

A Multi-Disciplinary Research Approach, Illustrated by the Boderc Project

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Abstract

Research of Multi-Disciplinary subjects is complicated by its nature. Systems Engineering is the application area of the research results. Systems Engineering is applied in industrial or commercial domains. The drivers and culture in these domains differ quite a lot from the drivers of the (academic) research community. We will discuss and illustrate a research approach called *Industry-as-laboratory*. We will discuss how to get from industrial problem to a research hypothesis, and how to validate the hypothesis.

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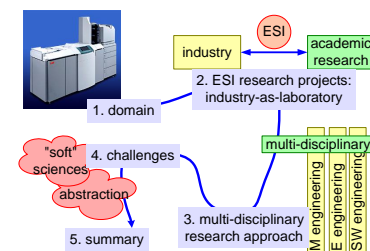
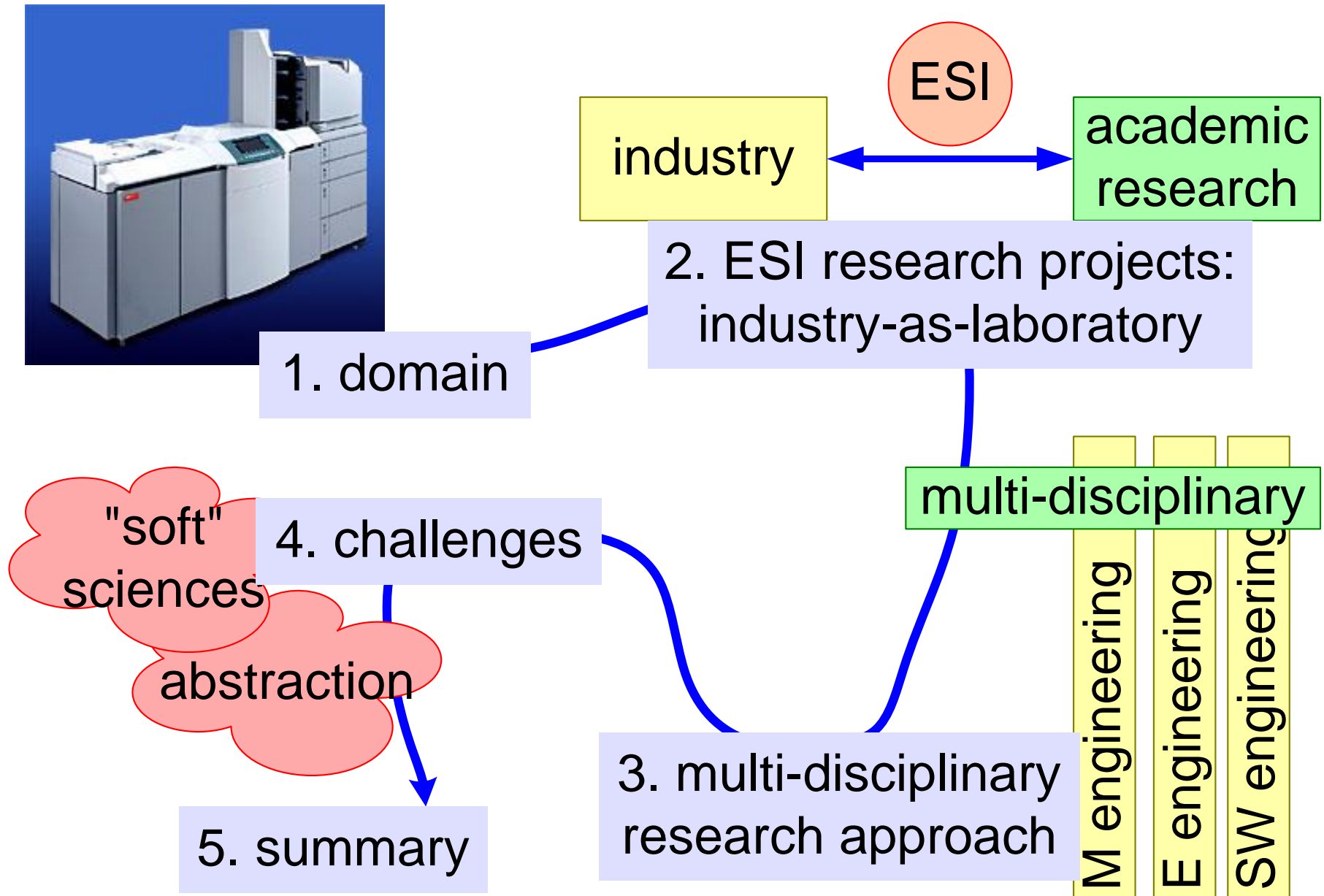


Figure Of Contents™



The Domain: Printers and Copiers by Océ



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2050



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Typical Industrial Problem in Mechatronic Systems

Many multi-disciplinary problems in product development

Mechanical engineering precedes
Electronics engineering precedes
Software engineering

Most of the problems show up late in engineering and in the integration phase

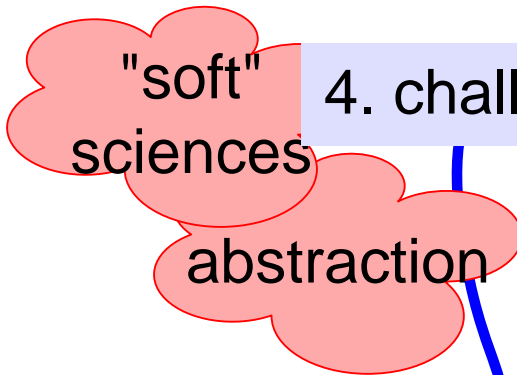
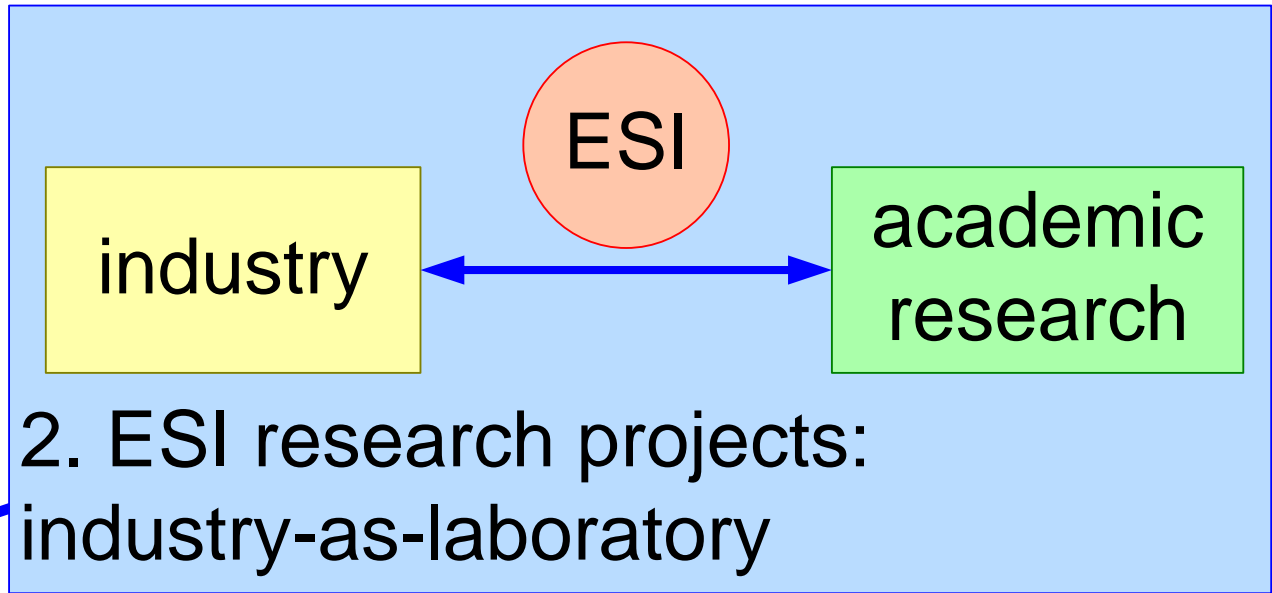
For instance mechatronics assumes 1 ms response
Software promises 10 ms response

