Industry-as-Laboratory Applied in Practice: The Boderc Project

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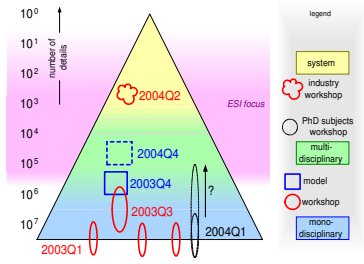
Abstract

Many academical methods never reach industrial application. Colin Potts has observed this for software engineering methods. He proposed a new research approach: Industry-as-Laboratory. New methods are applied and verified in an industrial context.
The Embedded Systems Institute (ESI) has adopted this approach to research embedded systems creation methods. The Boderc project, which started at the end of 2002, is the first ESI project to apply this method. In this article we discuss the Boderc project, the Industry-as-Laboratory approach, the experiences, and the lessons learned.



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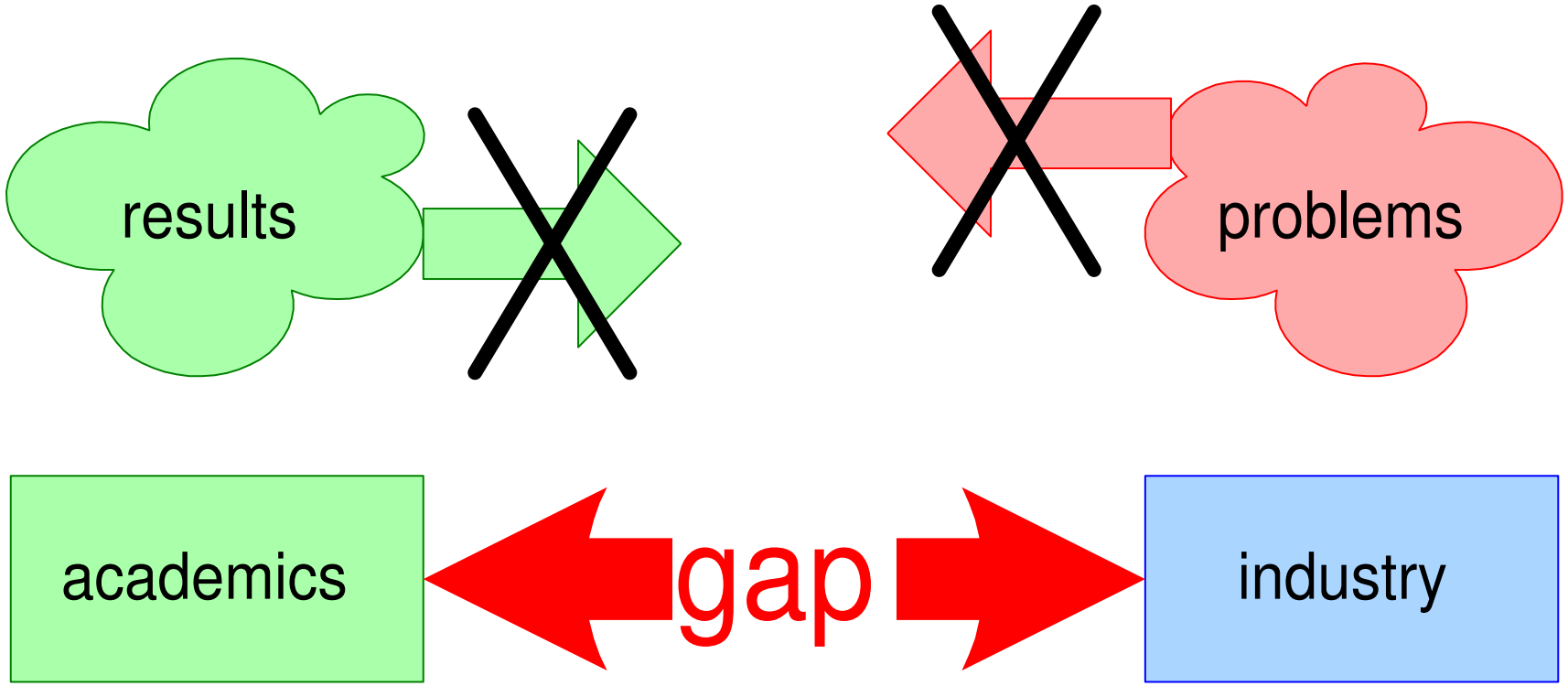
Problem: Gap between Academic and Industrial world



