

# Systems Engineering Course Research Methods; Framework

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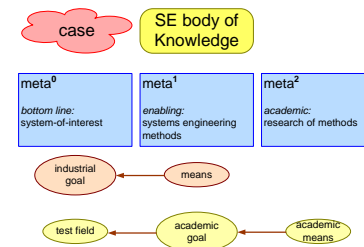
## Abstract

This module shows a framework for shaping and executing applied research, and offers guidelines for the various steps.

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# Colophon

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This course is a joint development of

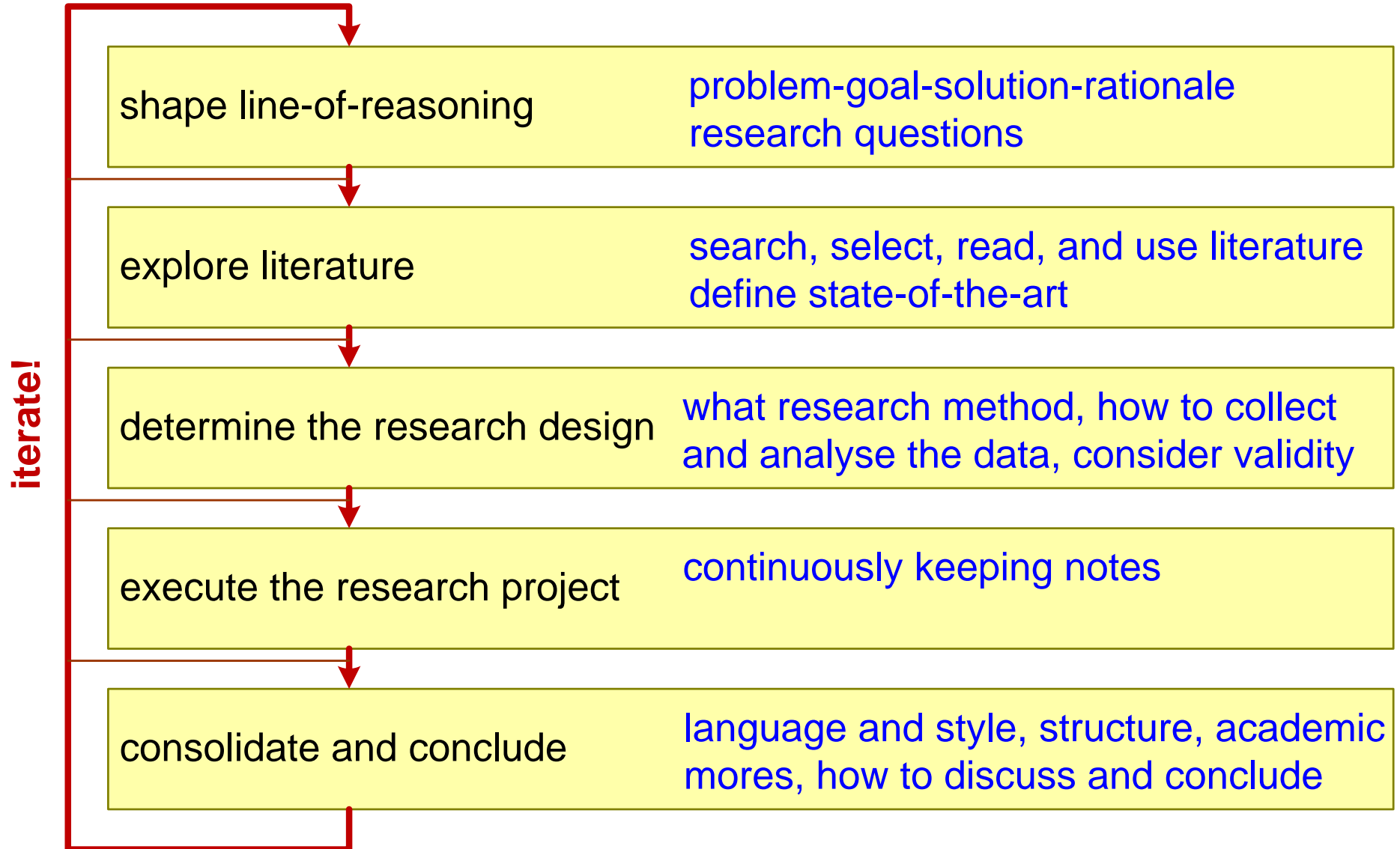
Kristin Falk

Satya Kokkula

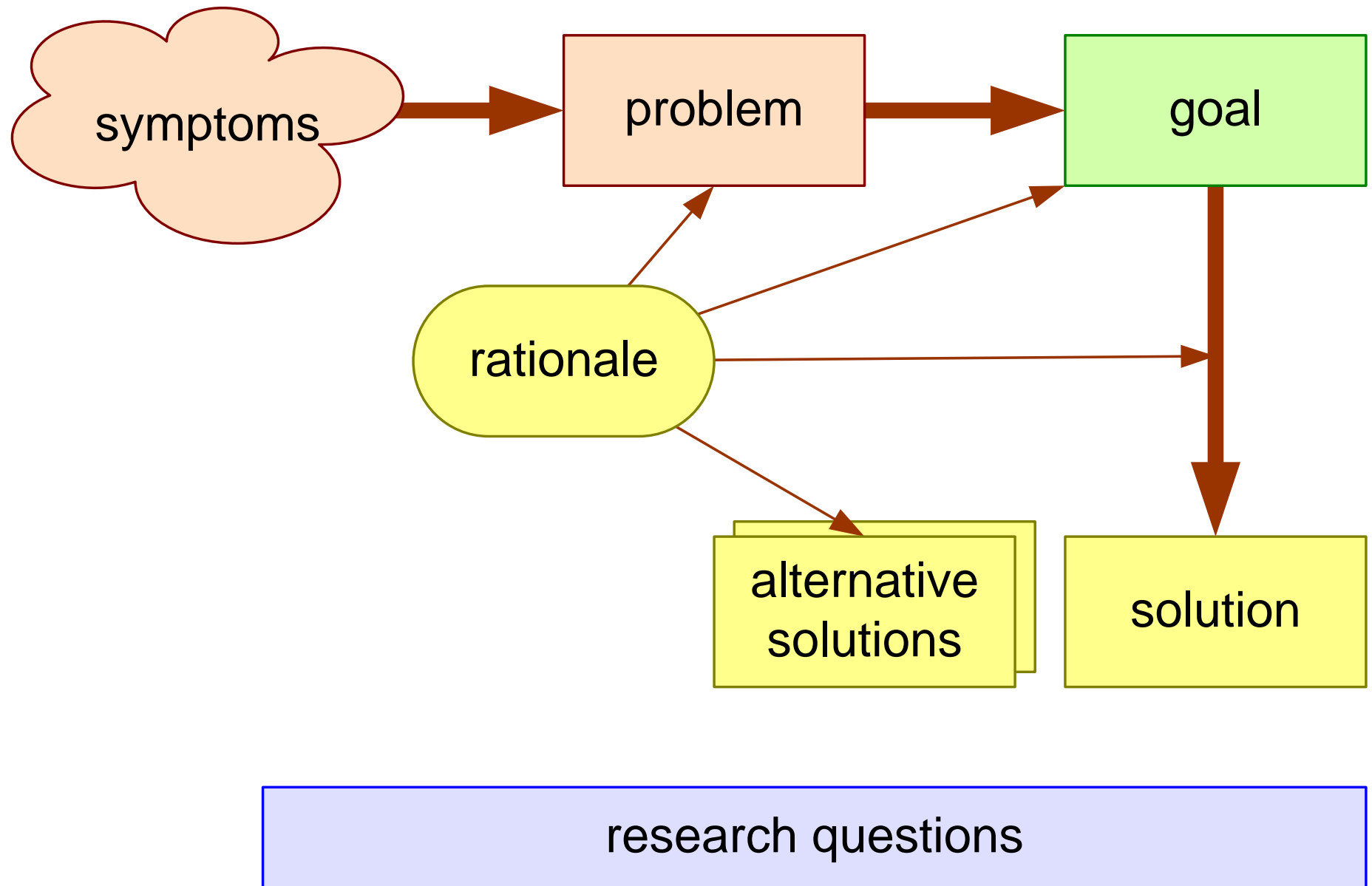
Elisabet Syverud

and Gerrit Muller

# Applied Research Framework



# Line of Reasoning



# Multiple Levels of Academic Abstraction

case

SE body of Knowledge

meta<sup>0</sup>

*bottom line:*  
system-of-interest

work over system  
missile  
production line  
turbine package  
control system  
tie-in system

