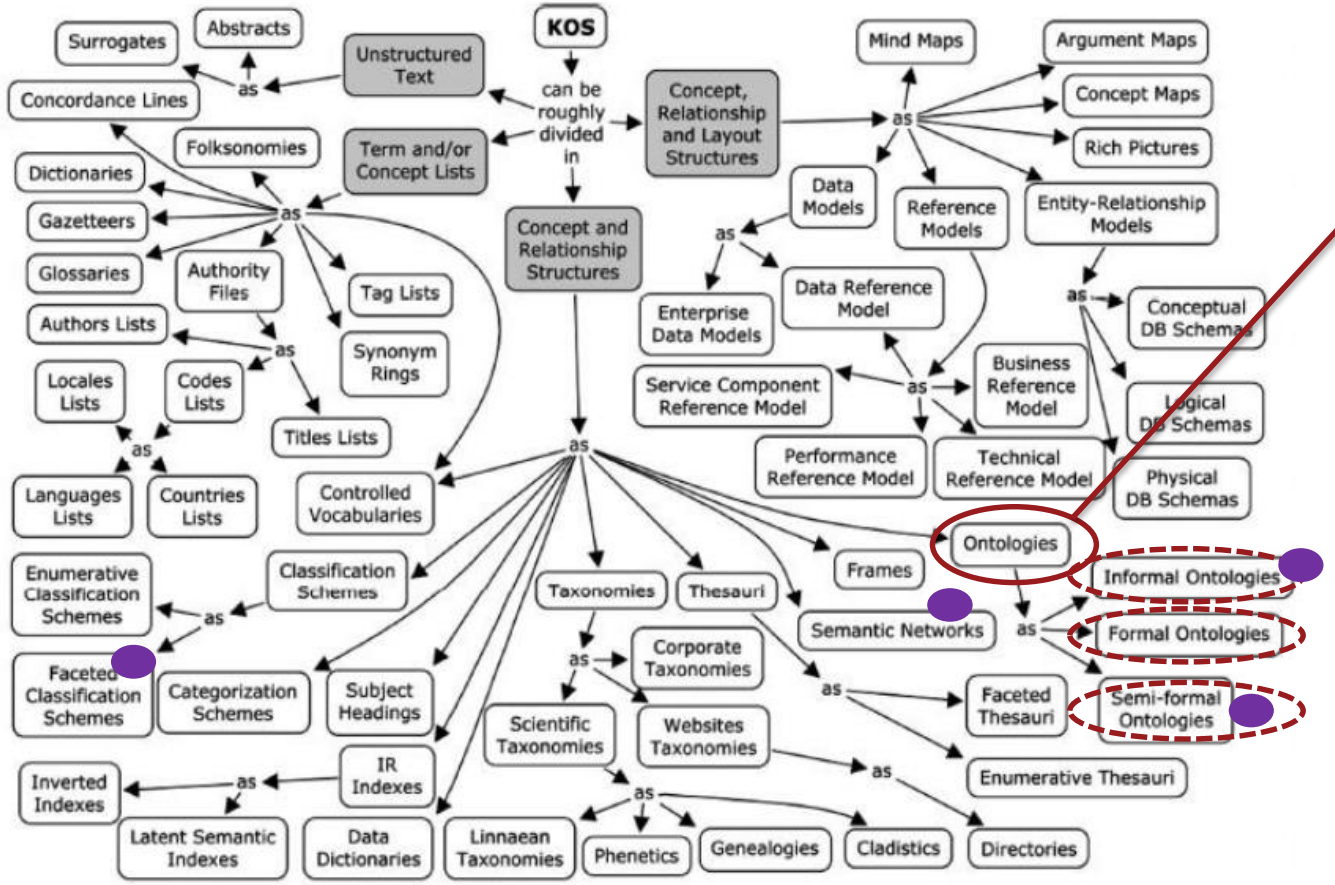
Michael Yokell. Dr. Mike Yokell is a Technical Director, Systems Engineering for Raytheon Technologies Corporation. He is certified by the International Council on Systems Engineering (INCOSE) as an Expert Systems Engineering Professional (ESEP). Mike also serves as an INCOSE liaison to International (ISO) Standards setting bodies for systems and software engineering. He is the editor of several new standards on system of systems engineering.

