Researching how to Connect Business and Customer World to Engineering World

by *Gerrit Muller* University of South-Eastern Norway-NISE
e-mail: gaudisite@gmail.com
www.gaudisite.nl

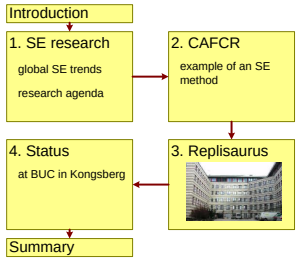
Abstract

The purpose of most engineering activities is to create a system that satisfies needs of a customer and that satisfies business objectives. However, the engineering world is technical oriented, where technical decisions tend to be made on technical trade-offs. The business and customer worlds are social and economical by nature. One of the objectives of Systems Architecting is to make design decisions in the technical world that are appropriate in the social and economical world.
Our research first of all tries to understand the current practice. The longer term goal is to enhance the current practice such that we can teach methods and techniques that actually improve current practice. We use the CAFCR model as a model to understand current practice and as model to develop methods and techniques.

Distribution

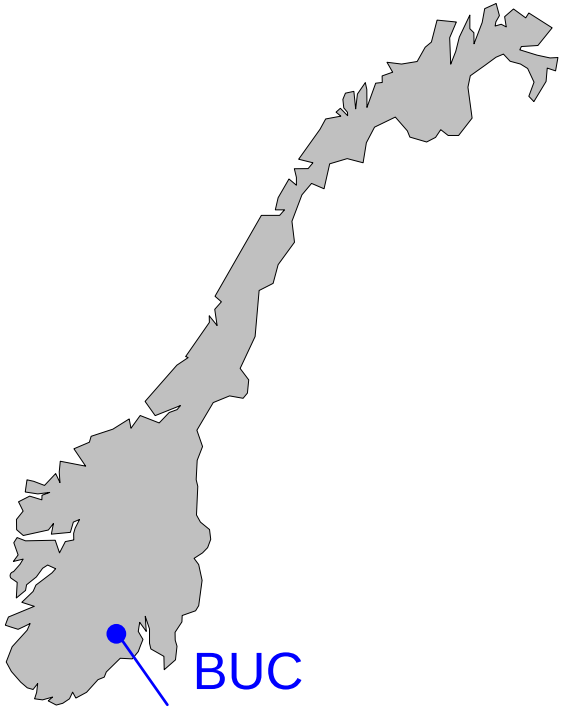
This article or presentation is written as part of the Gaudí project. The Gaudí project philosophy is to improve by obtaining frequent feedback. Frequent feedback is pursued by an open creation process. This document is published as intermediate or nearly mature version to get feedback. Further distribution is allowed as long as the document remains complete and unchanged.

April 2, 2021
status: preliminary draft
version: 0.1



Coordinates of the Speaker

Høgskolen i Buskerud (HiBu)
Buskerud University College (BUC)



Embedded Systems Institute (ESI)

Industrial + Academic Experience

manager system engineering

Gaudí

Systems Architecting research close to industrial companies

Philips HealthCare

ASML

Philips Research

ESI

Buskerud

HBV

HSN

USN

TNO

1980 1990 2000 2010 2020

industrial experience

time pressure pragmatics sales

cost constraints products

lots of people

research academic

reflection

evidence

exposure

education

best student paper award
quality education award
INCOSE fellow
USN excellent educator

