

# On the Characterization of Missions of Systems-of-Systems

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# Agenda

- 1 Introduction
- 2 Systematic mapping
  - Planning
  - Conduction
  - Reporting
- 3 A conceptual model for missions of SoS
- 4 Final remarks

# Introduction

## System-of-systems (SoS)

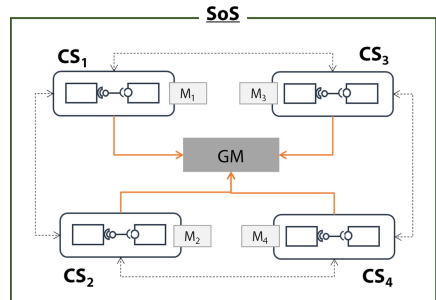
Widespread set of independent, heterogeneous constituent systems to form a larger system to accomplish a given **mission**

# Introduction

## Missions

Functional goals assigned to systems

- Each constituent system accomplishes its own individual mission
- Each constituent system is able to contribute to the accomplishment of the global mission of the SoS



# Introduction

## Motivation

In the current literature about SoS:

- Missions have been regarded as a goal, a functionality, or a set of tasks to be performed by the constituent systems
- Constituent systems cooperate by exchanging information in order to accomplish the mission of the SoS
- The existing initiatives do not properly address mission specification in the SoS context
- There is a special attention to specific domains, such as military systems
- There is no work dedicated to deal with missions of SoS in a general extent

# Introduction

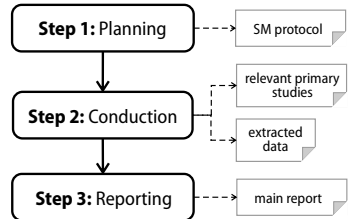
## Goals of this study

To analyze the literature in a broader context in order to

- identify elements that can be brought to the SoS context
- identify issues that must be considered when shifting from monolithic systems to SoS
- identify how missions of systems have been specified

# Systematic mapping

- Investigation into the literature with broad research questions
- Overview of the state of art
- Three main steps:
  - 1 Planning
  - 2 Conduction
  - 3 Reporting



# Systematic mapping

## Research questions (RQs)

- ① What are important elements for defining missions of systems?
  - Elements that characterize a mission
- ② What are the representations, implementations, languages and/or ontologies for missions of systems?
  - Mechanisms/models to represent and execute missions



# Systematic mapping: Planning

## Search strategy

### Search string

(mission OR missions) AND (system OR systems) AND  
(representation OR language OR ontology)

## Electronic databases



# Systematic mapping: Planning

## Inclusion criteria (IC)

Inclusion of studies that

- 1 define a set of elements or an ontology for representing missions of systems
- 2 present a tool or a mechanism for defining missions
- 3 present a language for representing missions of systems
- 4 define strategies for dealing with and/or implementing missions of systems

# Systematic mapping: Planning

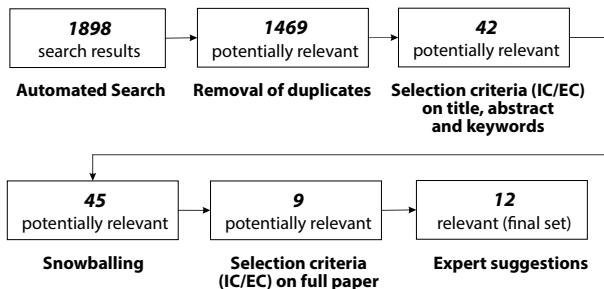
## Exclusion criteria (EC)

Exclusion of studies that

- 1 are not publicly available in its complete form
- 2 make use of missions, but out of the systems context
- 3 are previous versions of more complete papers about the same research
- 4 are not written in English

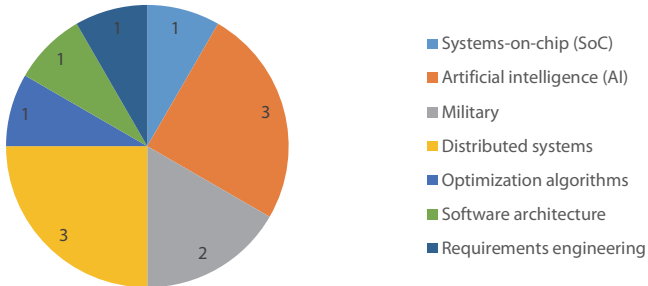
# Systematic mapping: Conduction

- April-May 2014 (thus considering studies published so far)
- Two Software Engineering researchers