Lack of systematic approaches to detect / solve these problems in early phases

Lots of tuning, trial and error
Unpredictable project timing and costs



1. domain



4. challenges

5. summary

3. multi-disciplinary research approach

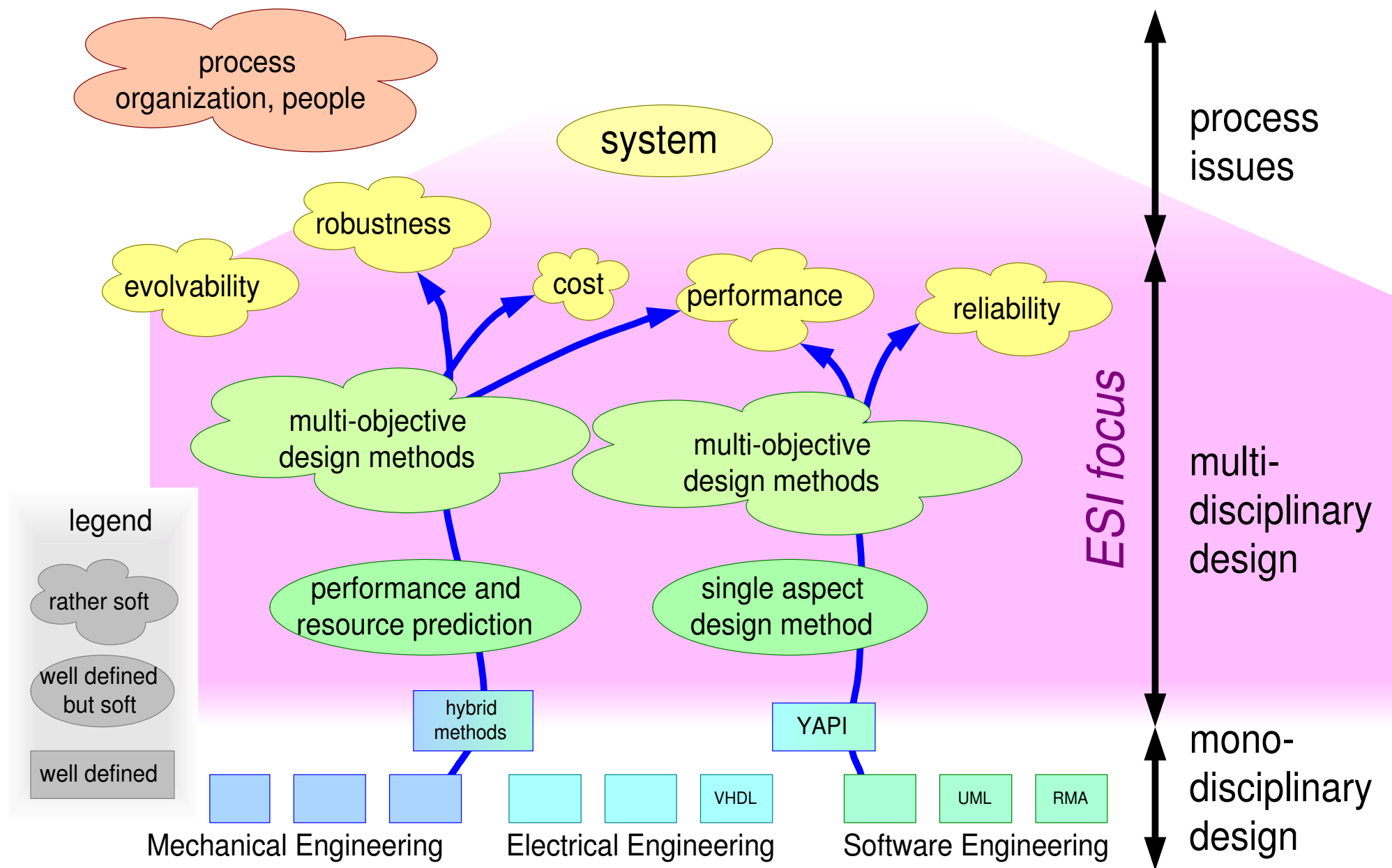