Figure Of Contents™

Introduction

1. SE research

   global SE trends

   research agenda

2. CAFCR

   example of an SE method

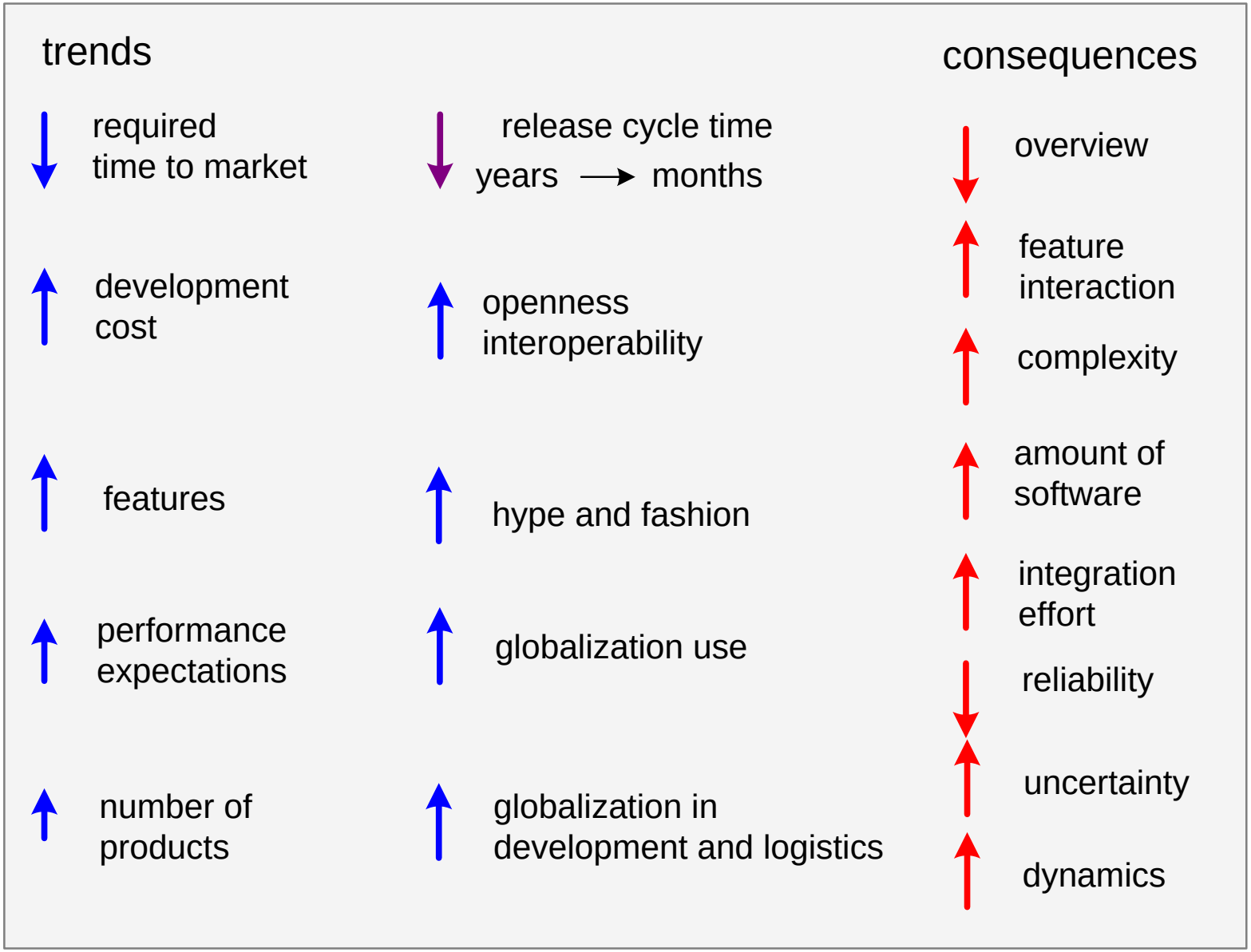
3. Replisaurus

4. Status

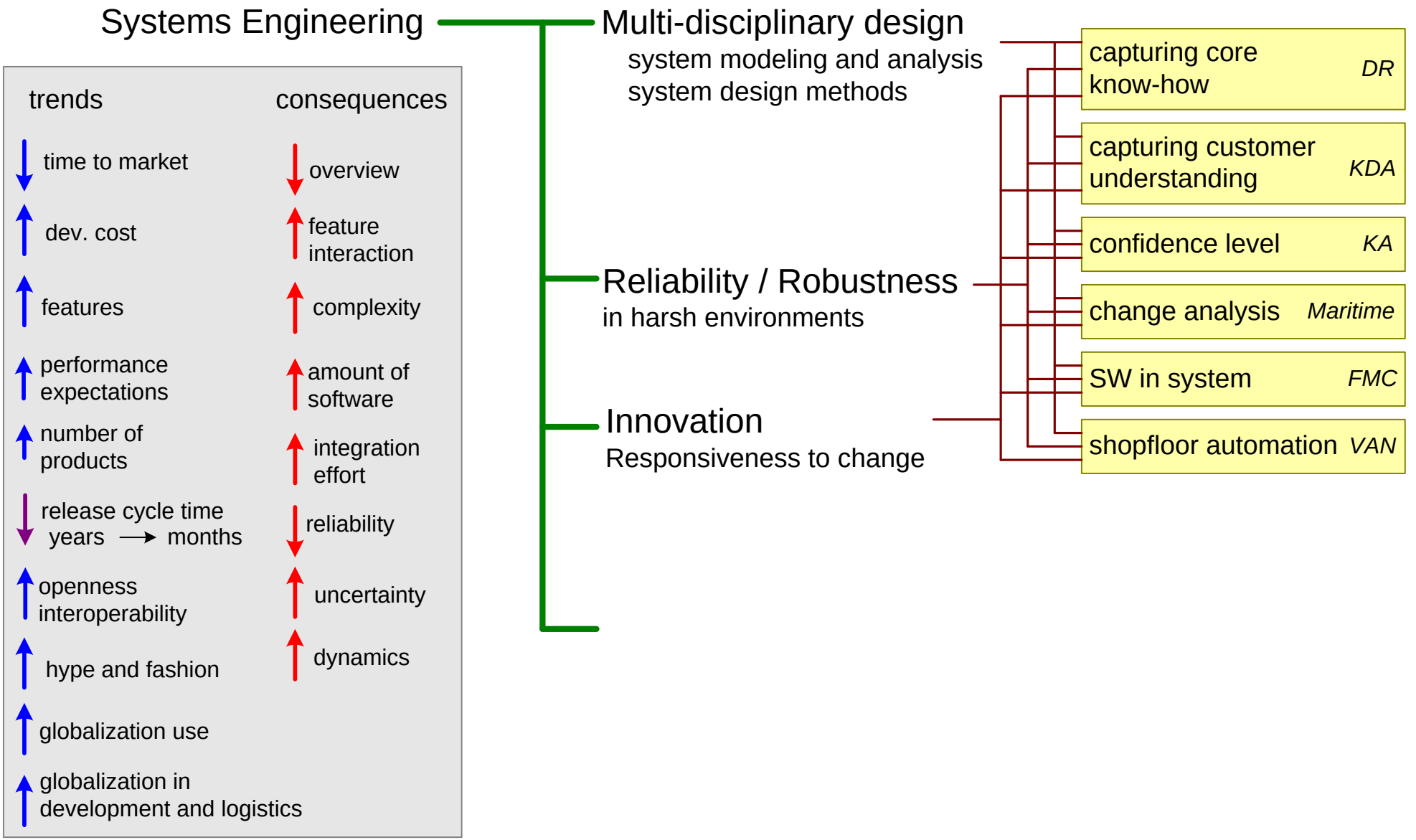