Systems of Systems Working Group

Ontology “setting the stage”



SoS

Many attempts and initiatives...

Local context dependencies or perspectives necessary for explanation.

REF: https://www.isko.org/cyclo/kos, secondary source to Souza, Renato Rocha, Douglas Tudhope and Mauricio B. Almeida. 2012. "Towards a Taxonomy of KOS: Dimensions for Classifying Knowledge Organization Systems". Knowledge Organization 39, no. 3: 179–192.

The SoS ontology in SE context

Yang, L., Cormican, K., Yu, M., (2019), ***Ontology-based systems engineering: A state-of-the-art review***, Computers in Industry 111 (2019) 148–171, Elsevier.

600

183

116

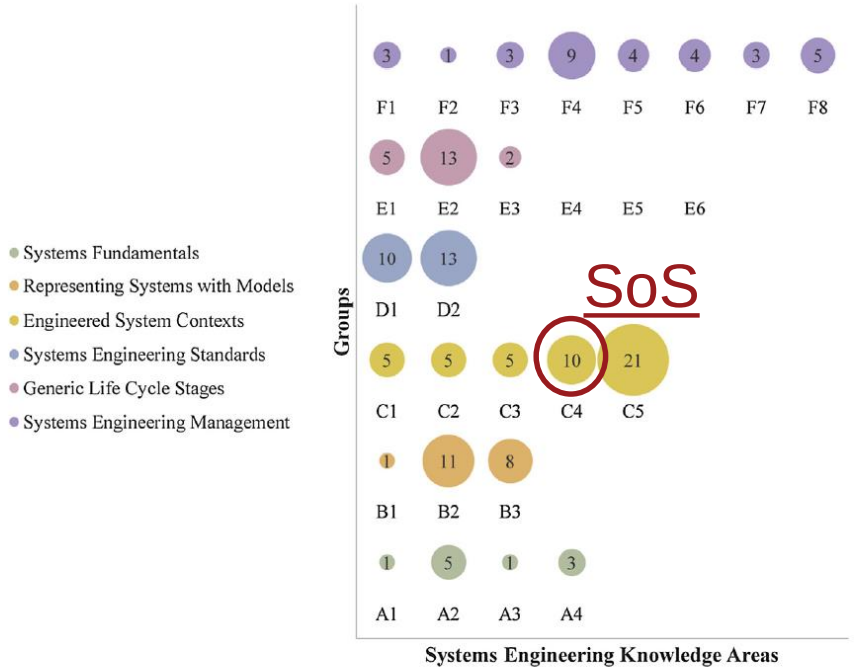


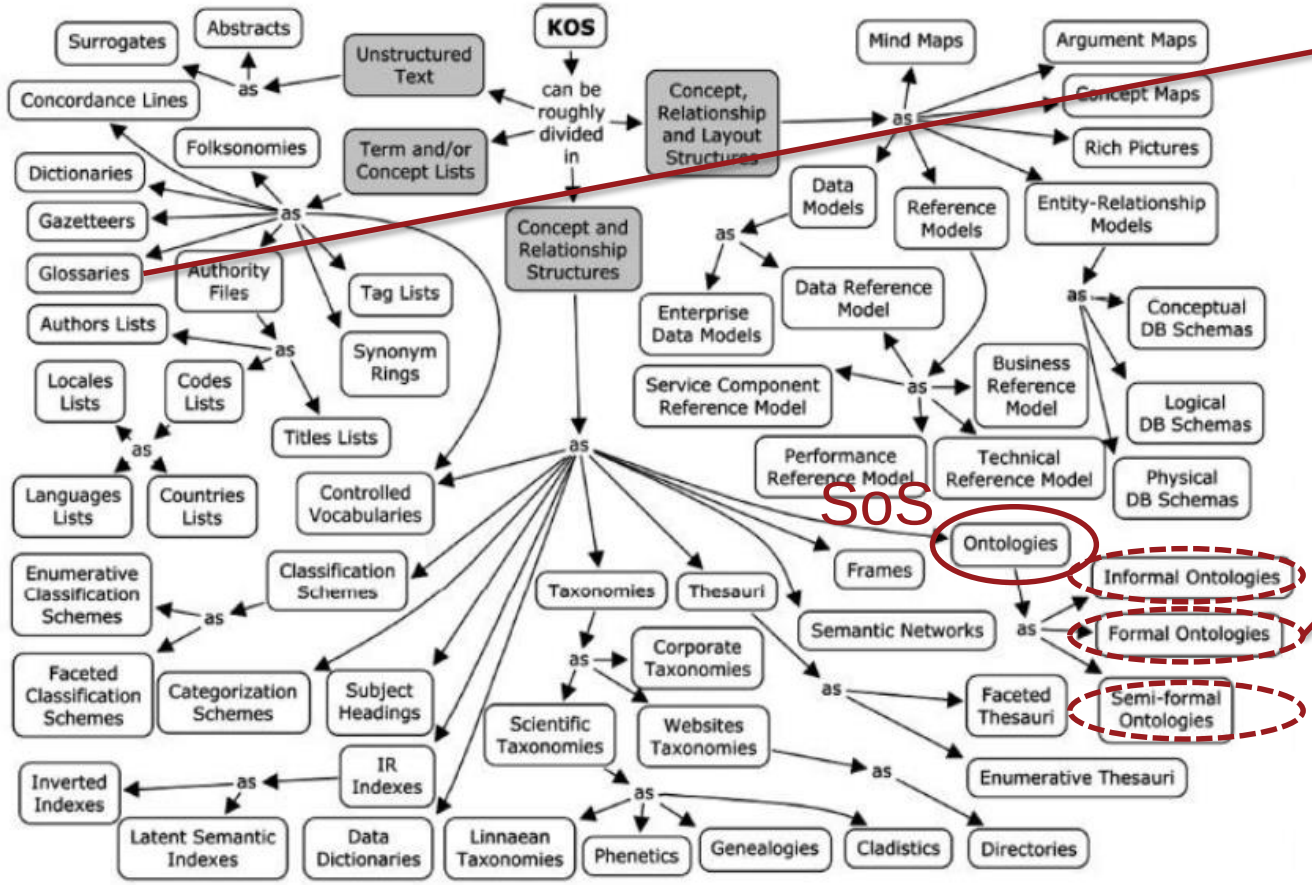
Fig. 3. Distribution of papers for SE knowledge areas.

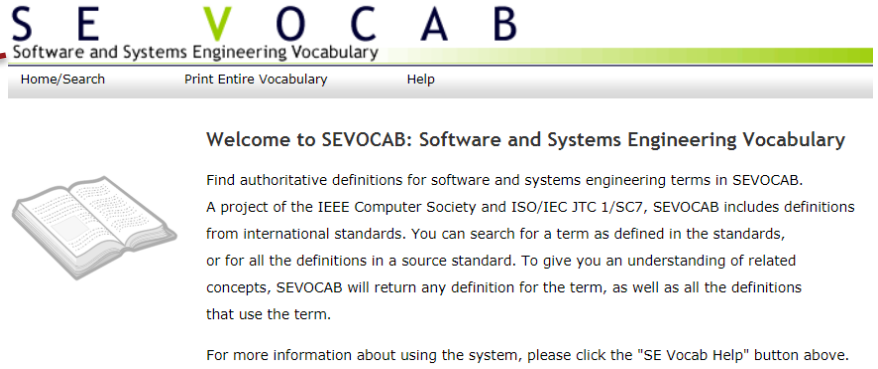
Example of topics covered

- Standards
- Mission
- Trace of effects
- Capabilities
- Configuration Management
- Unmanned vehicles