multi-disciplinary

M engineering

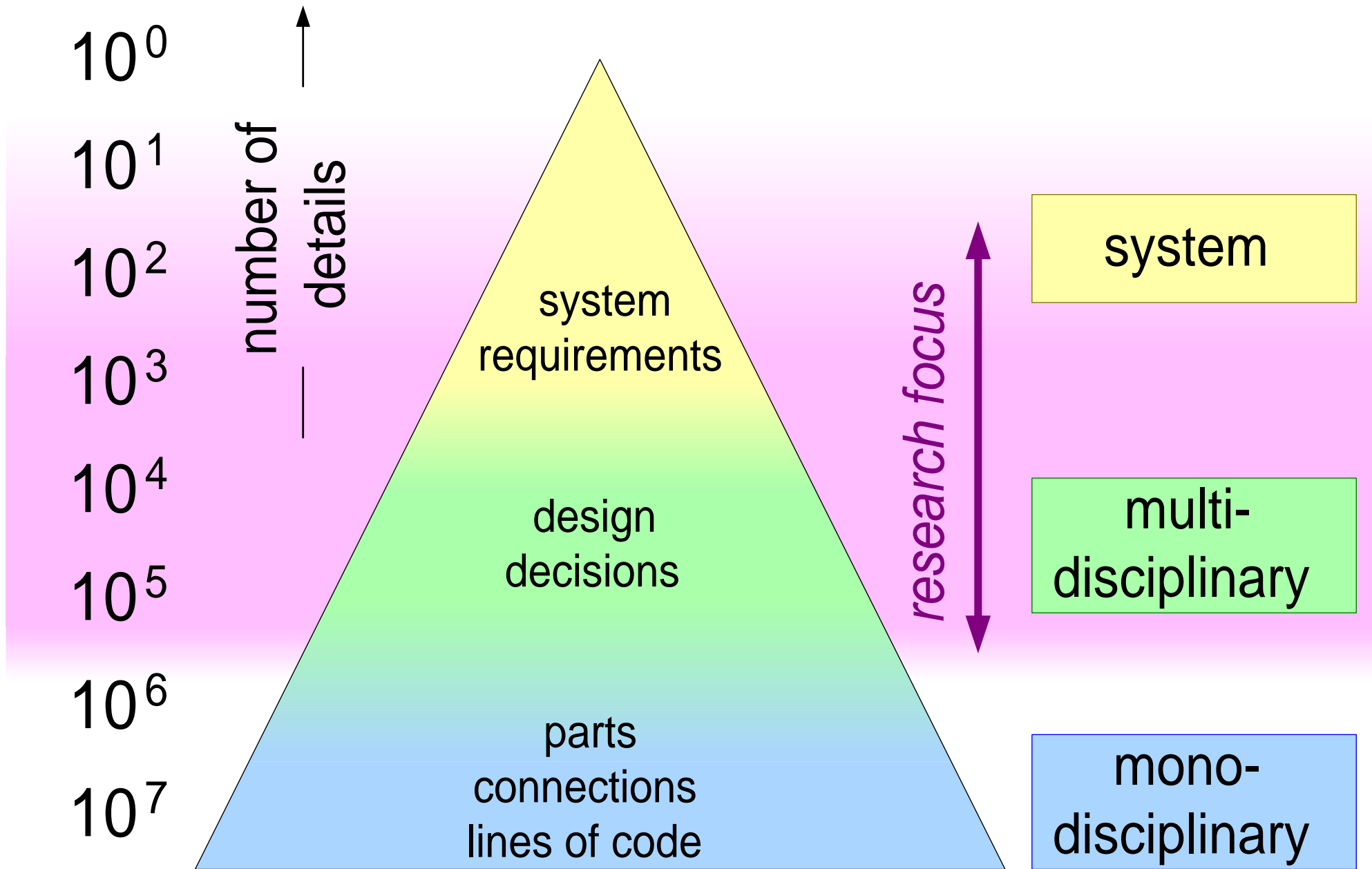
E engineering

SW engineering

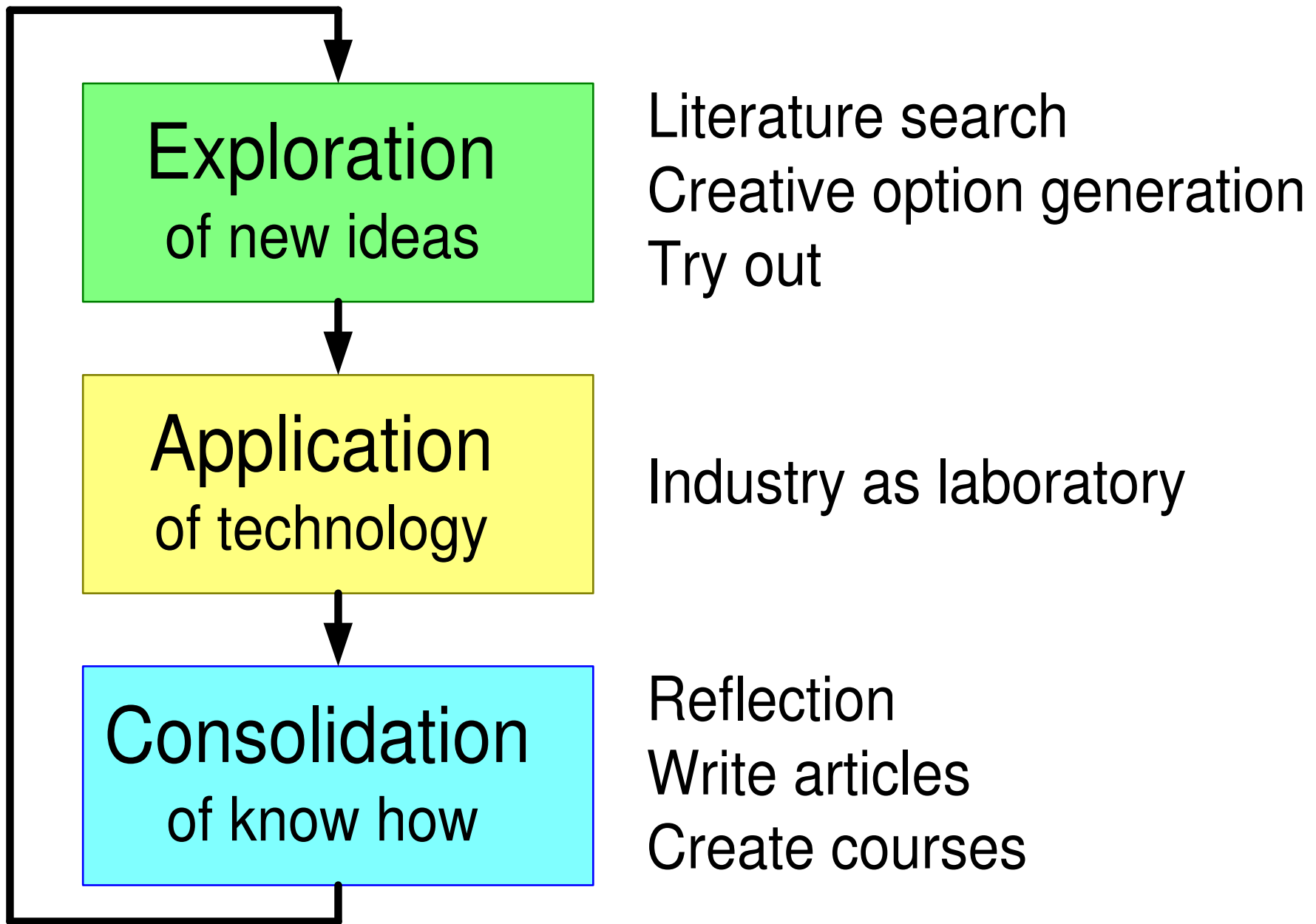
From Mono-Disciplinary to System



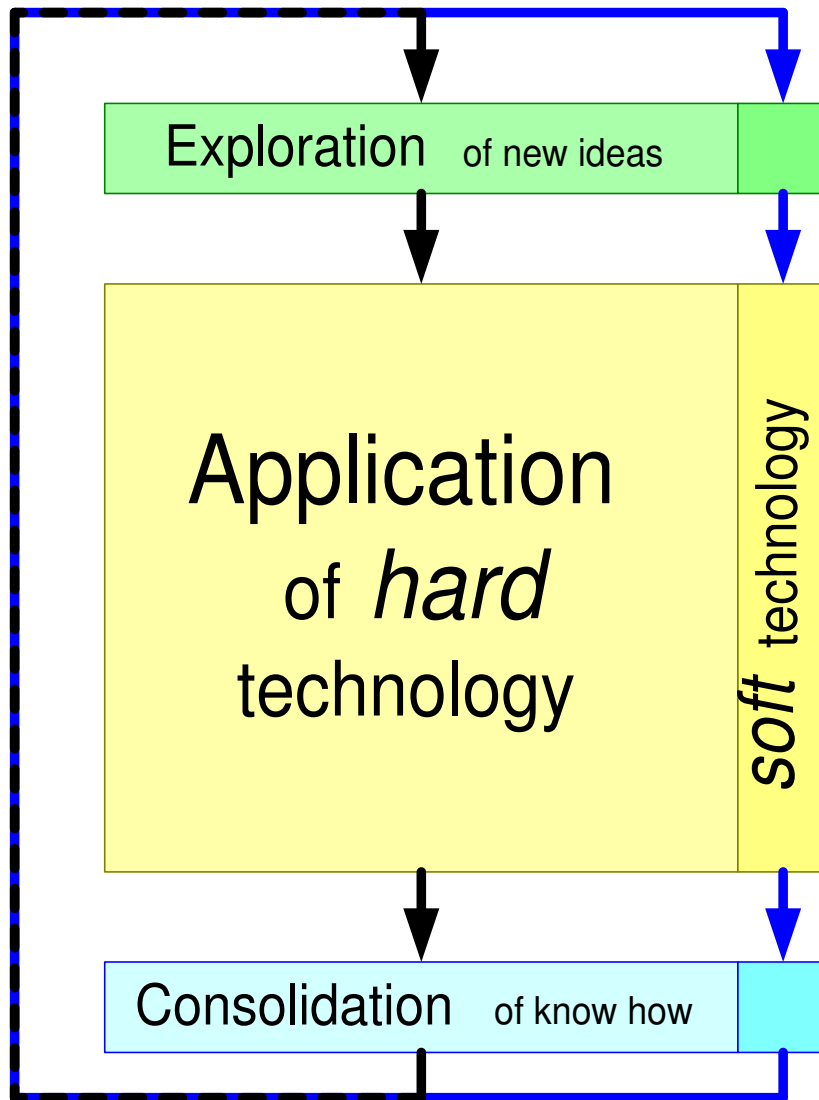
Exponential Pyramid, from requirement to bolts and nuts