   at BUC in Kongsberg

Summary

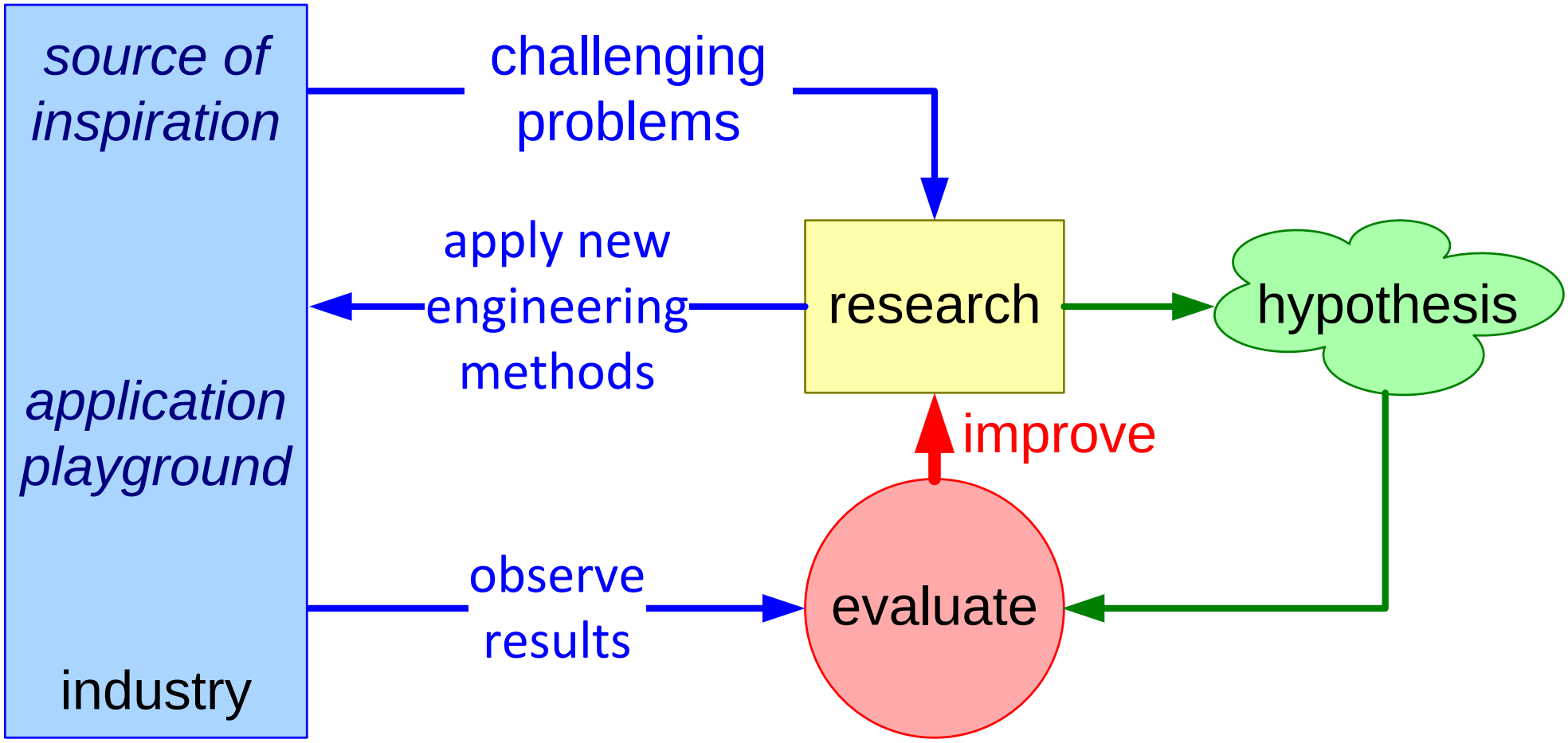
Today's Industrial Trends



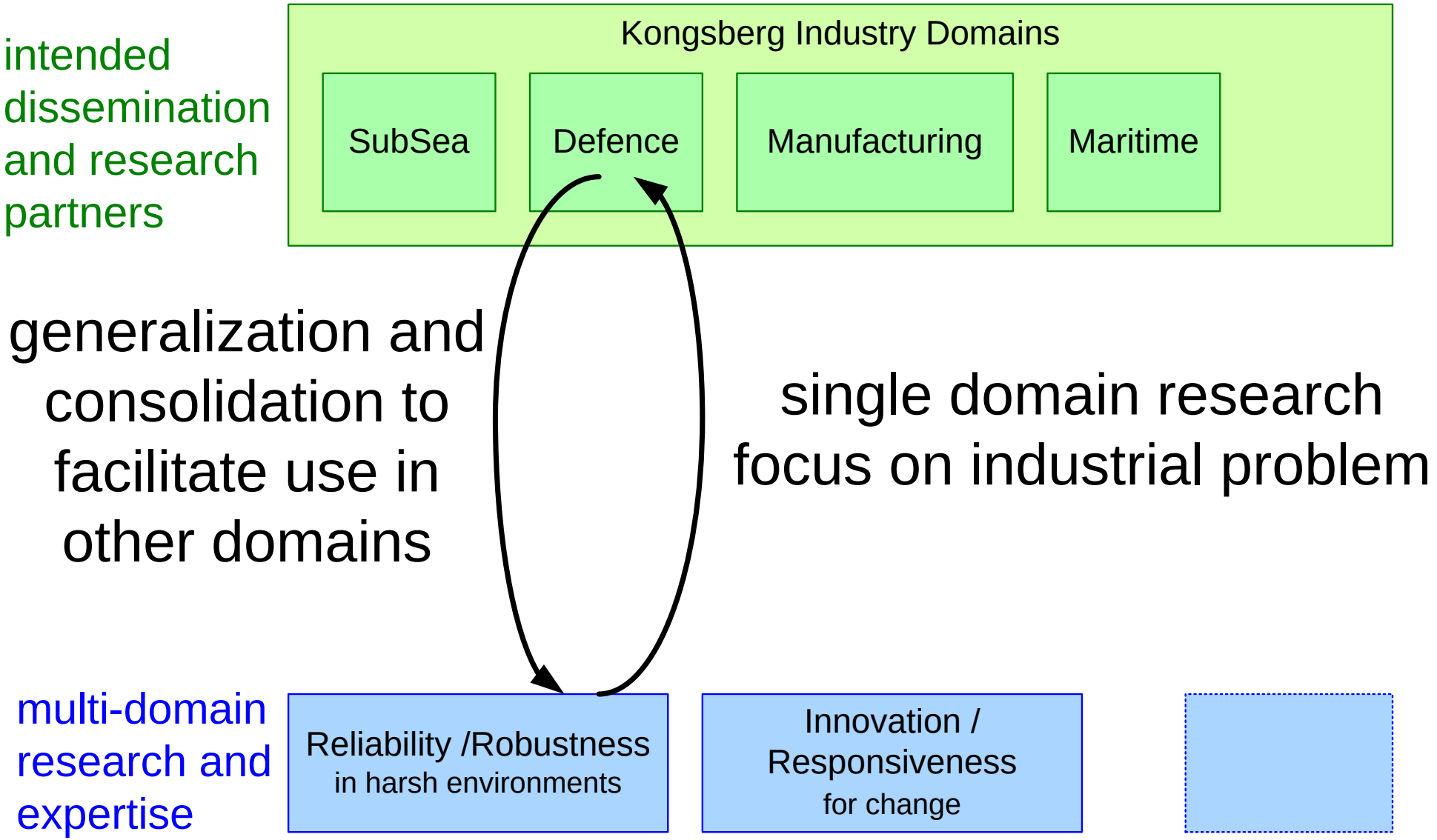
Buskerud research agenda as graph



Industry as Laboratory



Industry as Laboratory (2)