reflection

evidence

exposure

education

time pressure

pragmatics

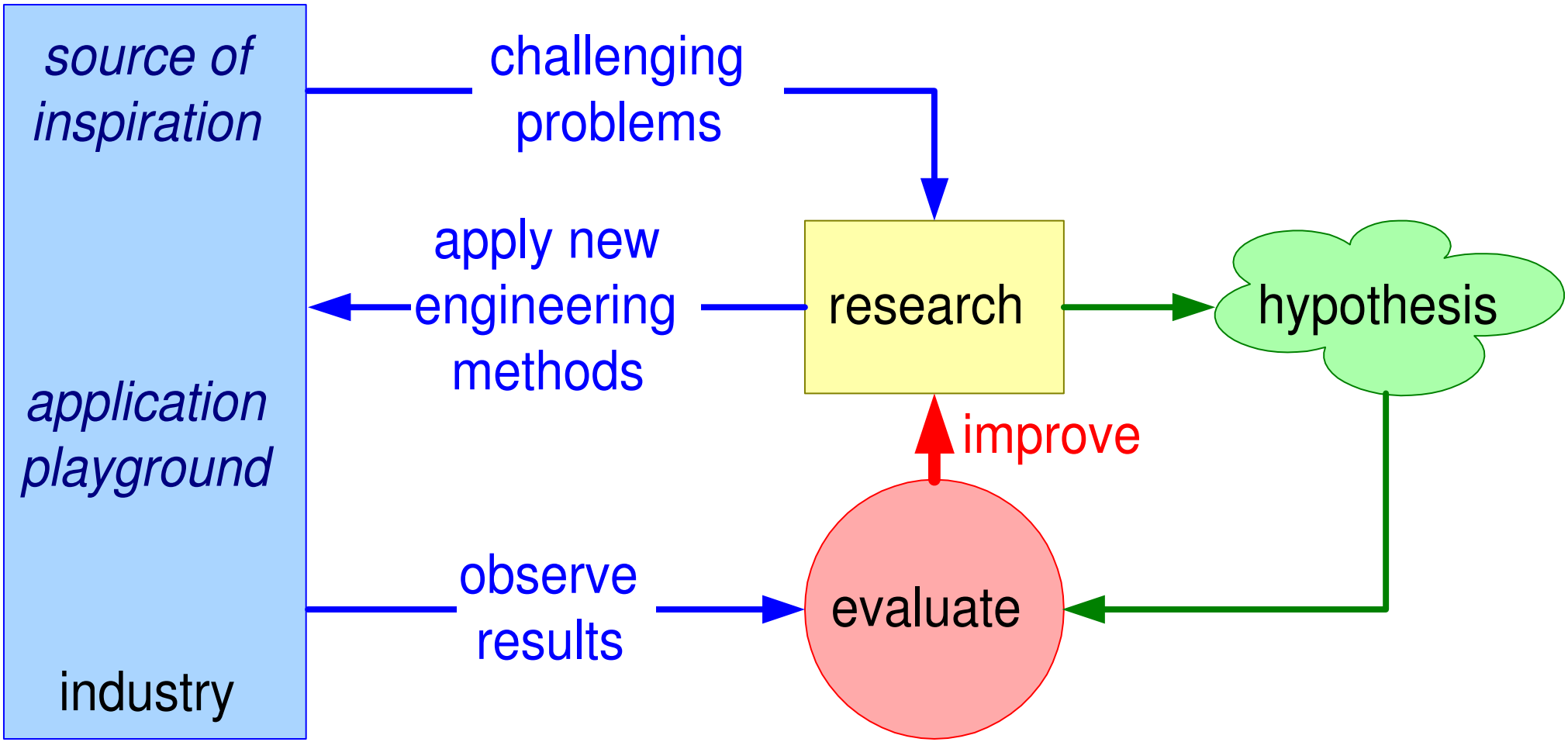
cost constraints

products

sales

lots of people

Industry as Laboratory



Typical Industrial Problem in Mechatronic Systems

Many multi-disciplinary problems in product development

Mechanical engineering precedes
Electronics engineering precedes
Software engineering

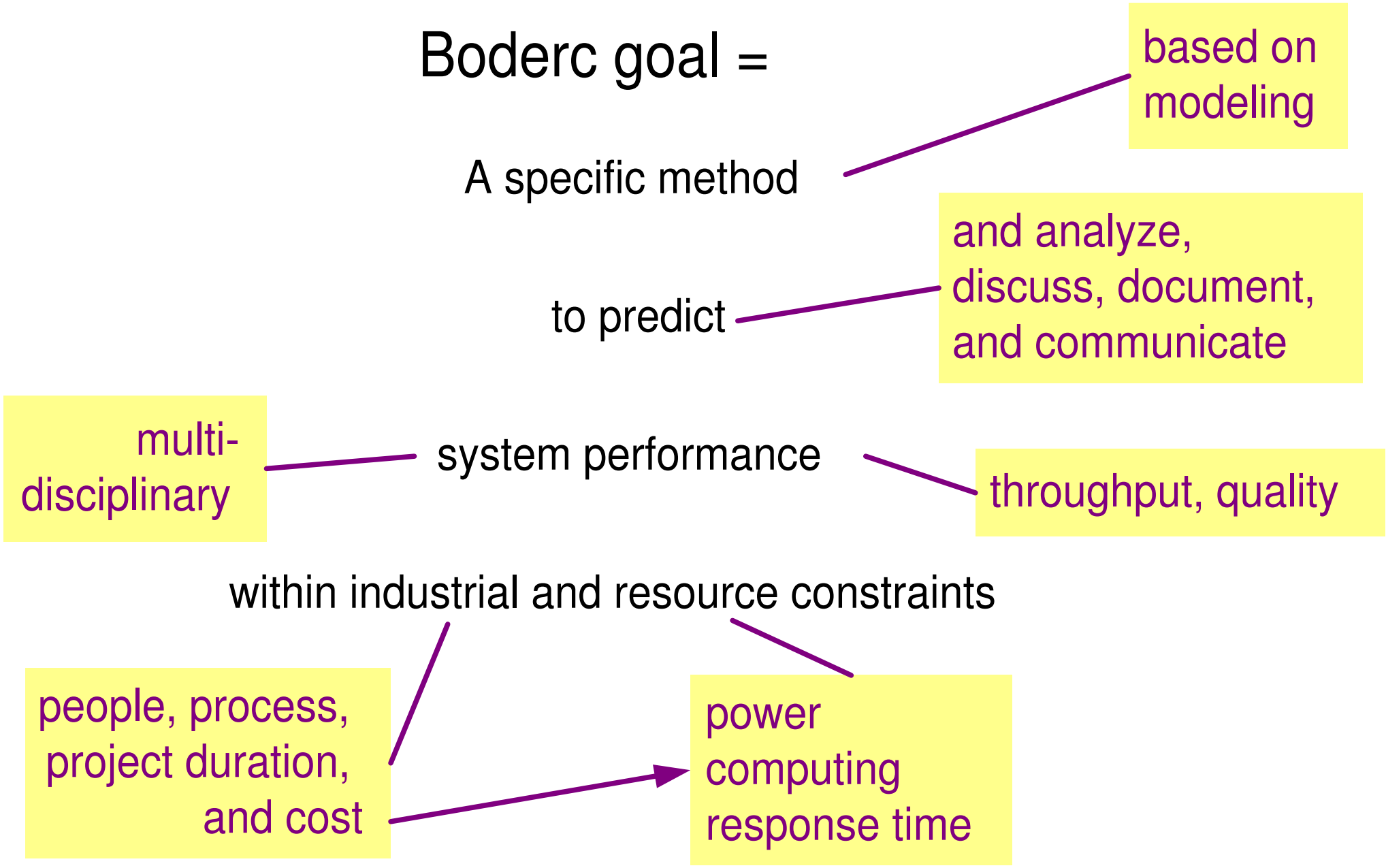
Most of the problems show up late in engineering and in the integration phase