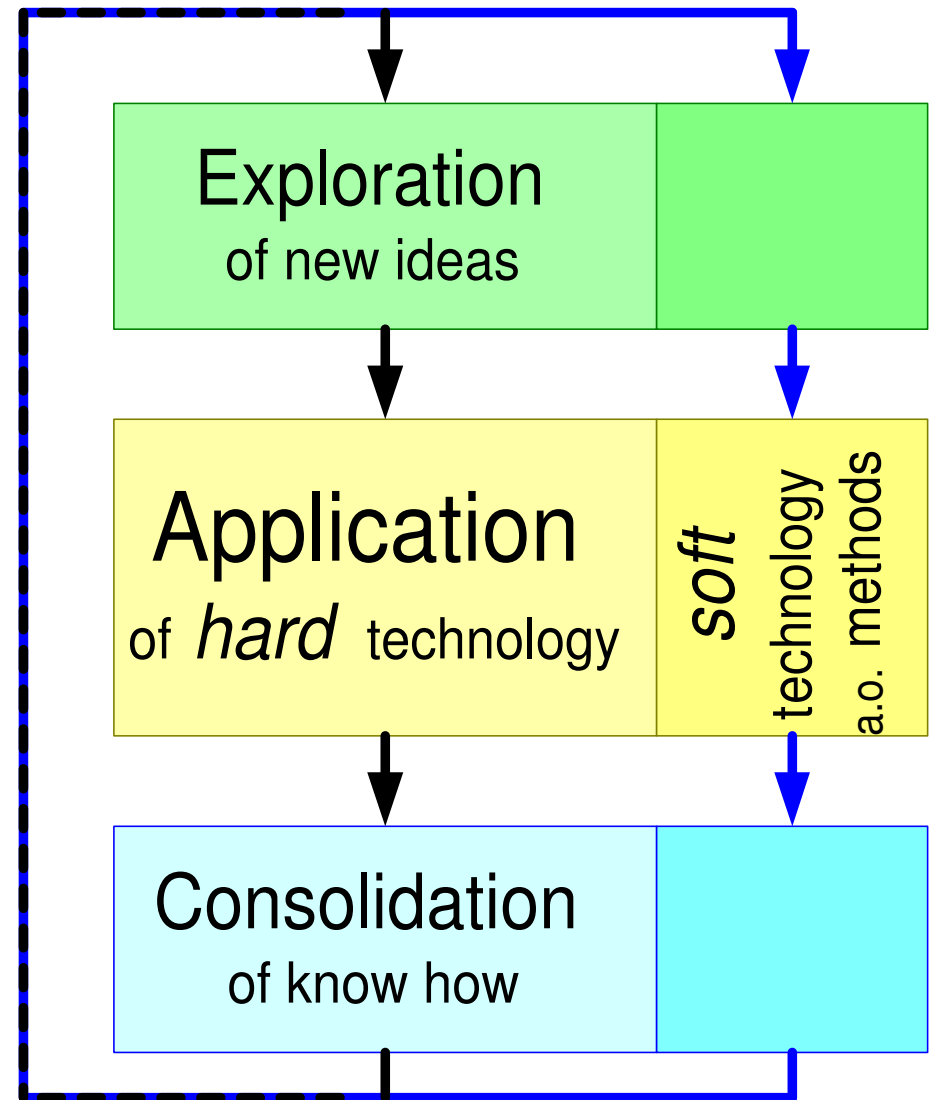
Technology Management Cycle



Method research requires application of methods

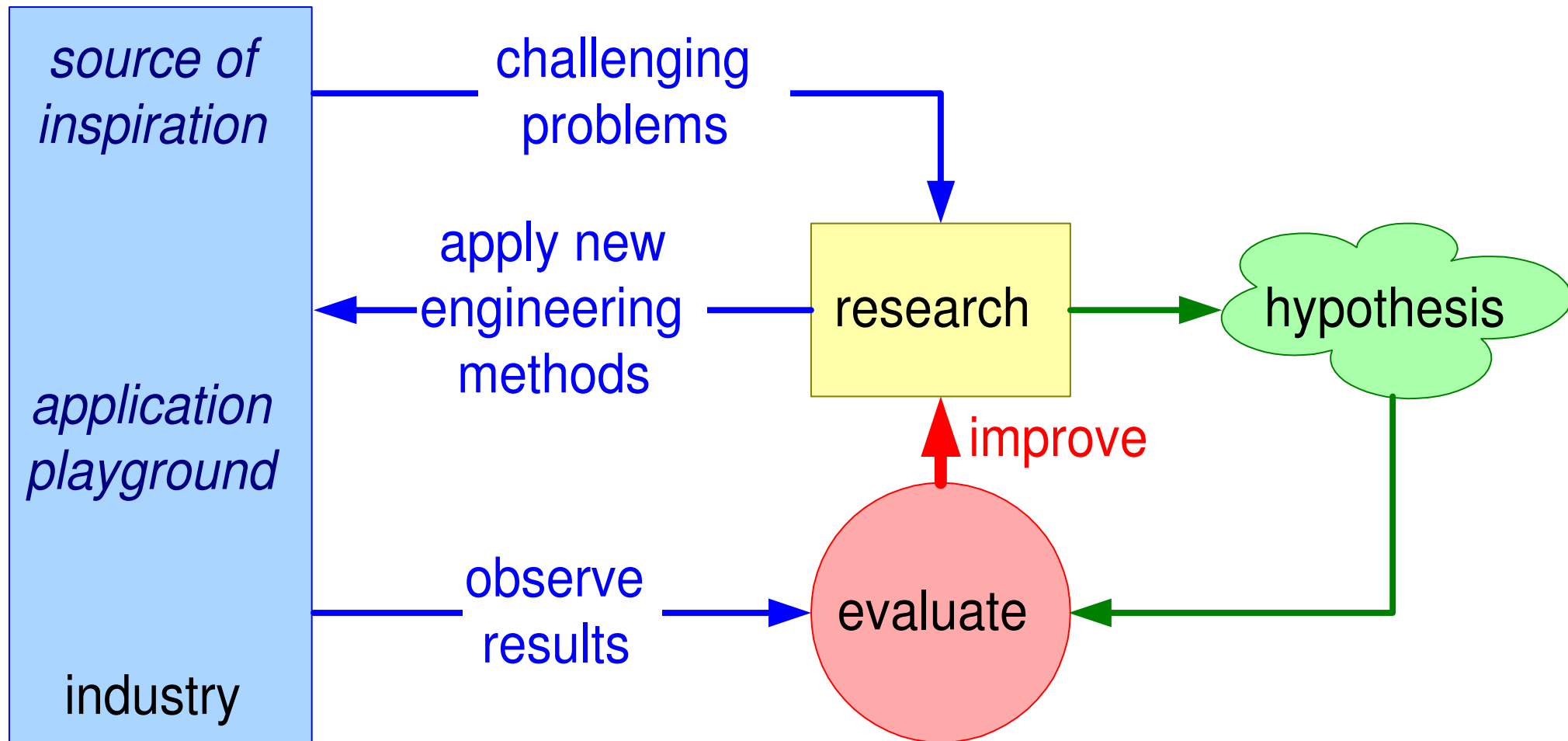


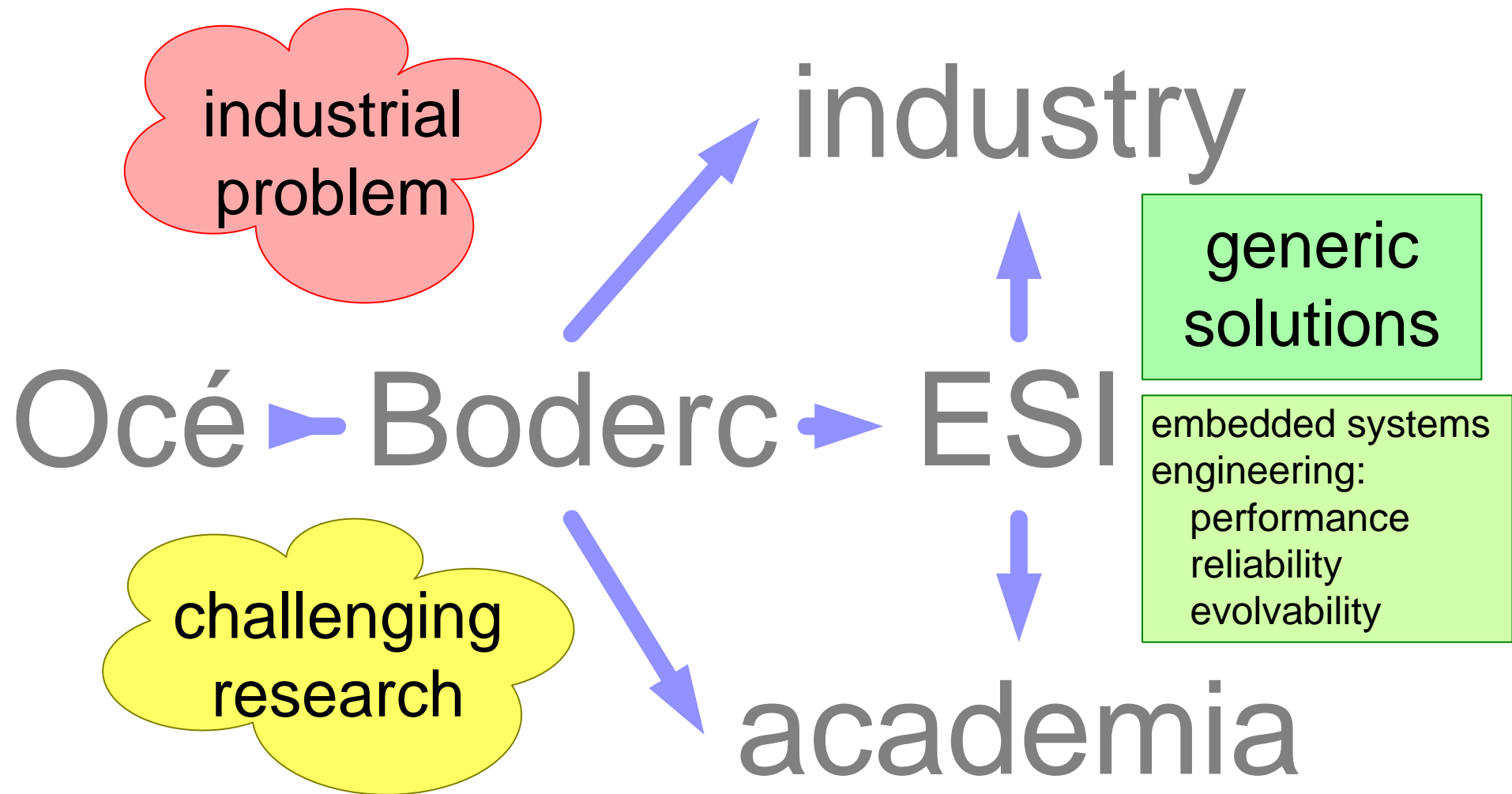
Product Development



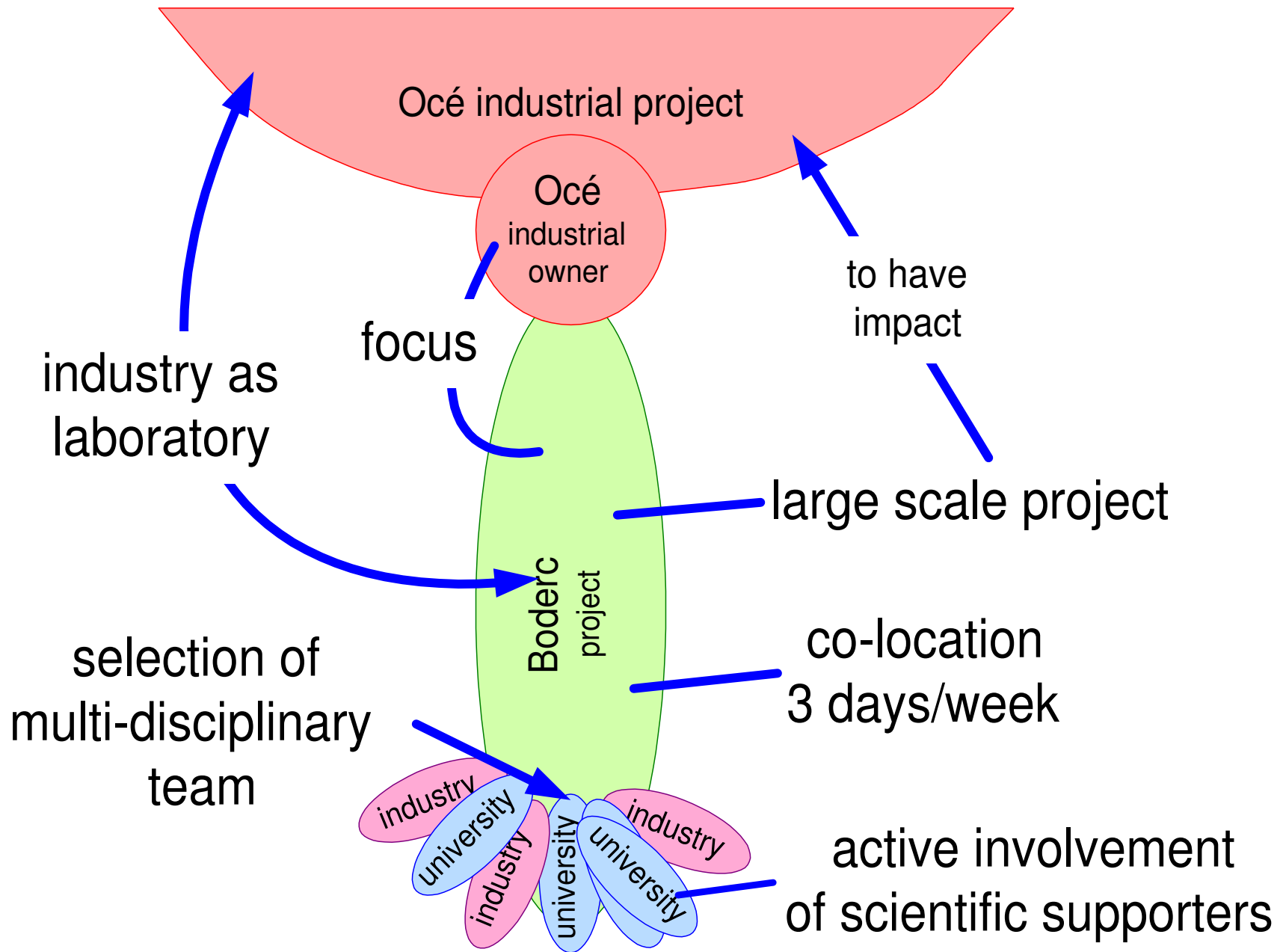
Research

Industry as Laboratory

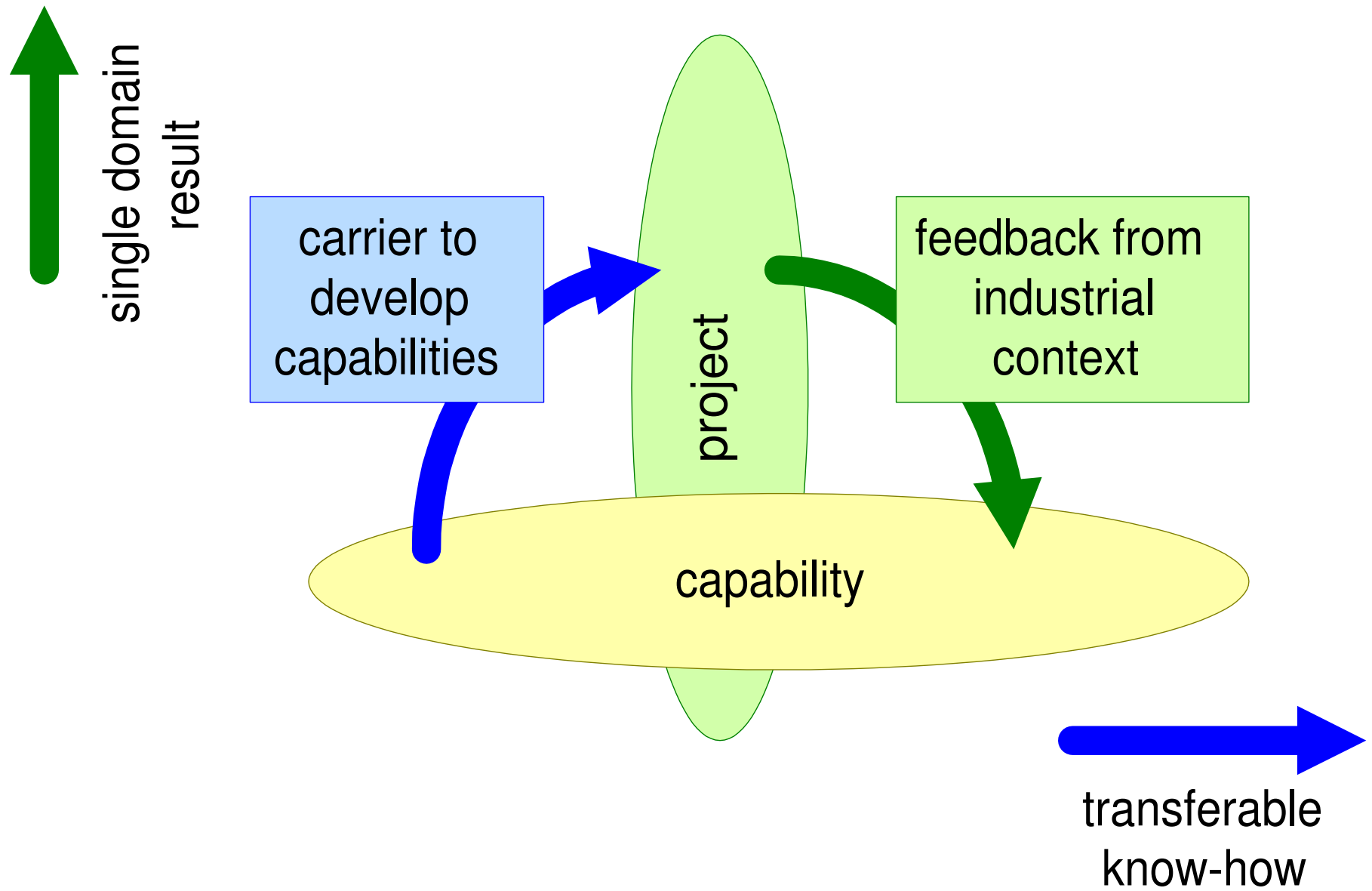




Critical Success Factors for projects



Project as Carrier for Capability Development





1. domain

industry

ESI

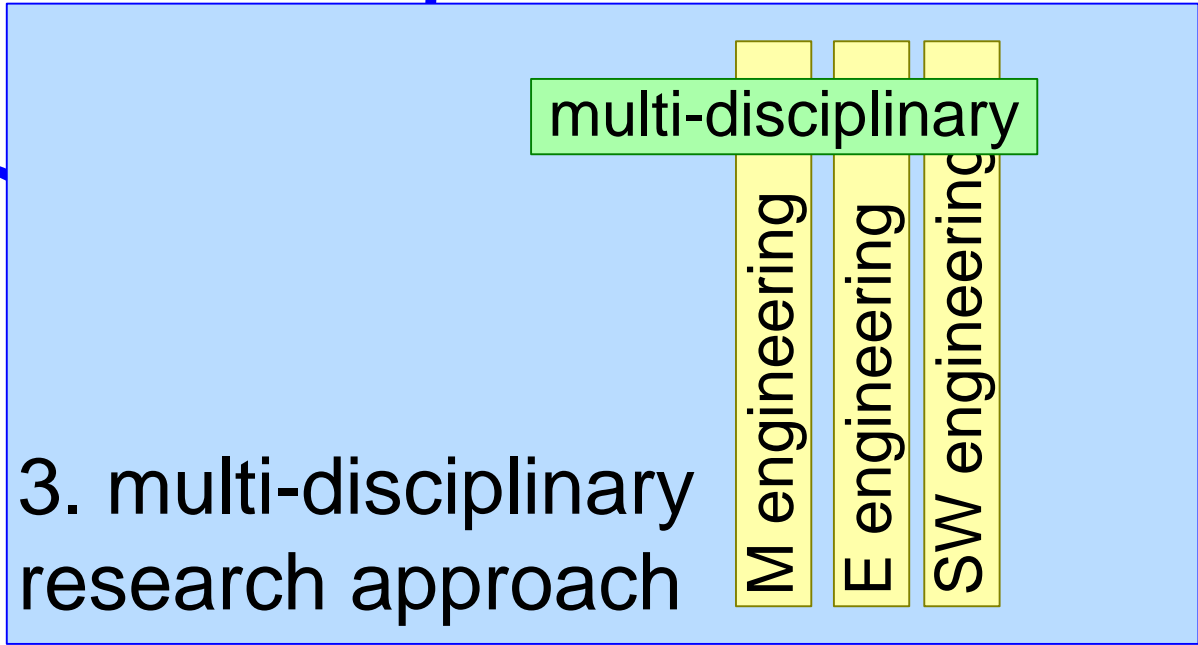