Method Example: CAFCR

Introduction

1. SE research

   global SE trends

   research agenda

2. CAFCR

   example of an SE method

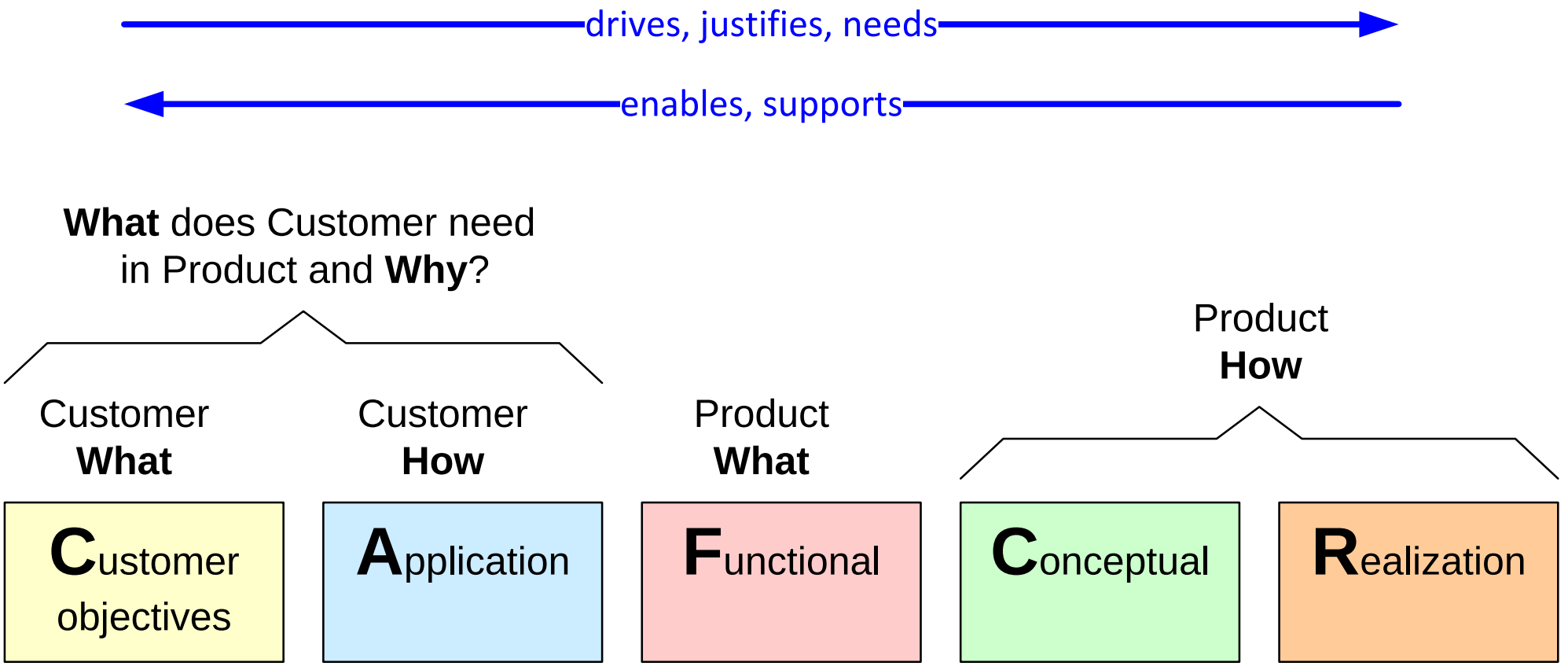
3. Replisaurus

4. Status

   at BUC in Kongsberg