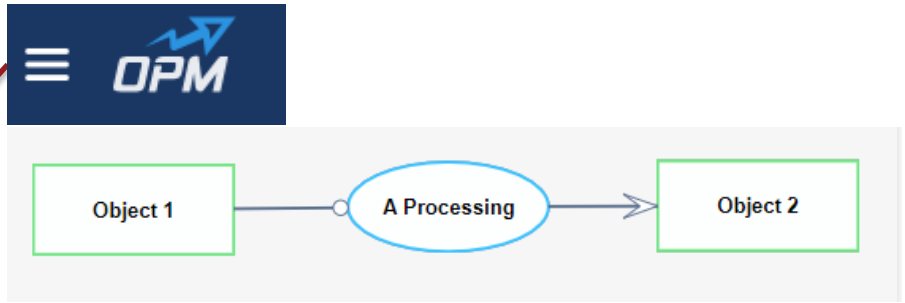
...

The paper contribution...





https://pascal.computer.org/sev_display/index.action



Object Process Methodology (OPM) is a conceptual modeling language and methodology for capturing knowledge and designing systems, specified as ISO/PAS 19450.

REF: https://www.isko.org/cyclo/kos, secondary source to Souza, Renato Rocha, Douglas Tudhope and Mauricio B. Almeida. 2012. "Towards a Taxonomy of KOS: Dimensions for Classifying Knowledge Organization Systems". Knowledge Organization 39, no. 3: 179–192.

- *Directed*
- *Acknowledged*

Focus: the architect role for managed SoS

Understand the system in a context **and** from different perspectives.

Define purpose and boundary.