academic research

2. ESI research projects:
industry-as-laboratory

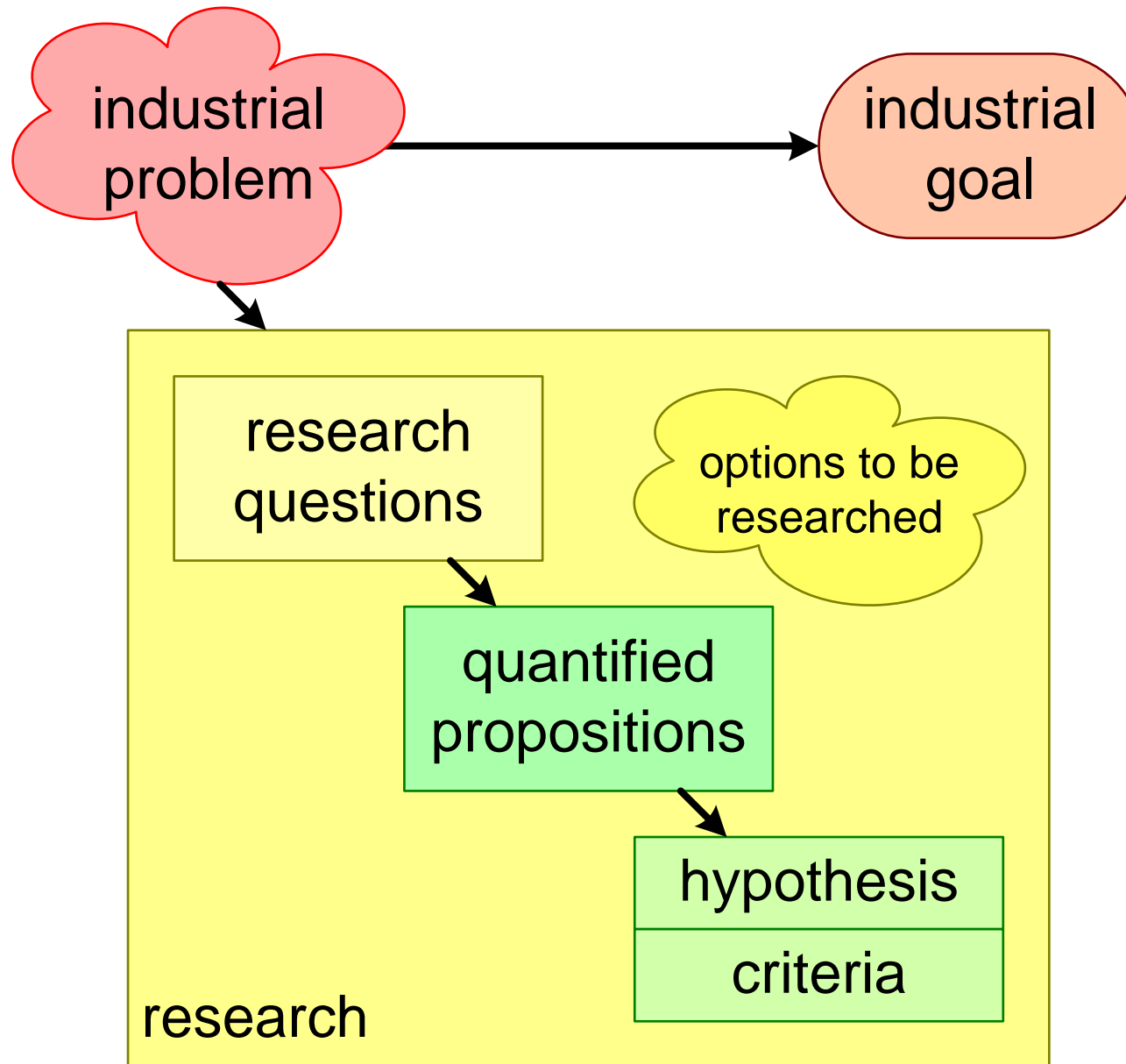
"soft" sciences
abstraction

4. challenges

5. summary



From Industrial Problem to Validated Research



Boderc Research Project Goal

Boderc goal =

A specific methodology

to predict

system performance

within industrial constraints and restricted design space

based on modeling

and analyze, discuss, document, and communicate

multi-disciplinary

throughput, quality

people, process, project duration, and cost

power computing response time

What Formalisms, Models, Techniques, Methods and Tools are needed?

What is an appropriate level of abstraction and effort to model?

What determines the useability of models?

Formalisms languages/syntax: 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

The product creation lead time
will be reduced significantly by
the use of multi-disciplinary models
during the early product development phases.