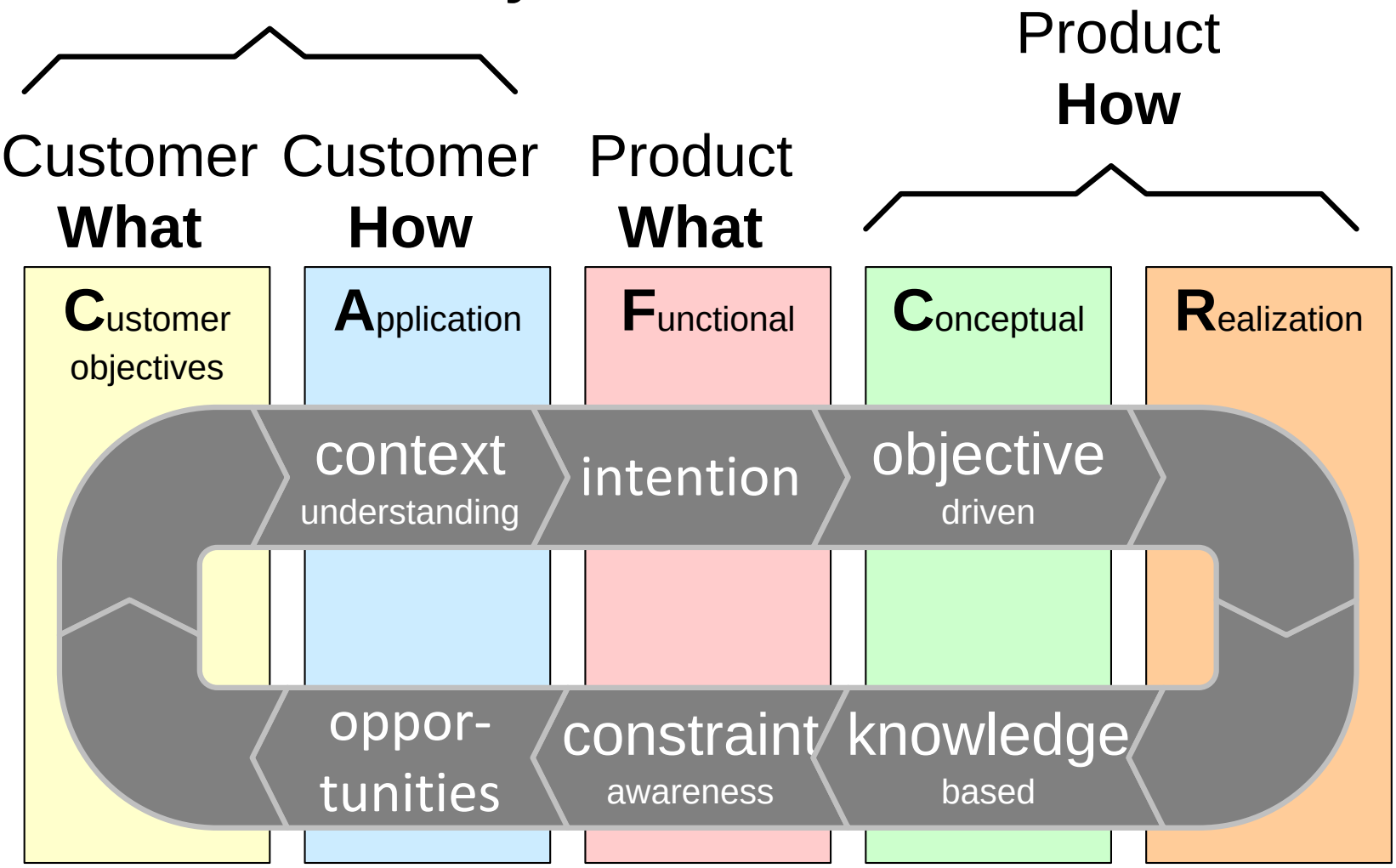
Summary

The “CAFCR” model

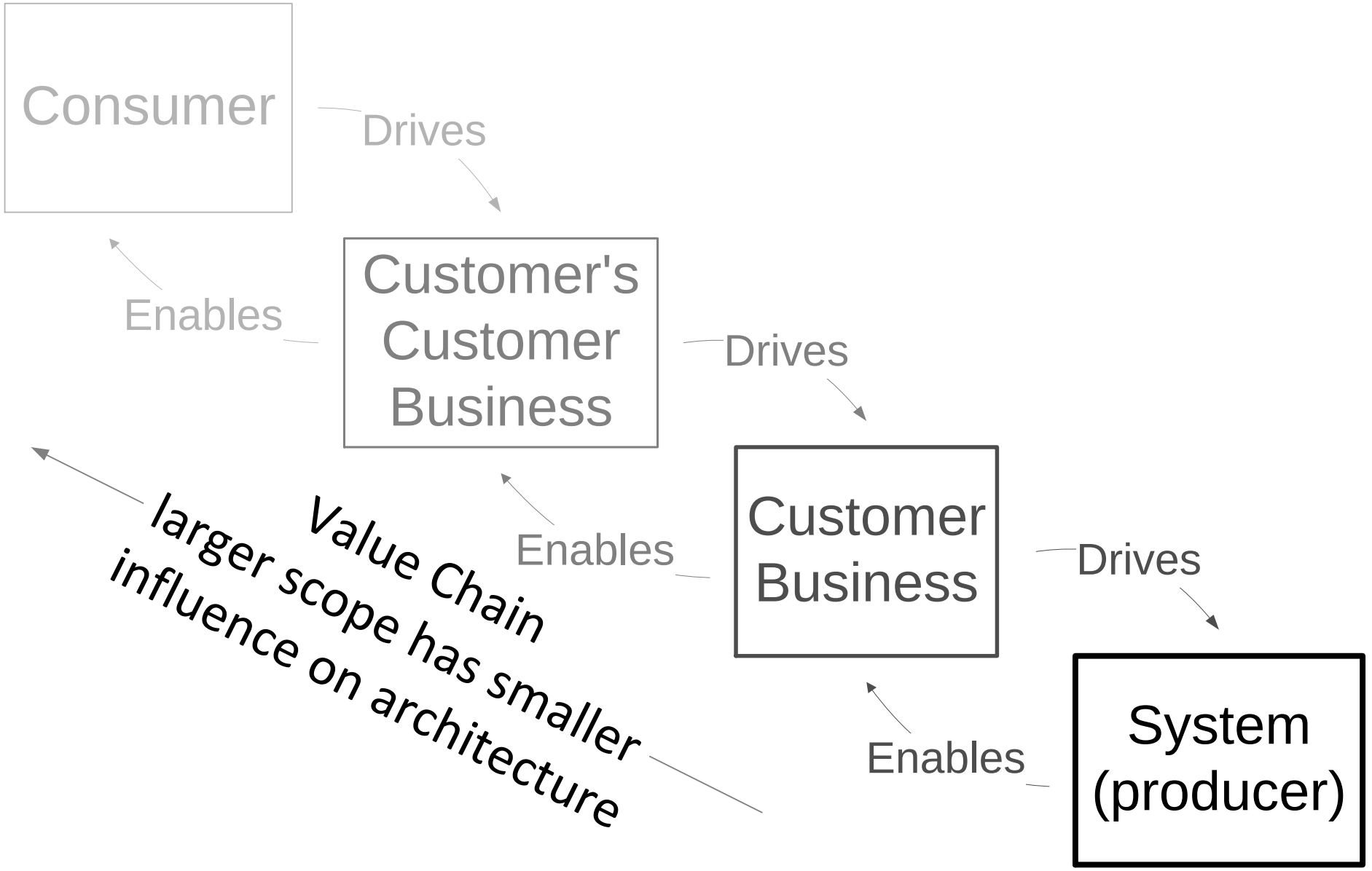


Integrating CAFCR

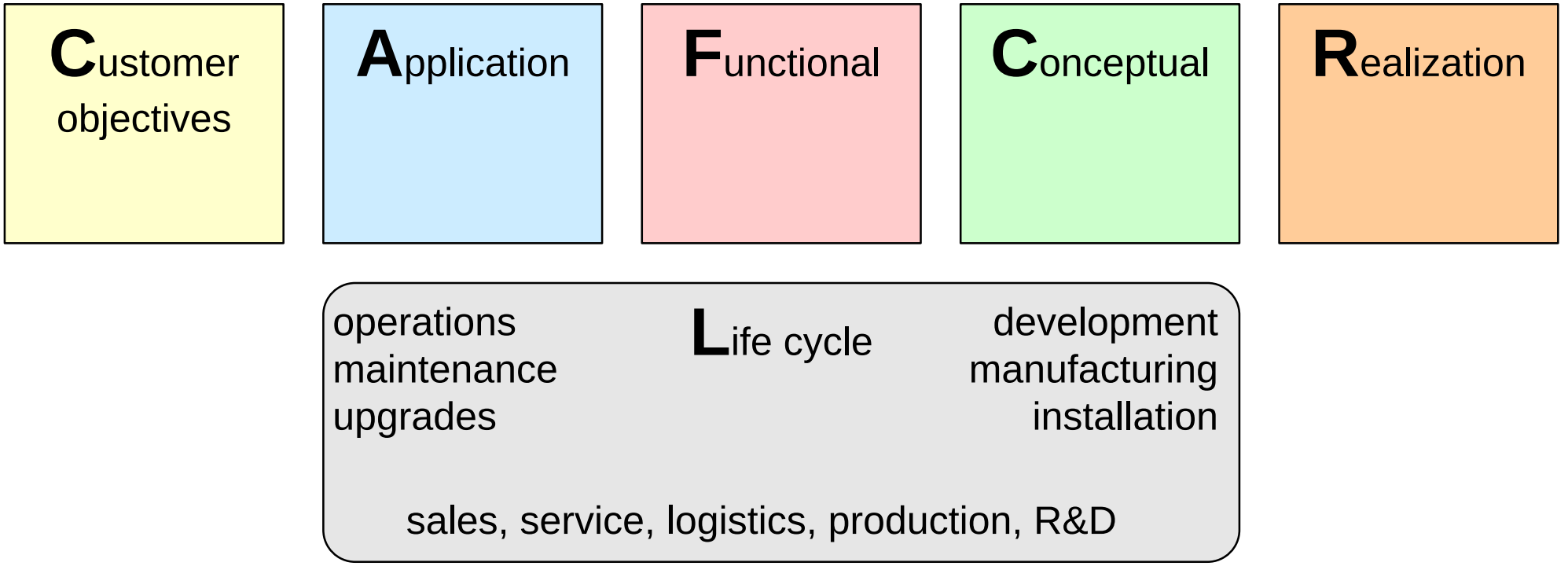
What does Customer need in Product and **Why**?