Case: safety

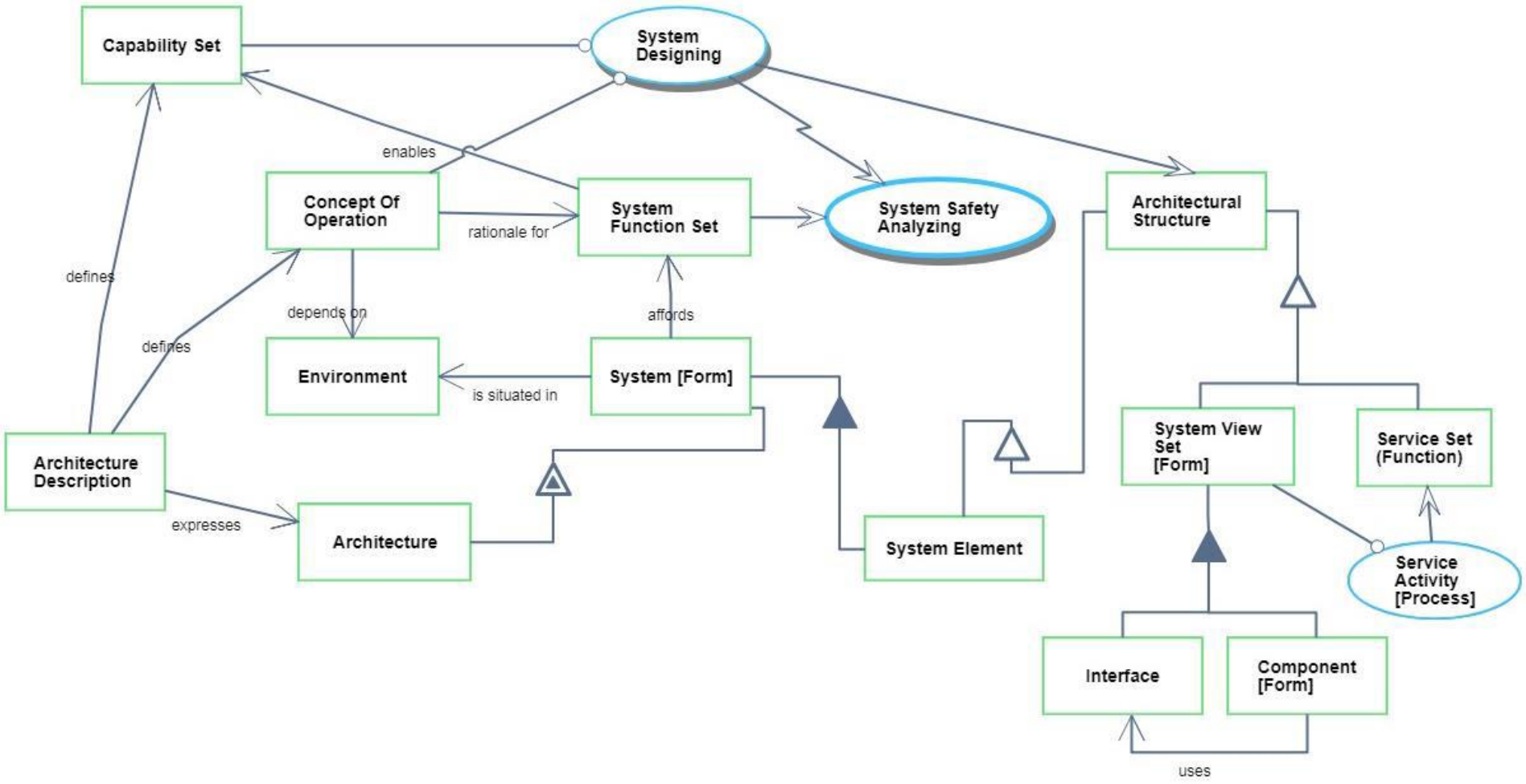
Use **and** communicate principles

Method or principle: ISO-26262

Store **and** update principles

Architecture description: ISO/IEC/IEEE-42010