1. domain

industry

ESI

academic research

2. ESI research projects:
industry-as-laboratory

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"soft" sciences
abstraction

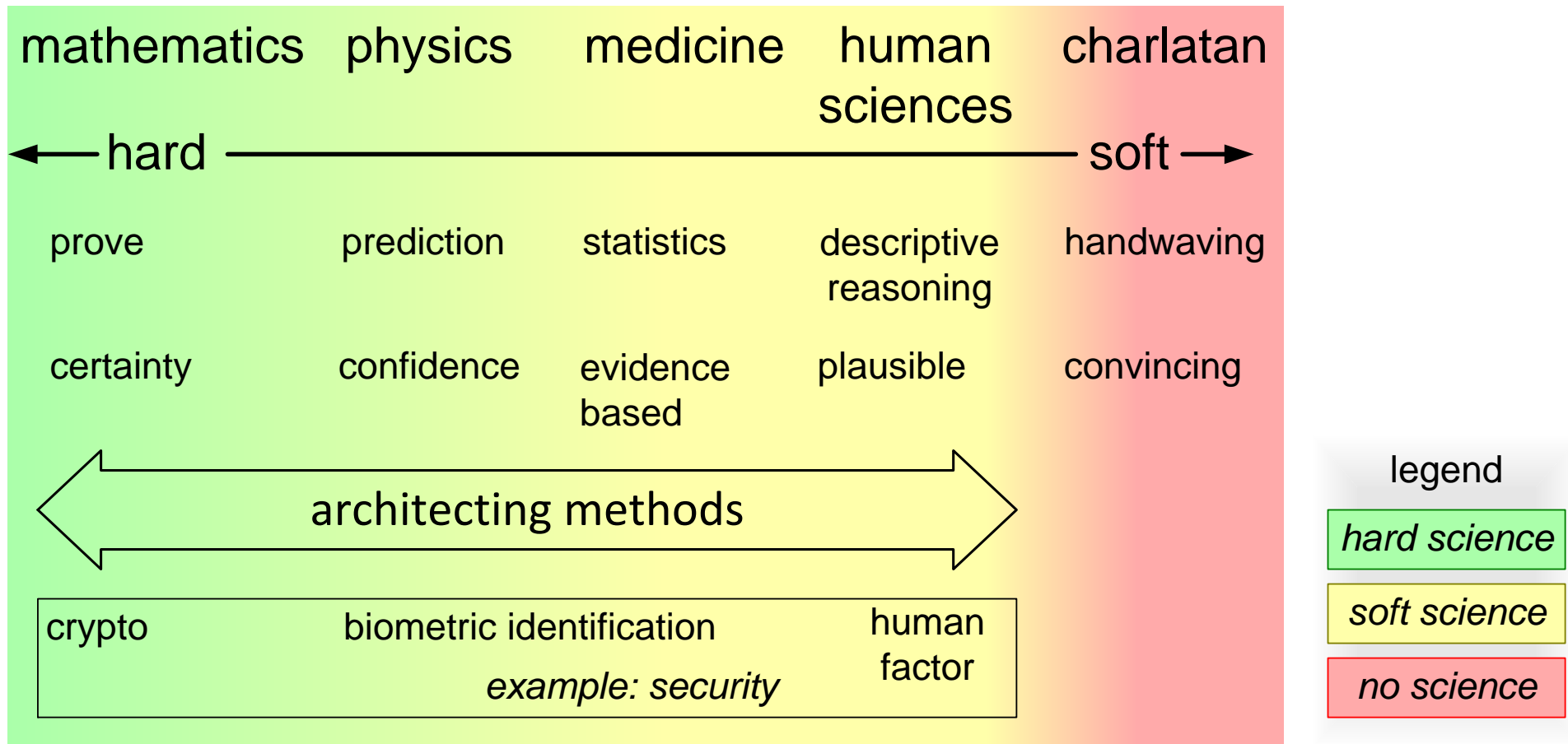
multi-disciplinary

3. multi-disciplinary
research approach

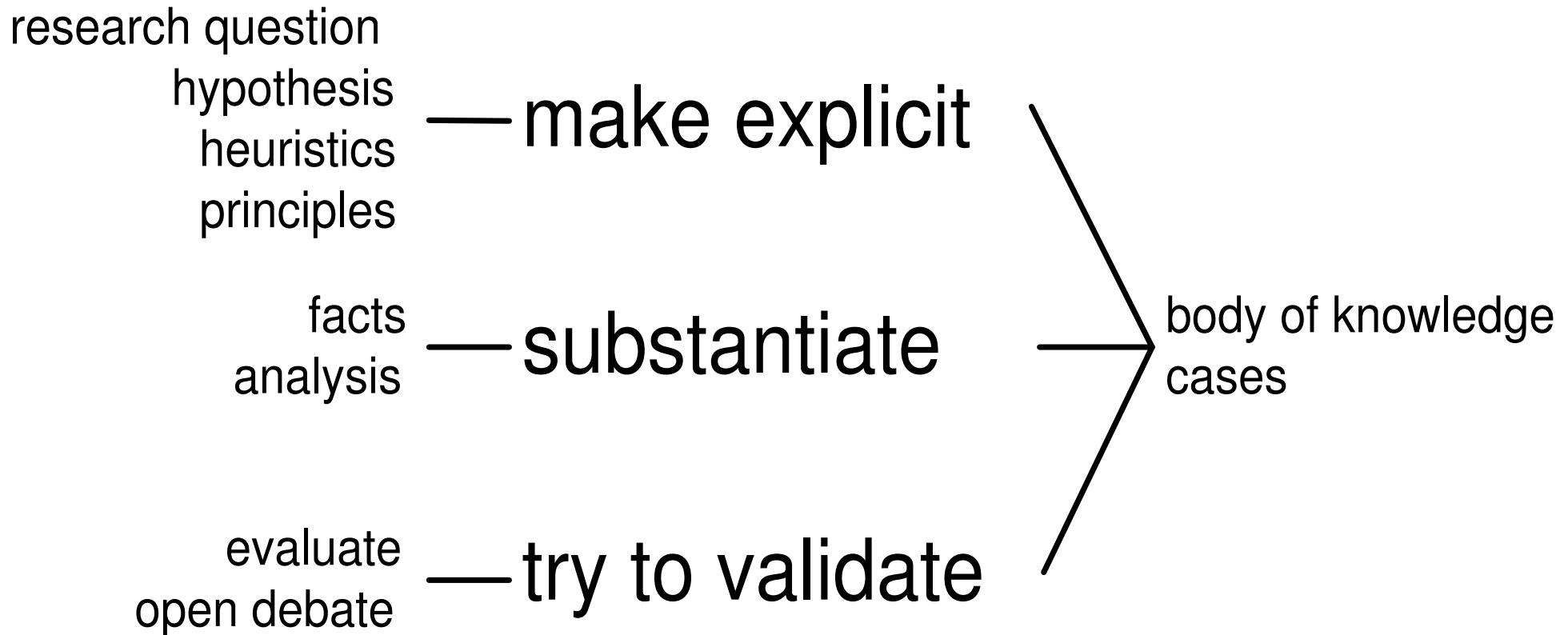
M engineering
E engineering
SW engineering