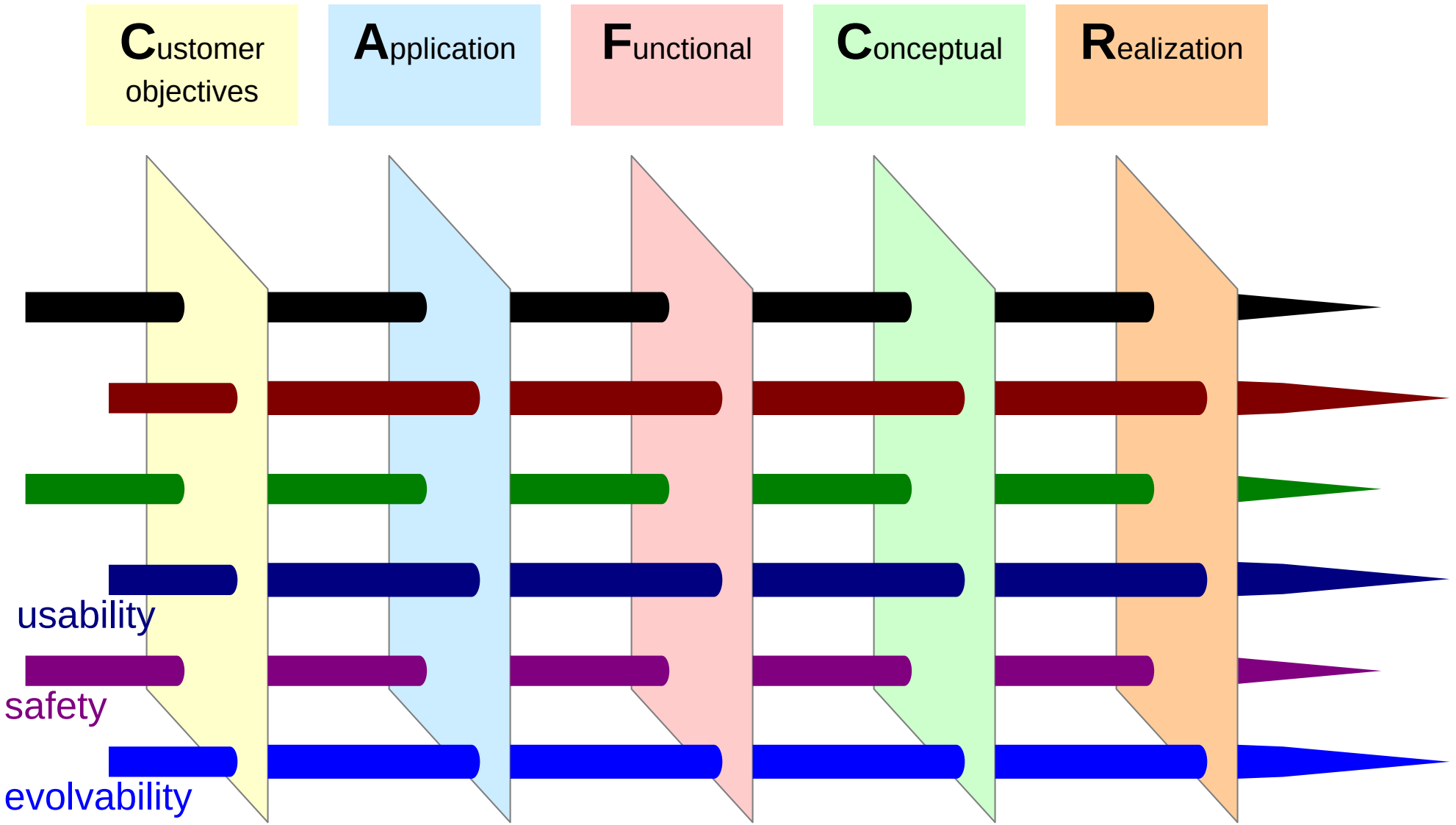
CAFCR can be applied recursively



CAFCR+ model; Life Cycle View



Quality needles as generic integrating concepts



Security as example through all views

Customer objectives	**A**pplication	**F**unctional	**C**onceptual	**R**ealization
sensitive information  trusted	selection classification people information authentication badges passwords locks / walls guards administrators	functions for administration authentication intrusion detection logging quantification	cryptography firewall security zones authentication registry logging	*specific* algorithms interfaces libraries servers storage protocols
	desired characteristics, specifications & mechanisms			
 not trusted	social contacts open passwords blackmail burglary fraud unworkable procedures	missing functionality wrong quantification	holes between concepts	bugs buffer overflow non encrypted storage poor exception handling
			threats	

Start-Up Company Replisaurus in Kista (Sweden)