The core concept



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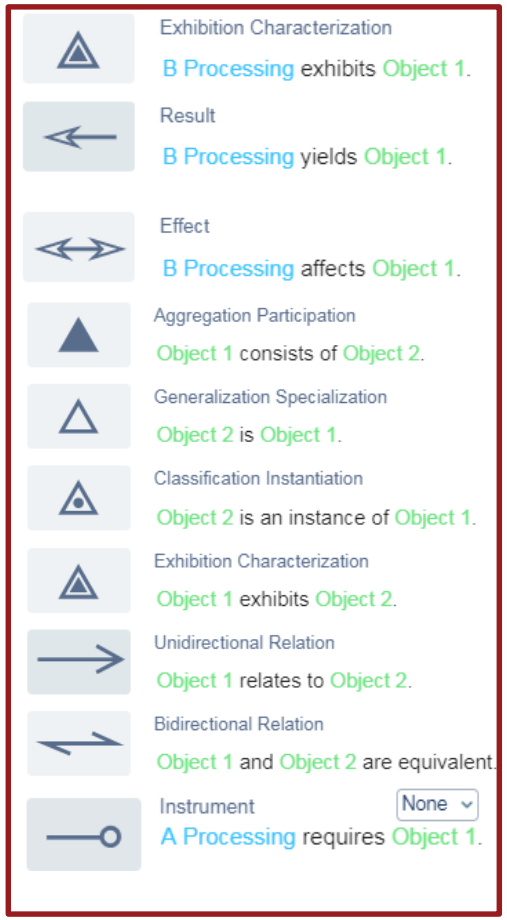
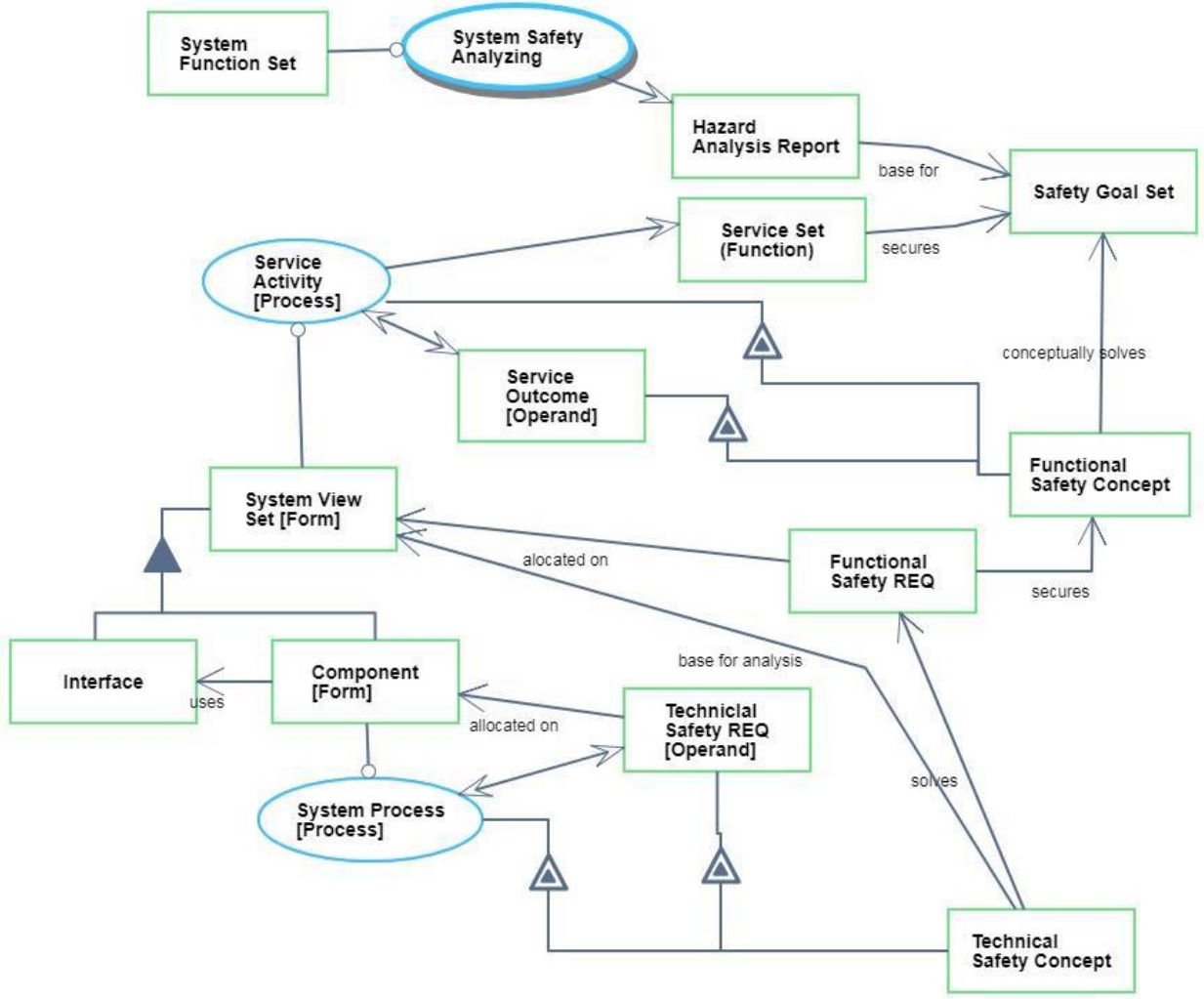