meta<sup>1</sup>

*enabling:*  
systems engineering  
methods

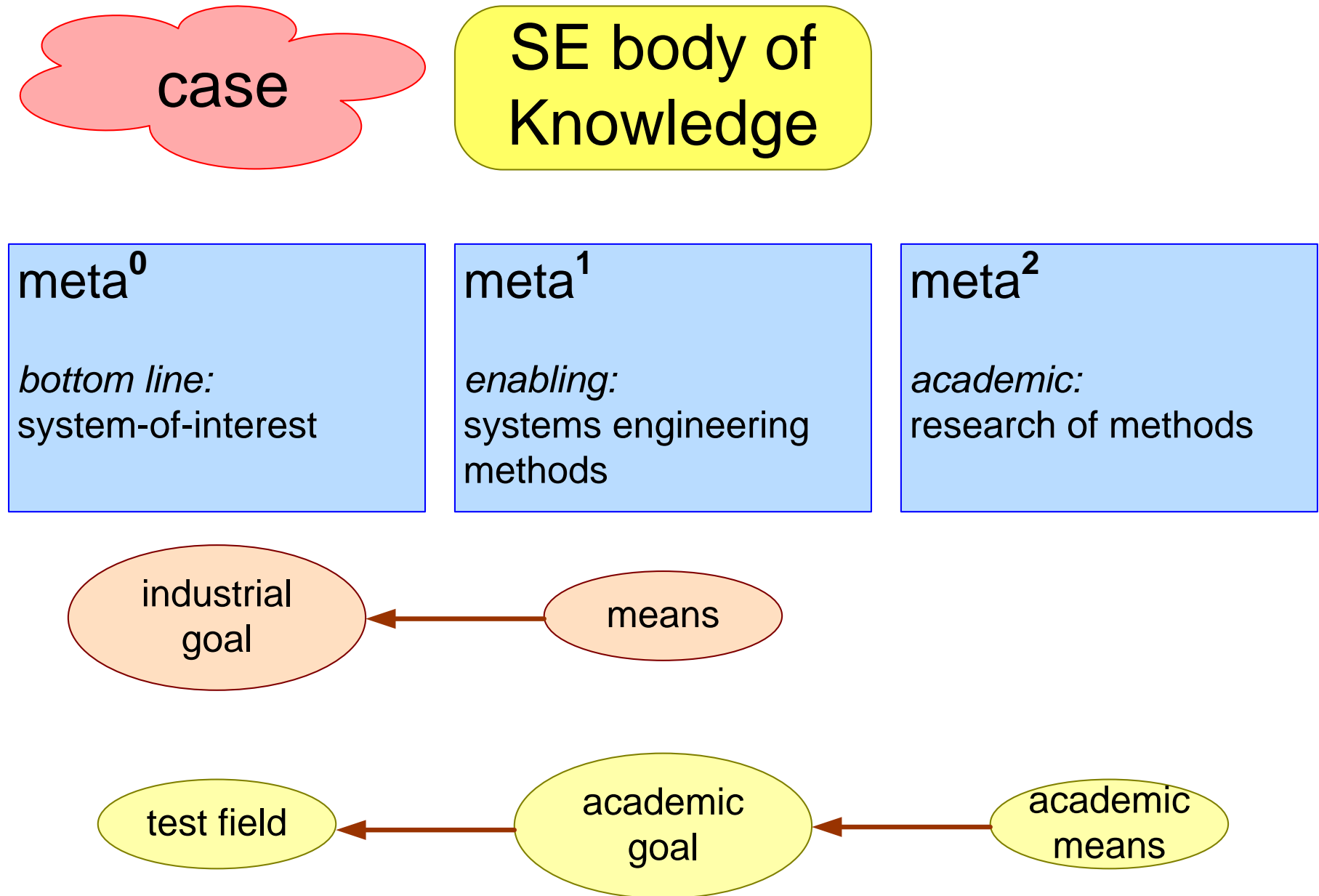
stakeholders and concerns  
ConOps  
operational needs  
need statement  
needs into requirements  
SMART requirements  
concept selection  
partitioning and interfaces  
documenting the architecture  
knowledge management  
conceptual modeling  
budget based design  
integration and verification plan  
design of qualification program