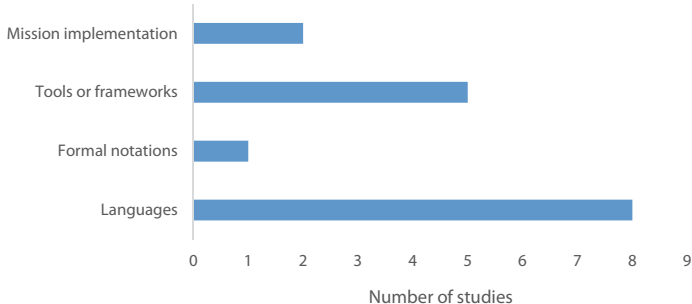
# Systematic mapping: Reporting

Application domains of the studies



# Systematic mapping: Reporting

## Approaches for addressing missions of systems



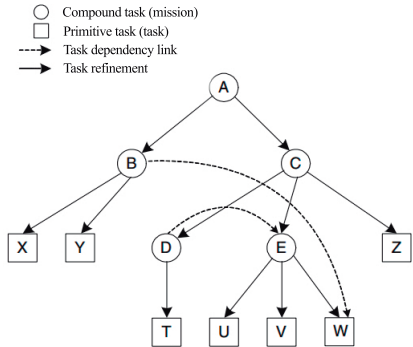
# Systematic mapping: Reporting

## Common elements of missions

- ① **Task:** Atomic operation to be executed by the system
- ② **Trigger (precondition):** Conditions that must hold to enable the system execute
- ③ **Executor:** Part of the system that executes a task
- ④ **Priority:** Commitment degree of the system to the mission
- ⑤ **Parameter:** Input and/or output of a mission
- ⑥ **Constraints:** Additional conditions to be verified
- ⑦ **Final condition:** Set of conditions for finishing the execution of the mission
- ⑧ **Relationships:** How missions interfere in each other

# Systematic mapping: Reporting

A mission can be decomposed into several sub-missions and tasks





# A conceptual model for missions of SoS

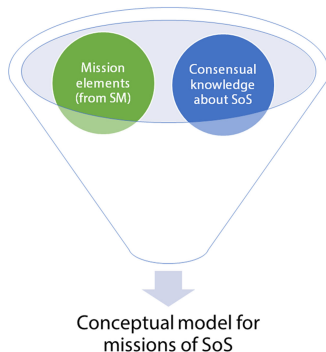
Dealing with missions in SoS is more complex when compared to their counterparts in monolithic systems

- Existence of different mission levels – constituent systems and the SoS itself
- Interference of a mission of a given constituent system in the mission of another
- Higher priority to the individual missions of constituent systems
- Lack of detailed information regarding the constituent systems (executors)

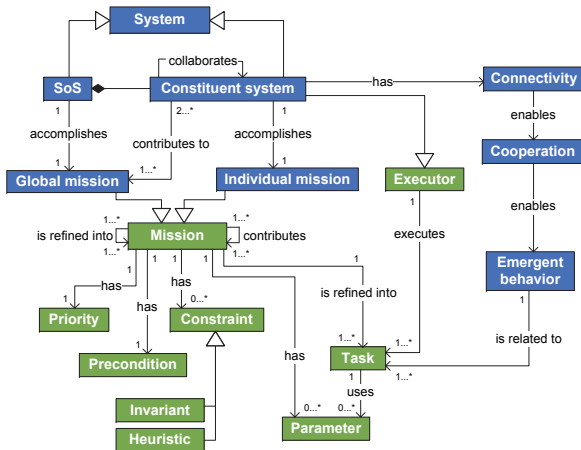
# A conceptual model for missions of SoS

## Proposal of a preliminary conceptual model for missions of SoS

- Knowledge of the mission elements identified in the systematic mapping
- Alignment with the consensual knowledge available at the literature about SoS



# A conceptual model for missions of SoS



## Legend:

- Consensual concepts in the SoS literature
- Elements identified through the systematic mapping

# Final remarks

- Lack of studies focusing on missions for SoS
- An special attention to this topic is needed as missions pervade the life cycle of a SoS
- Concepts identified in a broader context and in several domains can be brought to SoS
  - of course considering the specificities of this scenario
- A preliminary conceptual model proposed to organize the knowledge about missions of SoS
  - further detailing in future works
  - proposal of a notation for specifying missions of SoS

# Questions



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