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

Boderc Research Project Goal



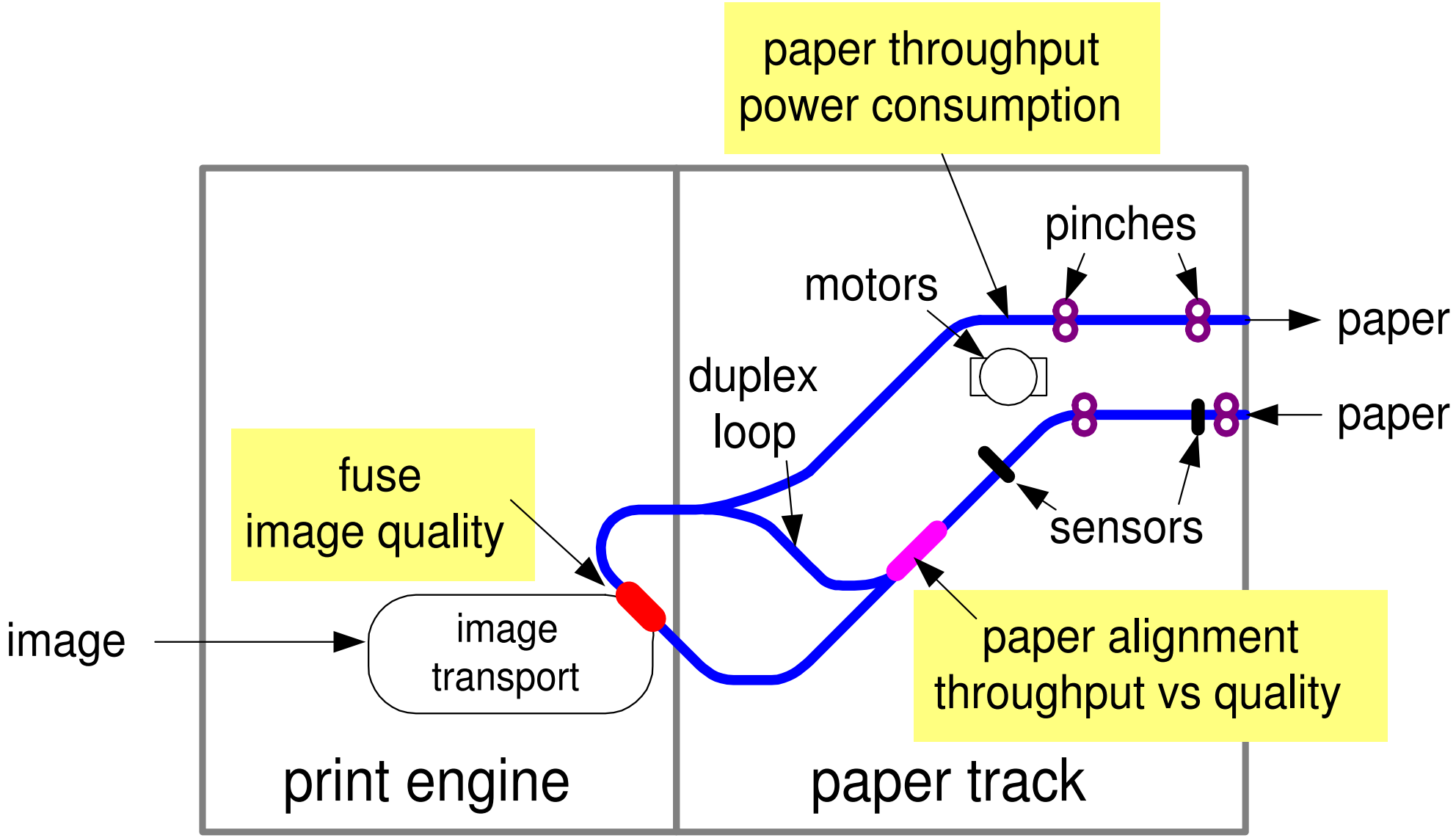
The Domain: Printers and Copiers by Océ

31x5E

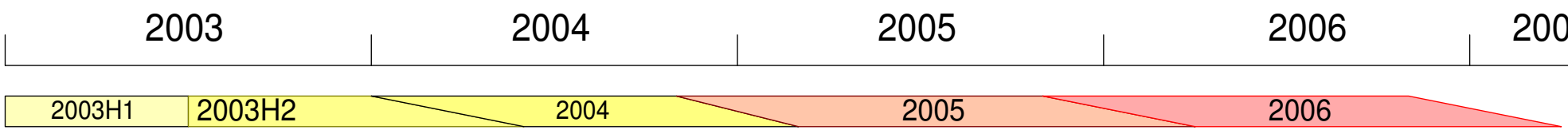
2050

2090

Predicting the Past



Masterplan Boderc Project



2003H1
exploration of
problem,
context,
research status
potential solutions

2003H2
“predict the past”:
model and measure
an existing printer

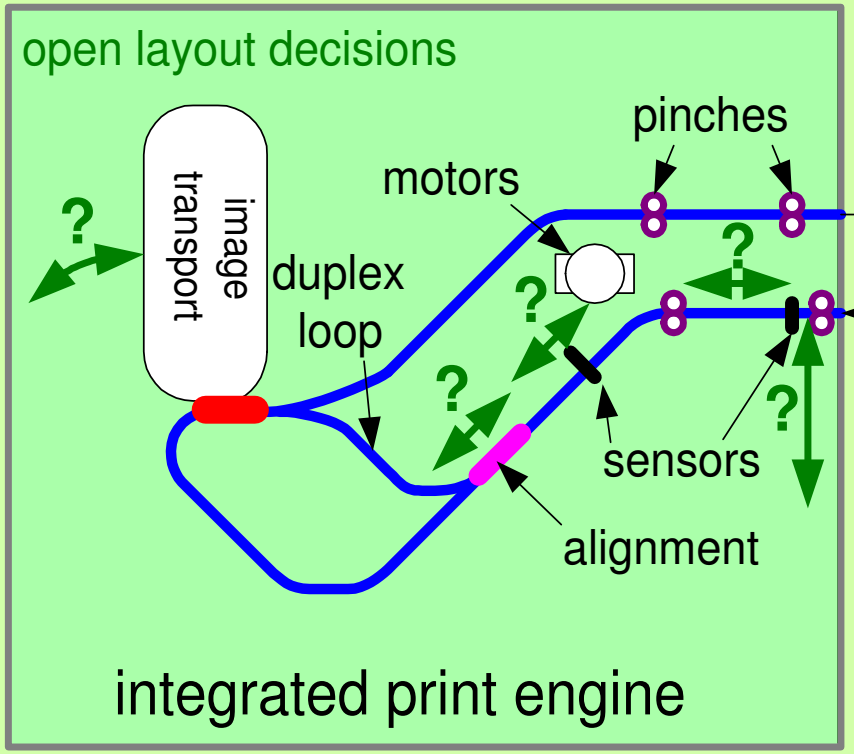
2004
work on new methods:
model a new printer
apply in industry

2005
explore
collect facts
verify in industry

finish and consolidate

Predicting the Future

uncertainty in all requirements and all design options



moving targets:

cost target?
performance target?
size?
weight?
power?

open design issues:

#motors?
#pinches?
#sensors?
#processors?
#control modes?