The specialization case extension



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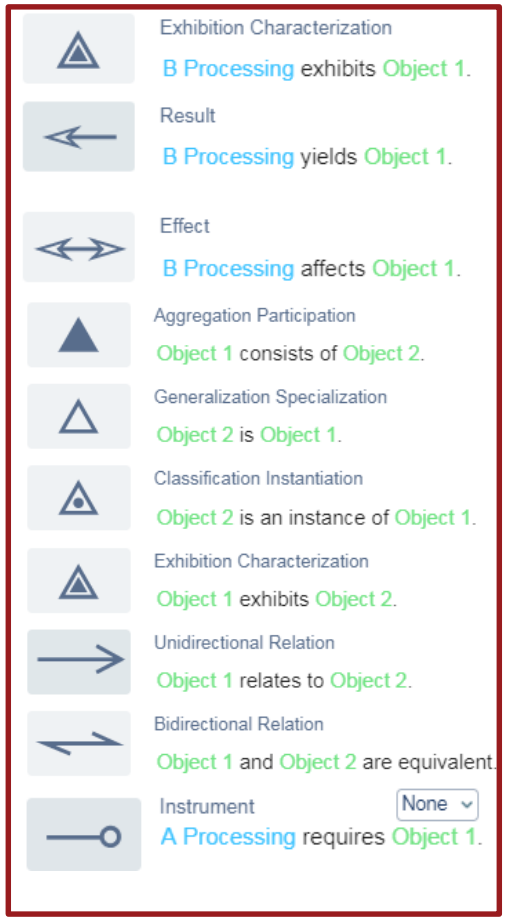
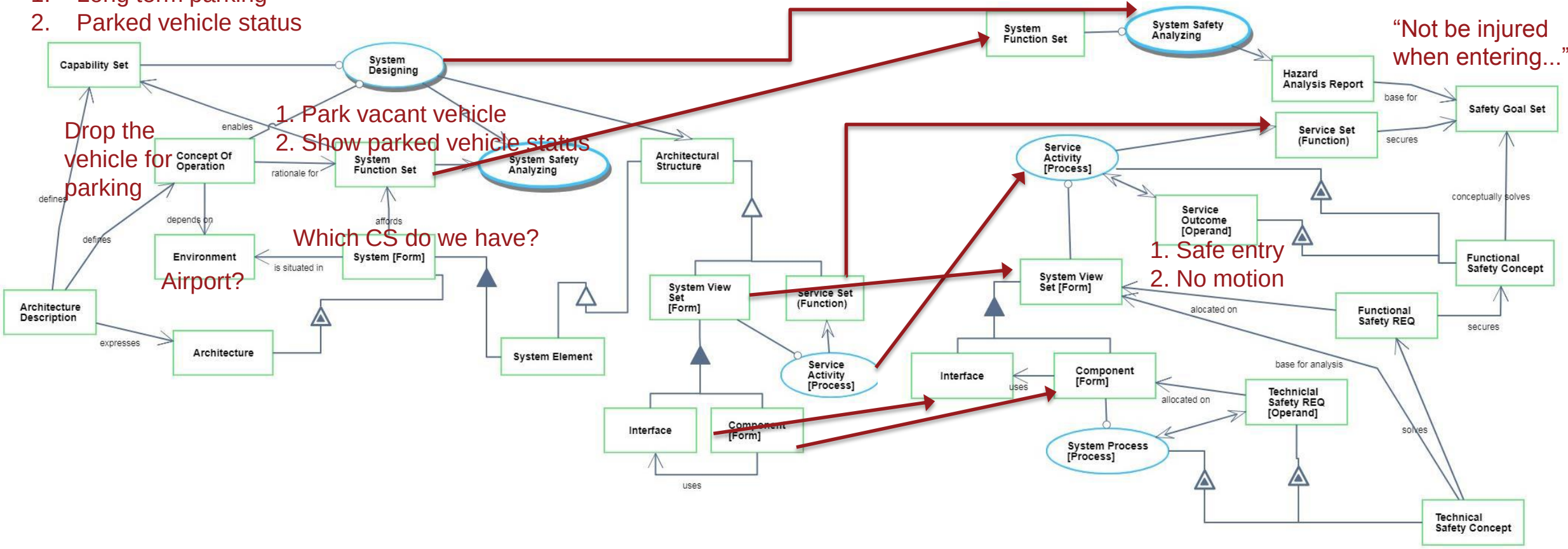