5. summary

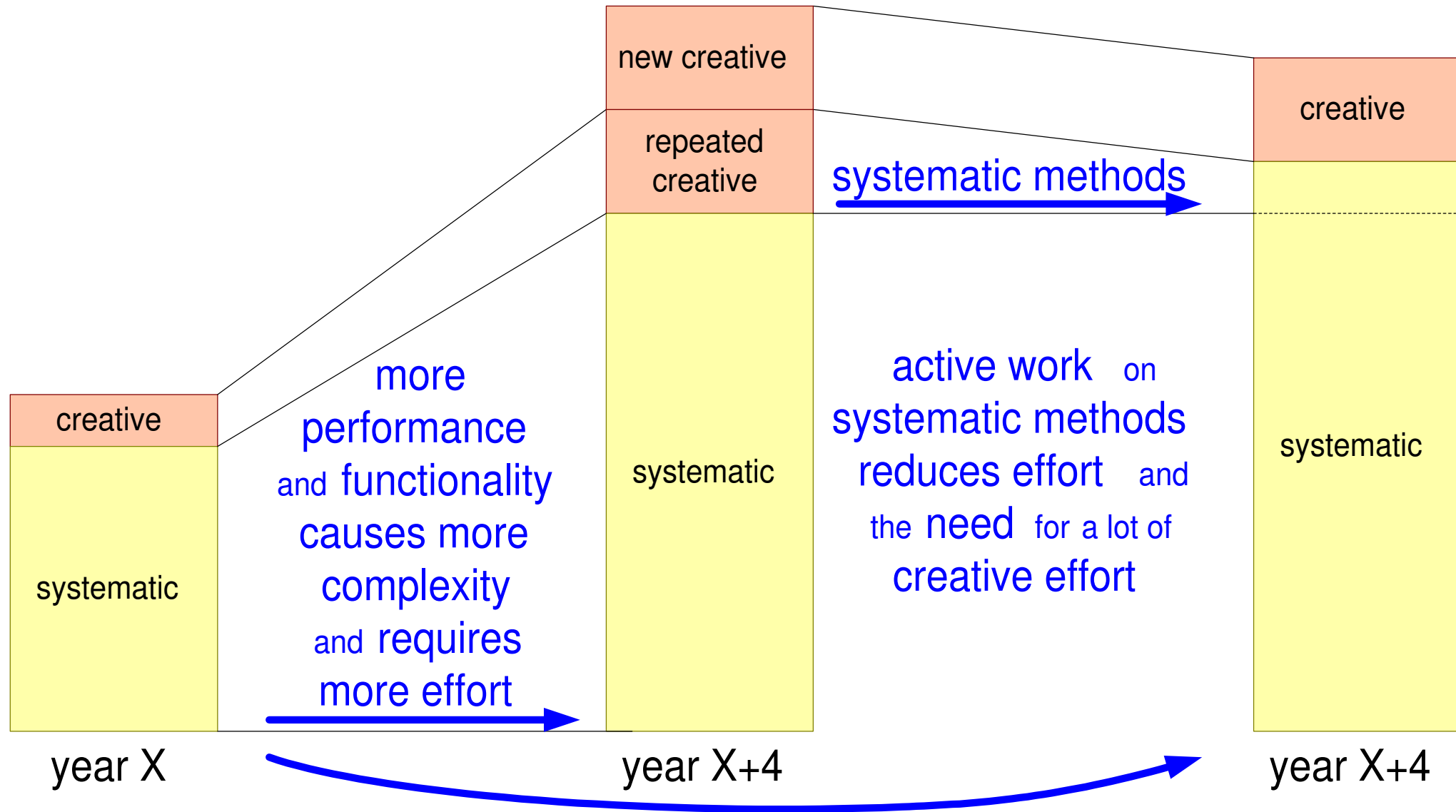
Spectrum of sciences



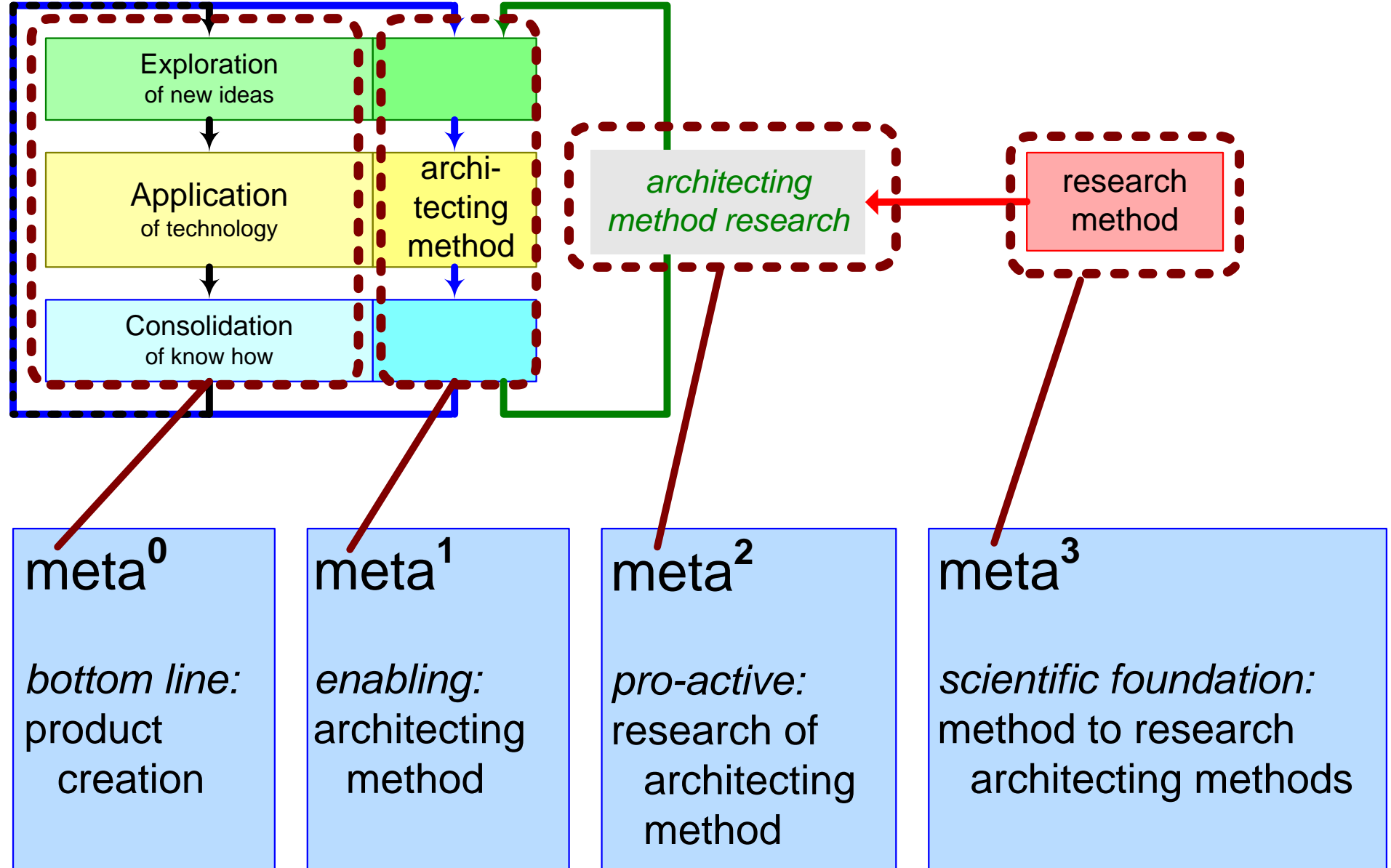
soft is not in conflict with scientific attitude

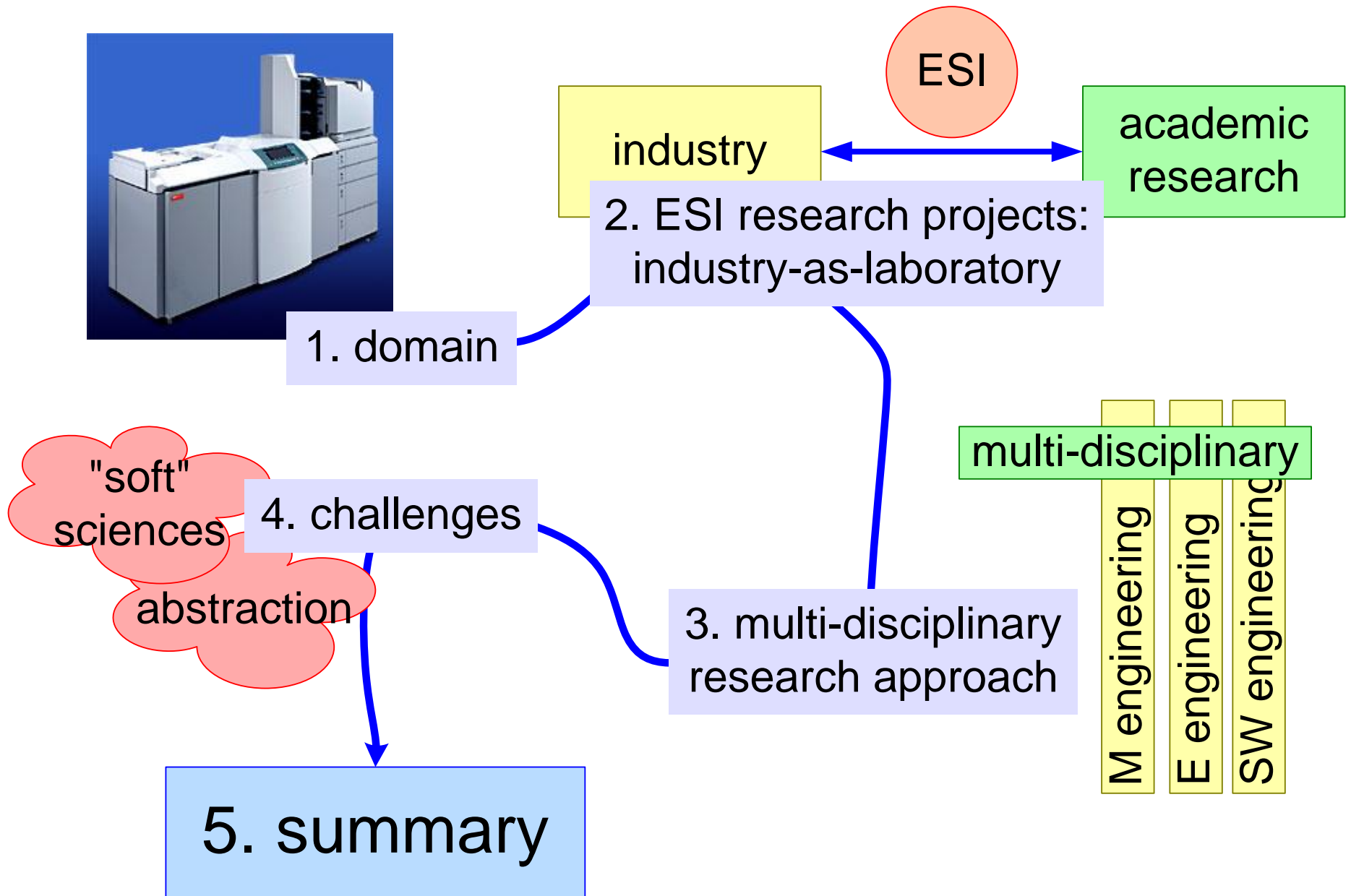


Systematic Know-how to cope with Growing Complexity



Moving in the *meta* direction





Summary