power and space

throughput and response

control architecture

3 multi-disciplinary modeling teams

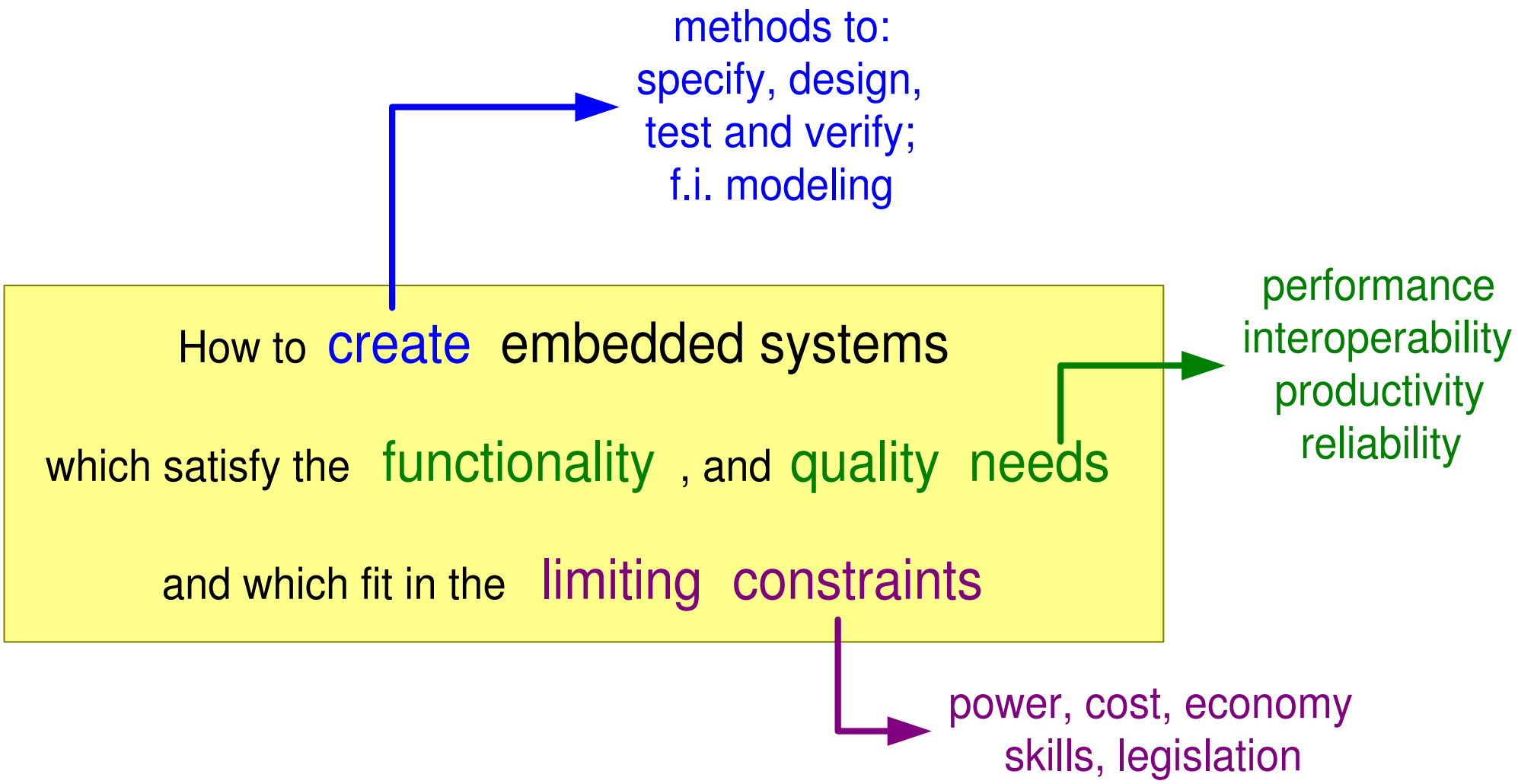
Boderc Project Team Composition

		fte's	people
	research fellows	1	3
industrial	CIP employees	4	5
	industrial participants	2	4
academic	post doc	0	0
	PhD students	6	6
	academic coaches	2	8
	total	15	26

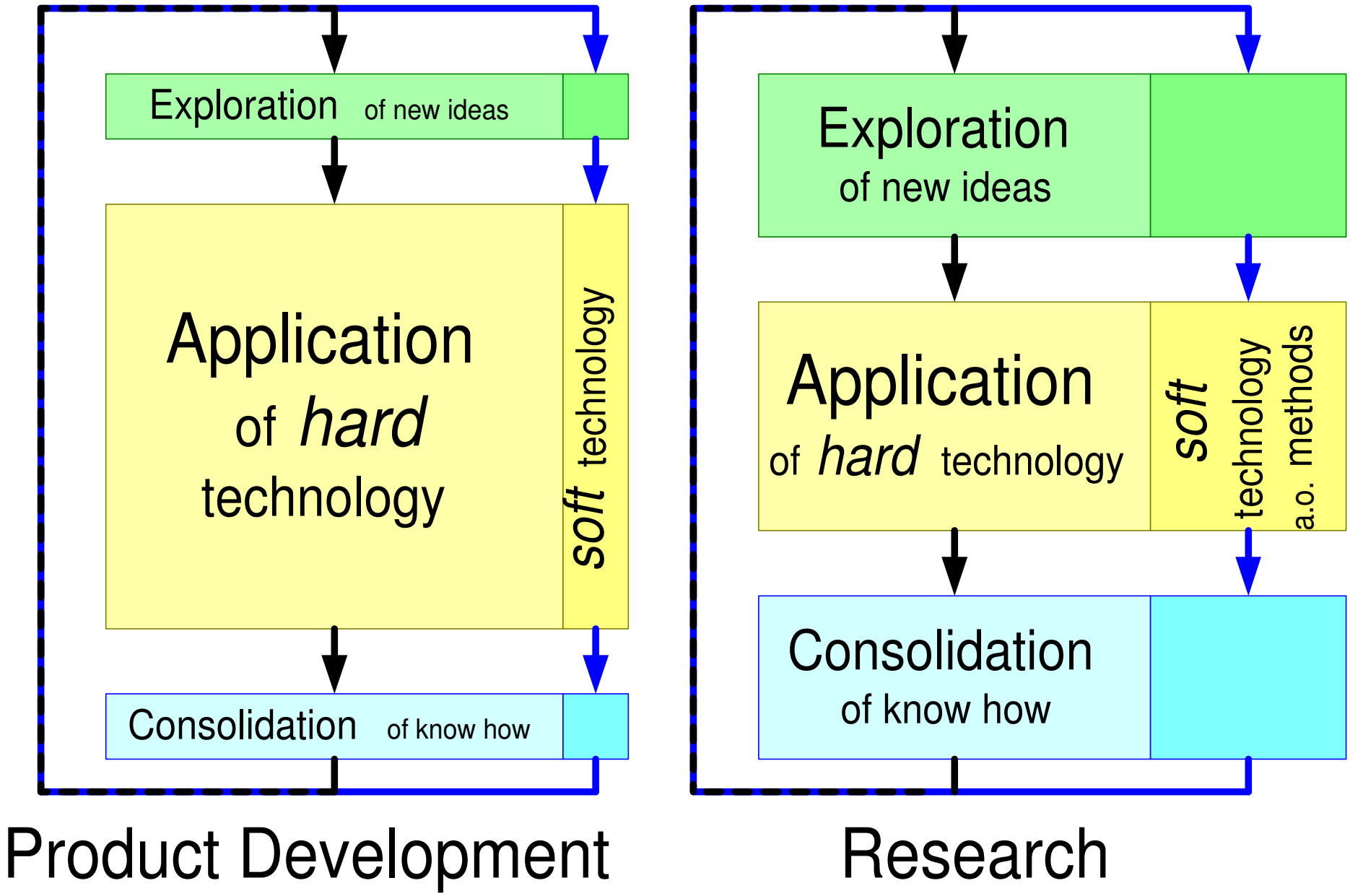
lesson learned:
1 or 2 post docs might provide a better balance