meta<sup>2</sup>

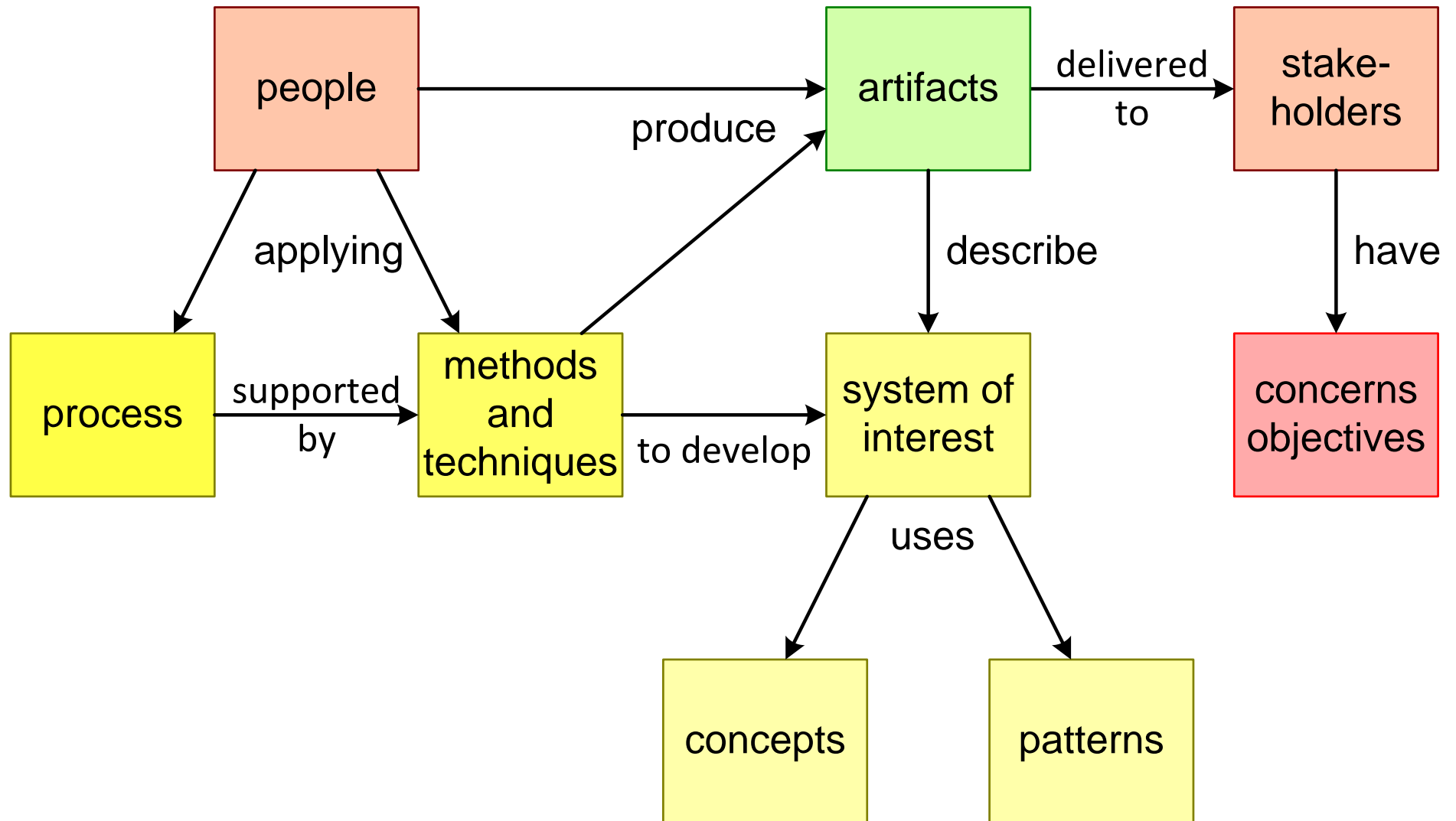
*academic:*  
research of methods

measuring  
experimenting  
modeling  
surveys  
interviews  
referring to literature  
argumenting

# Industrial versus Academic Perspective



# Research Context



# Some Terminology

**Formalisms** languages/syntax: for example, differential equations, timed or hybrid automata, finite state machines, et cetera

**Models** instantations of formalisms to understand, explore, optimize or verify specification or design

**Techniques** to get the required information from models: e.g. performance

**Methods** to provide guidelines how to use formalisms, create models, use techniques and apply tools

**Tools** to support efficient application of formalisms, techniques and methods