The example case “automated parking facility”

1. Long term parking
2. Parked vehicle status



Results

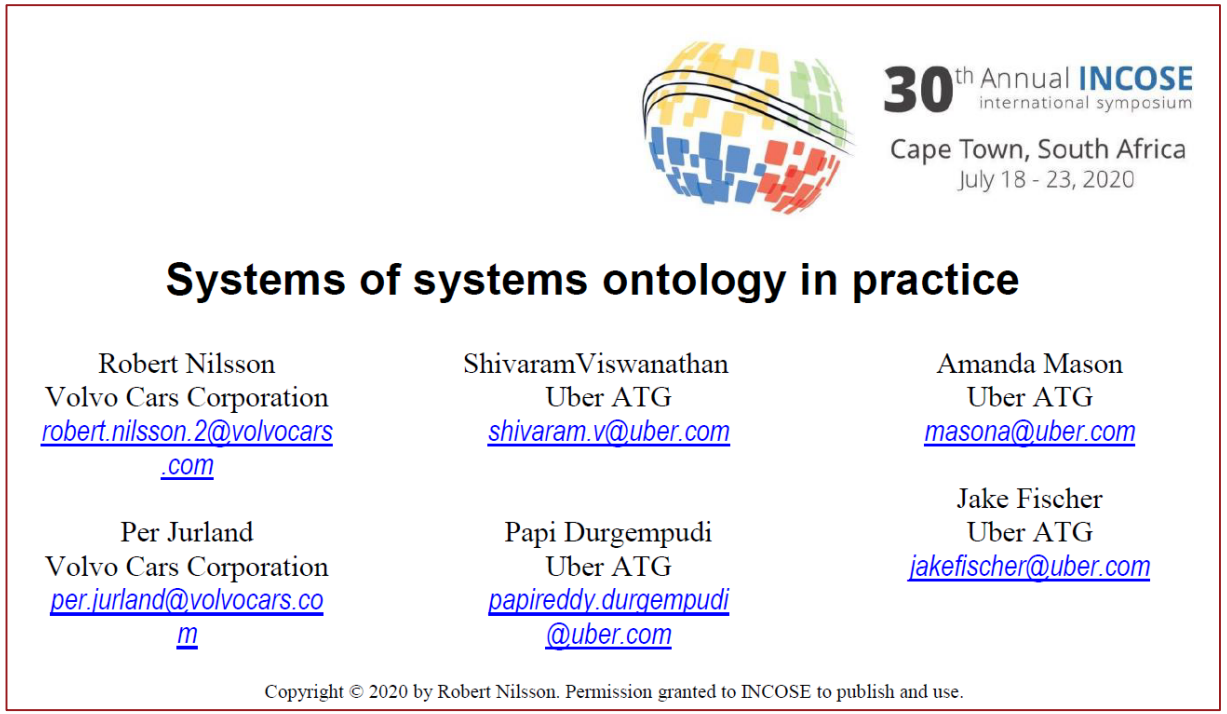
- The concept model, ontology proposal, with its; parts, parts origins, intentions and relations is documented and tested by an instantiation (case: safety).

- 15 out of 16 objects needed in concept model where already defined in the SE-VOCAB hosted by IEEE.

- It is has been exemplified that the concept model can be used for architectural work to:
  1 - Define a SoS
  2 - Communicate principles
  3 - Document principles

Further work for interested...

Paper in press



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Systems of systems ontology in practice

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