Introduction

1. SE research
   - global SE trends
   - research agenda

2. CAFCR
   - example of an SE method

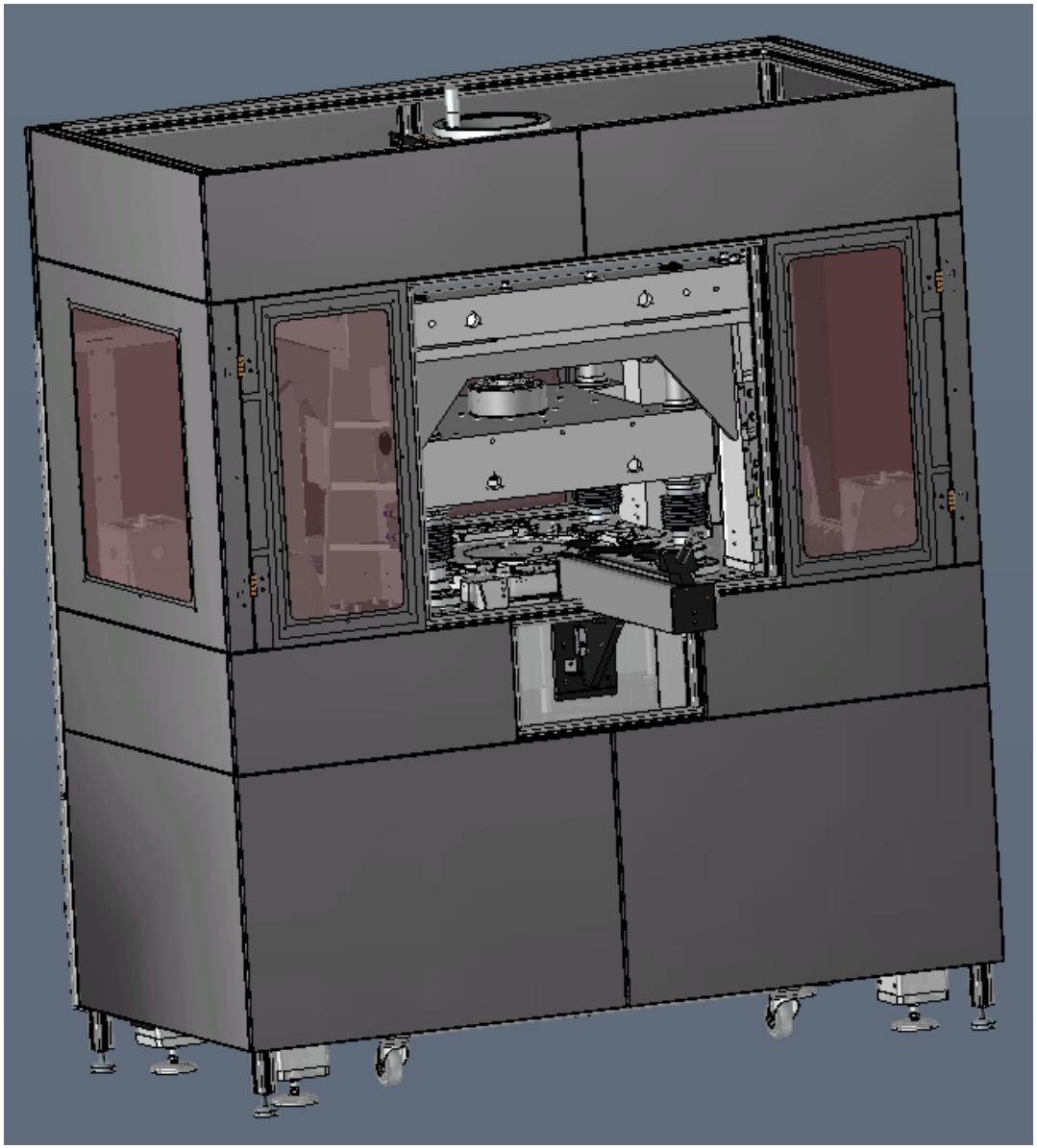
3. Replisaurus

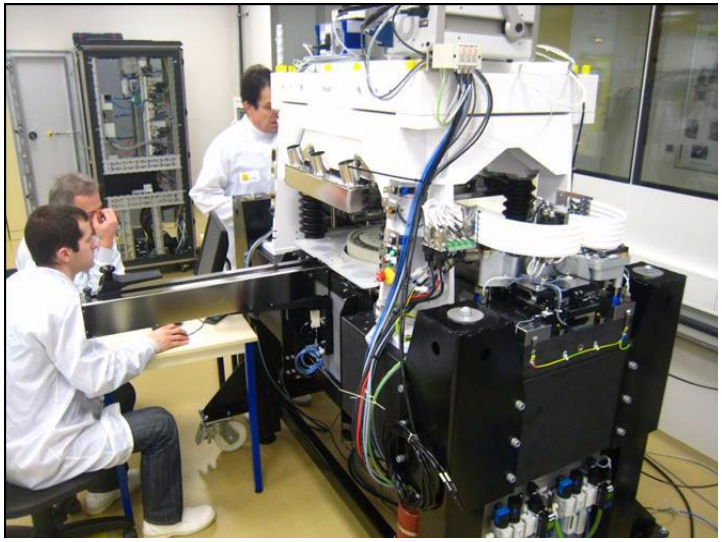