abbreviations:
fte: full time equivalent
CIP: Carrying Industrial Partner

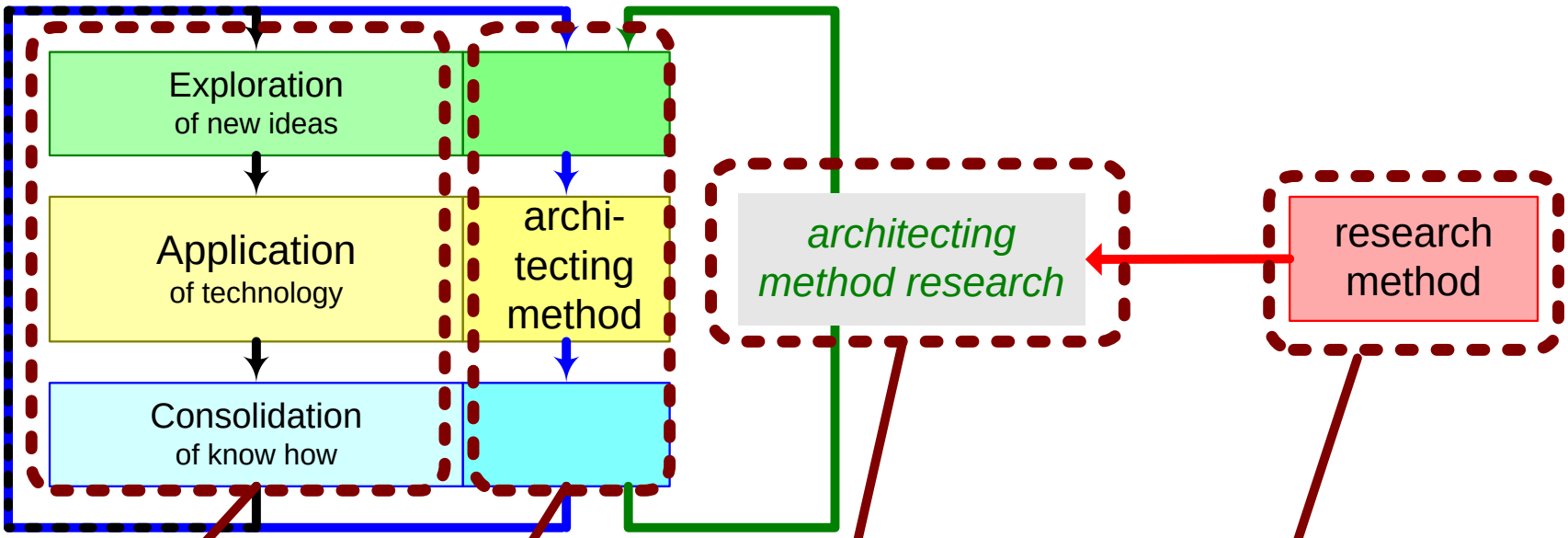
Role of Buskerud University College ESI



Method research requires application of methods



Moving in the meta direction



meta^0

bottom line:
product creation

meta^1

enabling:
architecting method

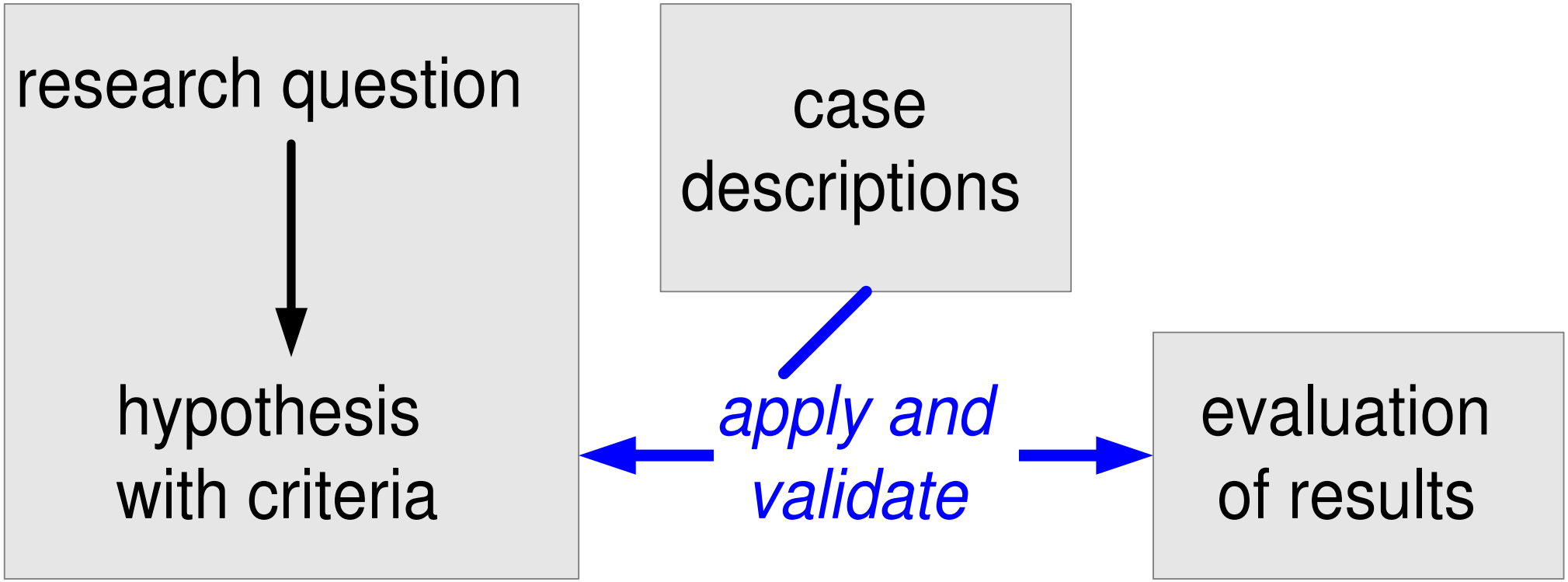
meta^2

pro-active:
research of architecting method

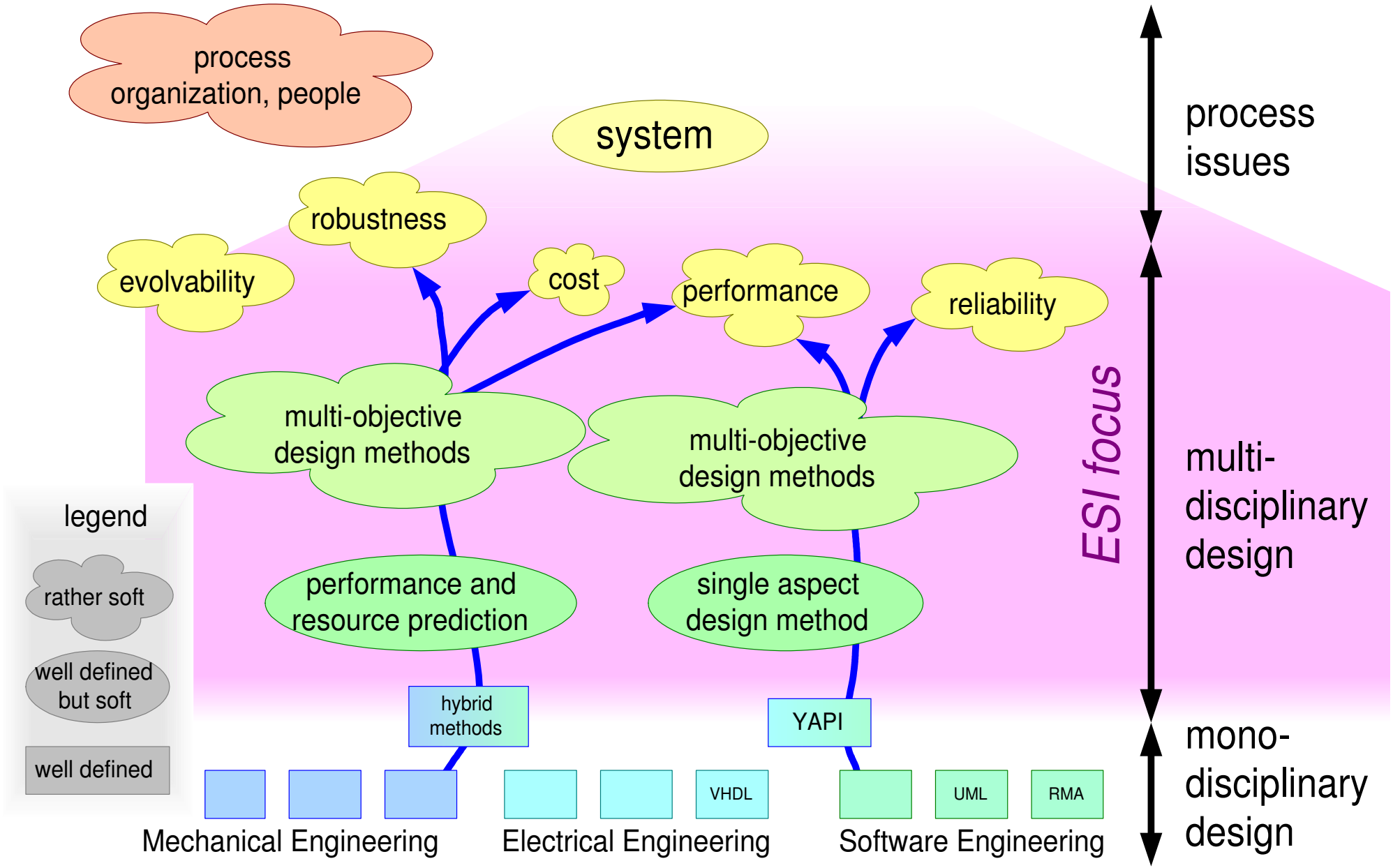
meta^3

scientific foundation:
method to research architecting methods

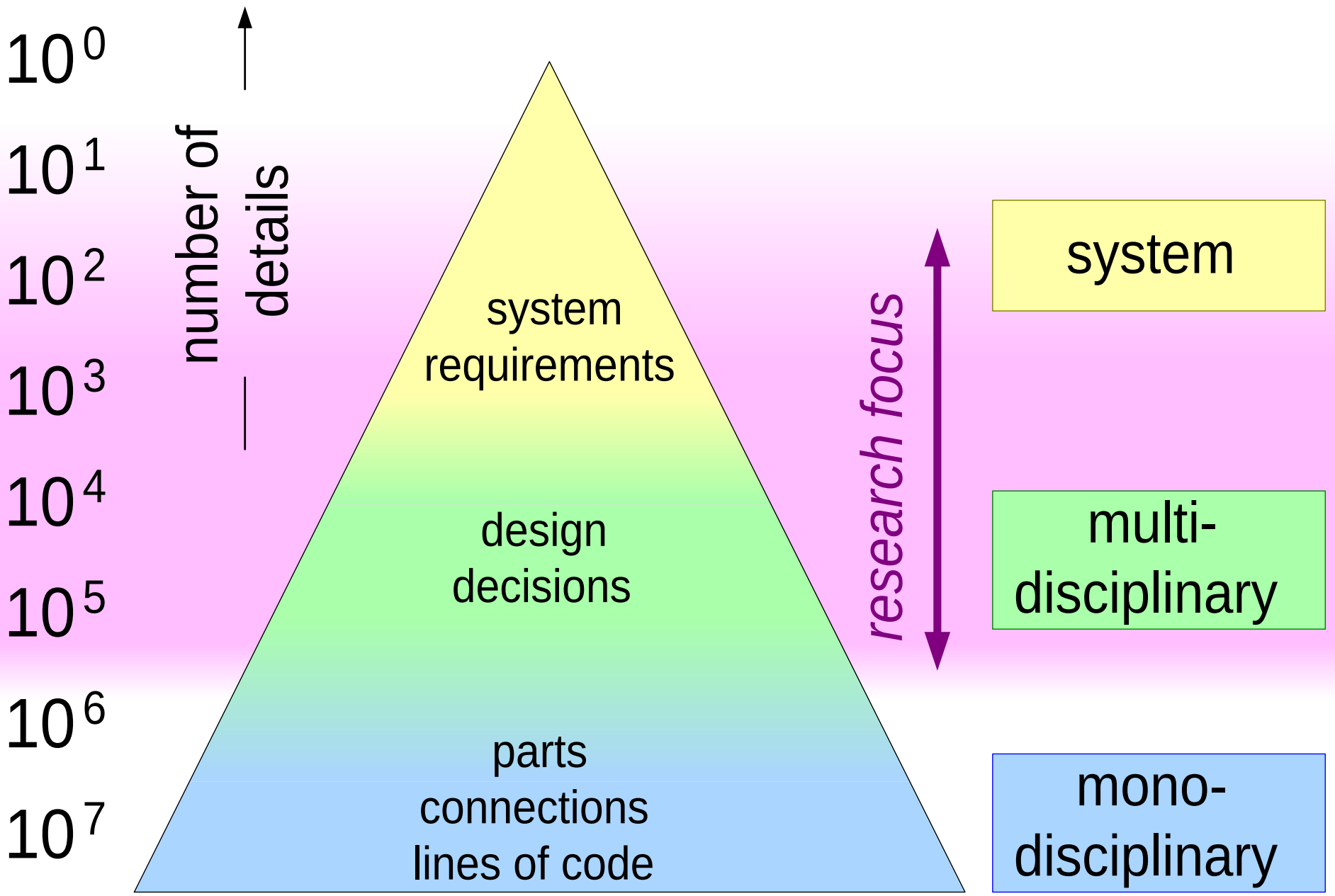
Research Question and Hypothesis



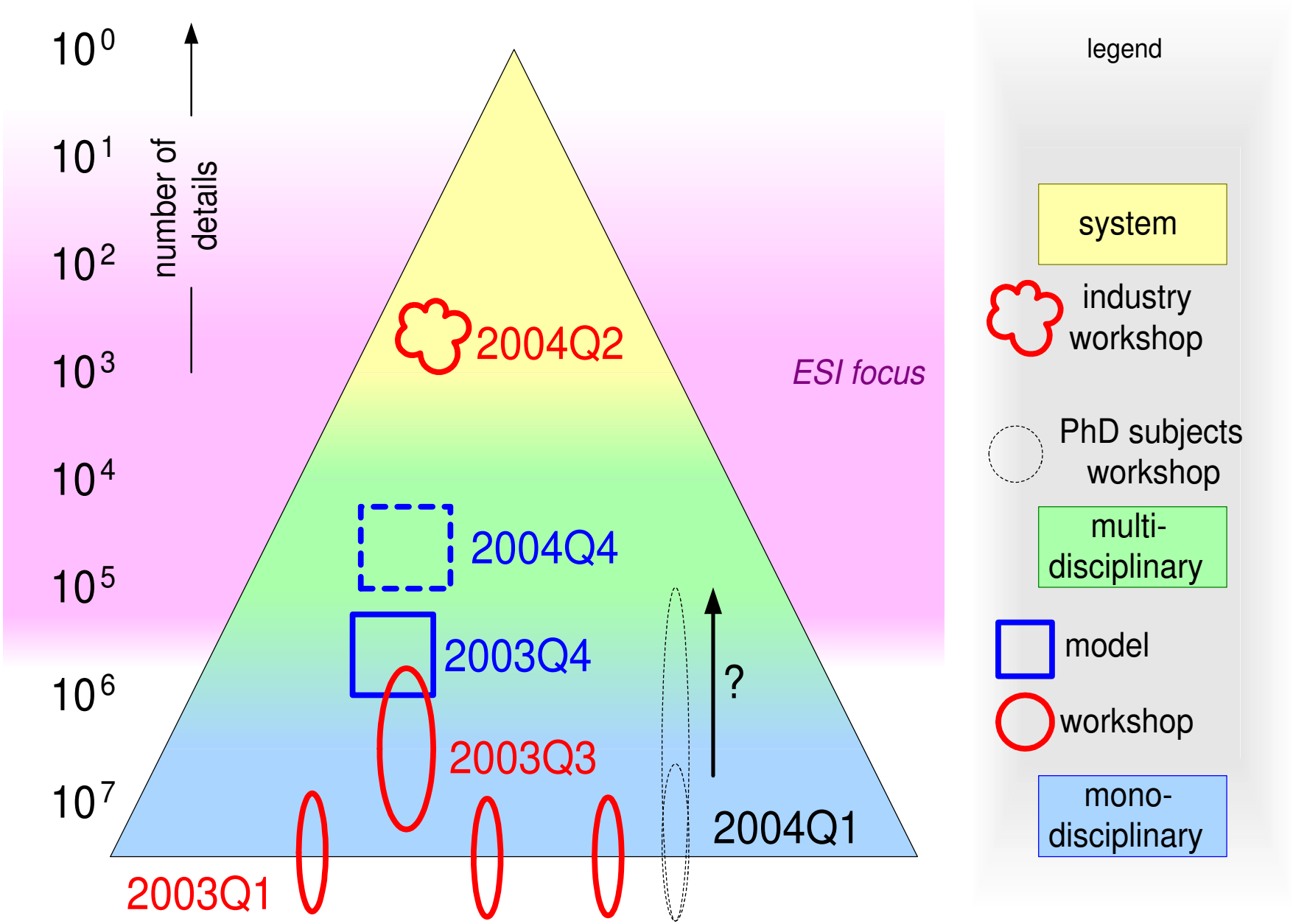
From Mono-Disciplinary to System



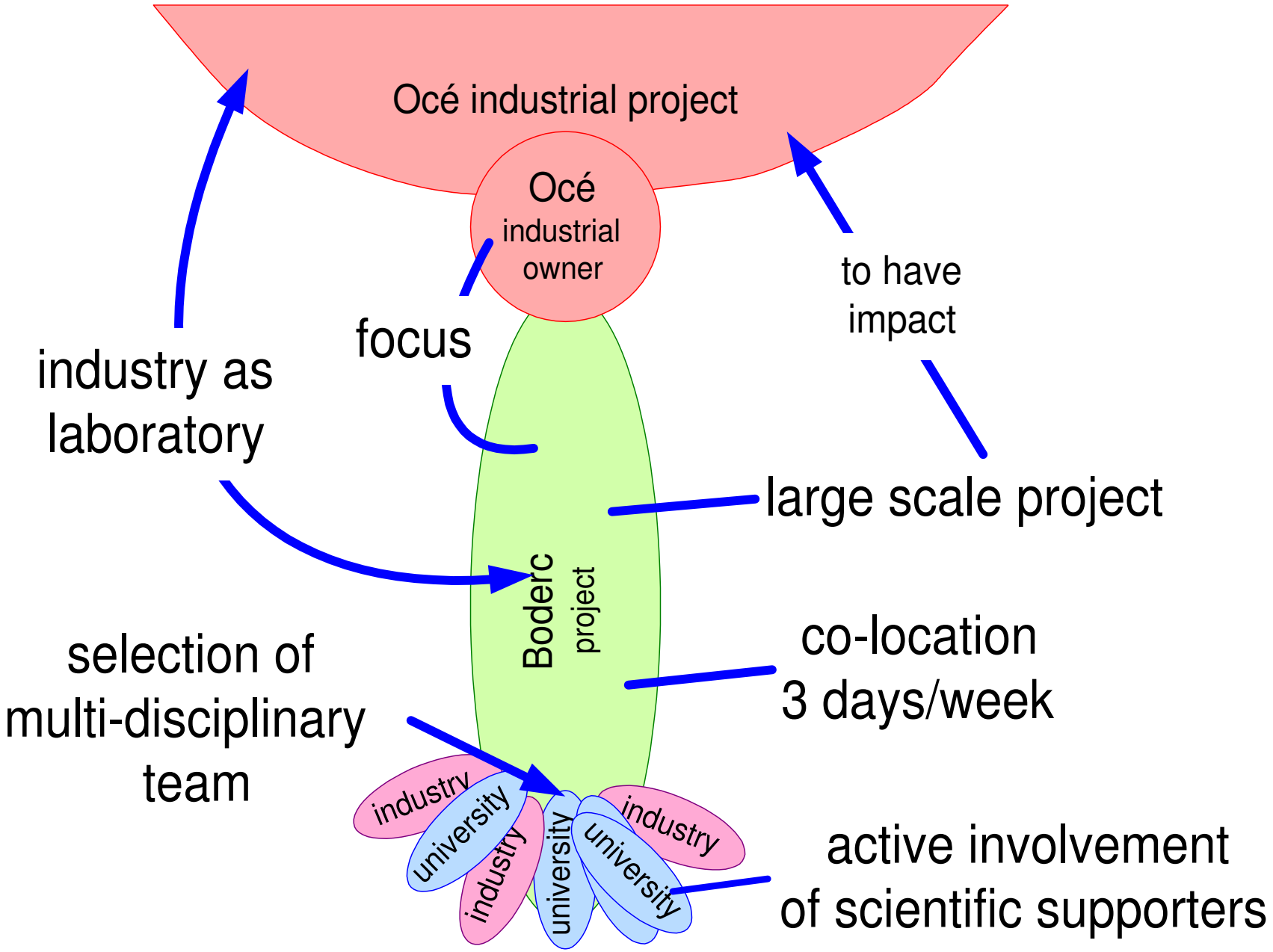
Exponential Pyramid, from requirement to bolts and nuts



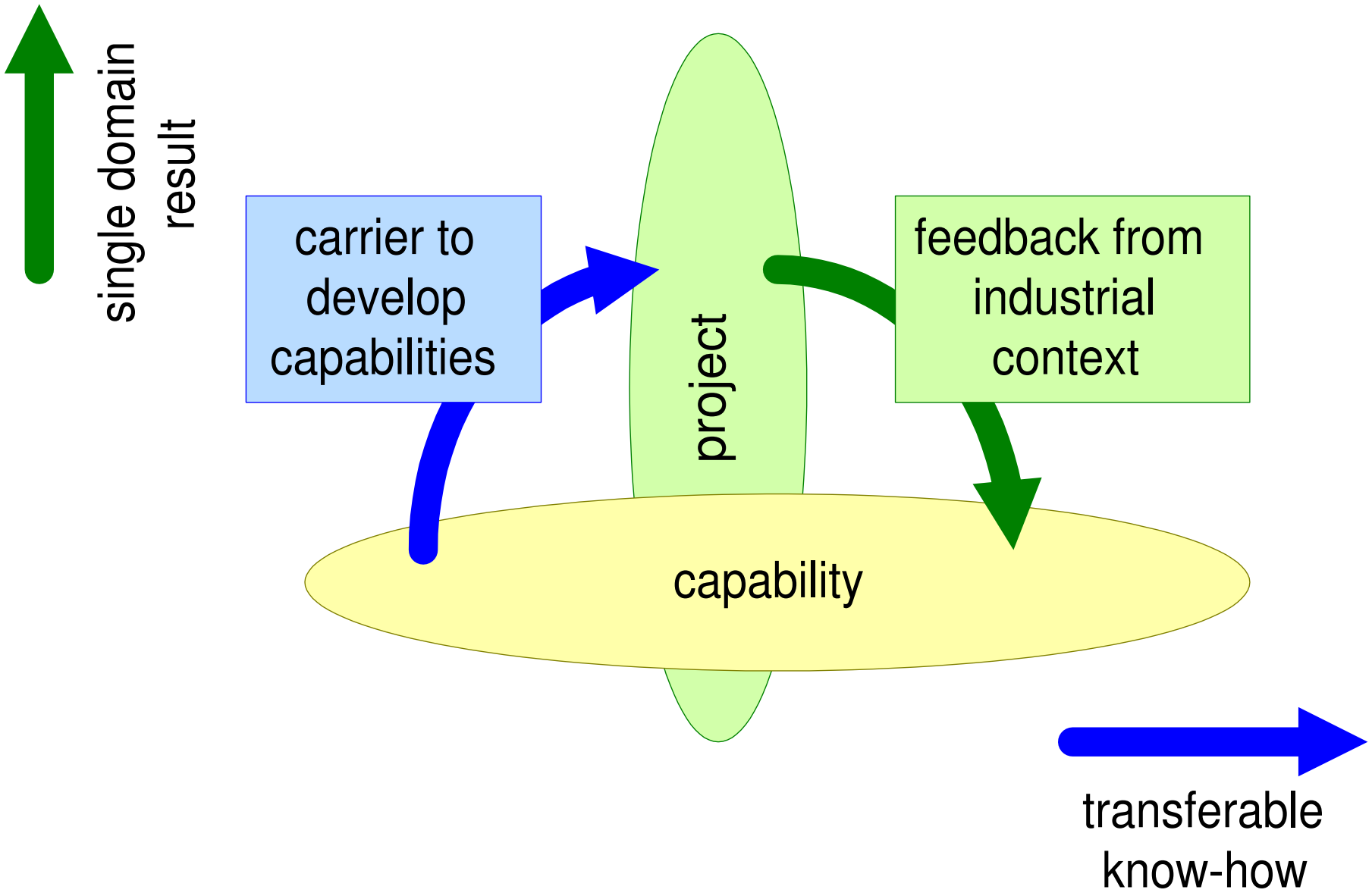
Stretching Upwards



Critical Success Factors for projects



Project as Carrier for Capability Development



Conclusion: Lessons Learned

- The industry as laboratory approach addresses the gap between industry and academics .
- The gap between industrial multi-disciplinary problems and academic research results is **huge**.
- The academic and industrial partners are willing to address this gap.

Conclusion: Lessons Learned (2)

- 4 years is too short if the research has to be done by PhD students.

  needed years: 2 learning +
  2 exploration and application + 1 consolidation

- Additional projects are needed to do research on the same methods in different settings

  f.i. wafersteppers,
  healthcare or consumer electronics

- More attention is needed for the composition of the project team

  balance experienced-inexperienced and industrial-academic.

Conclusion: Lessons Learned (3)

- The real research work (exploration, application, and consolidation) requires full-time pe ople.

  Part time people can only be effective in a coaching role

- Communication across disciplinary boundaries is really very difficult

- Mix of project members in disciplines, experience and background facilitates appreciation of multi-disciplinary problems.

  as experienced in the workshop 2004Q2

- Industry as laboratory facilitates the understanding of the customers, the application and the market in relation to the design.

  f.i. key driver model, and budget approach

- The use of early results by industry is a source of inspiration for research

  f.i. throughput and response model