Kista
Sweden

4. Status
   - at BUC in Kongsberg

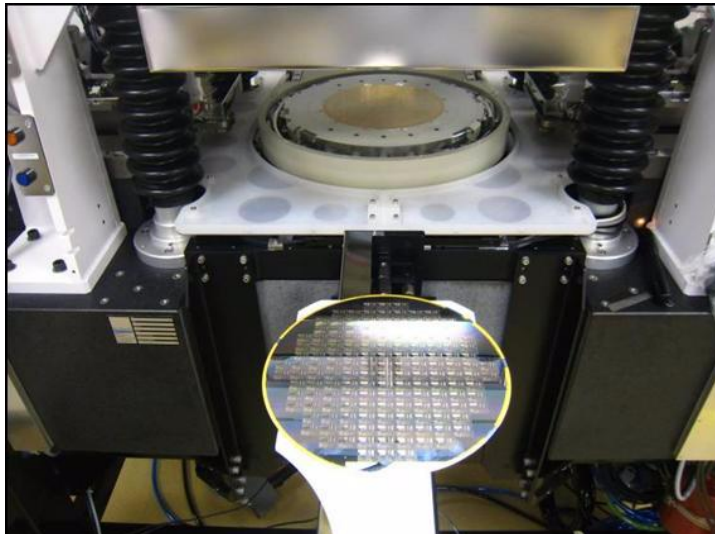
Summary

The Copper Printer

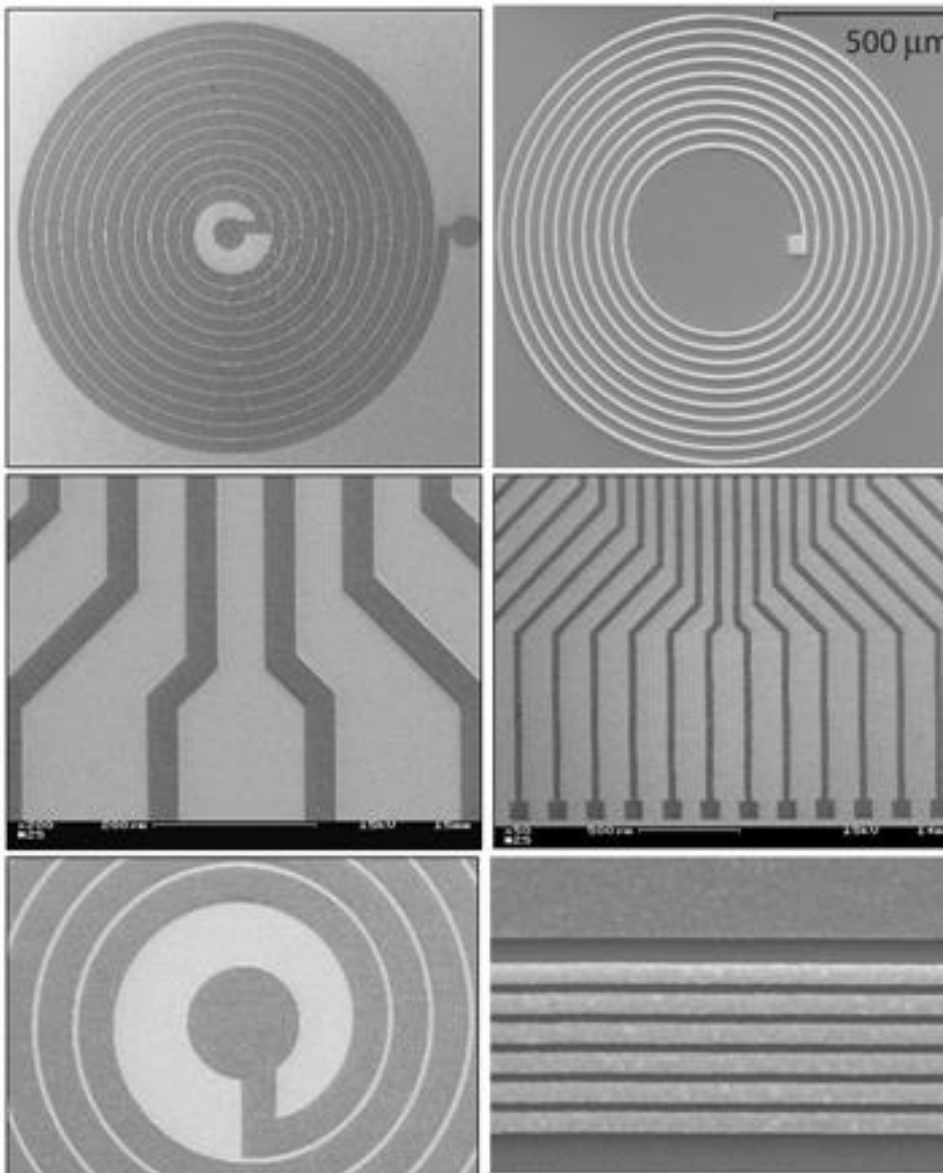




courtesy Replisaurus
www.replisaurus.com

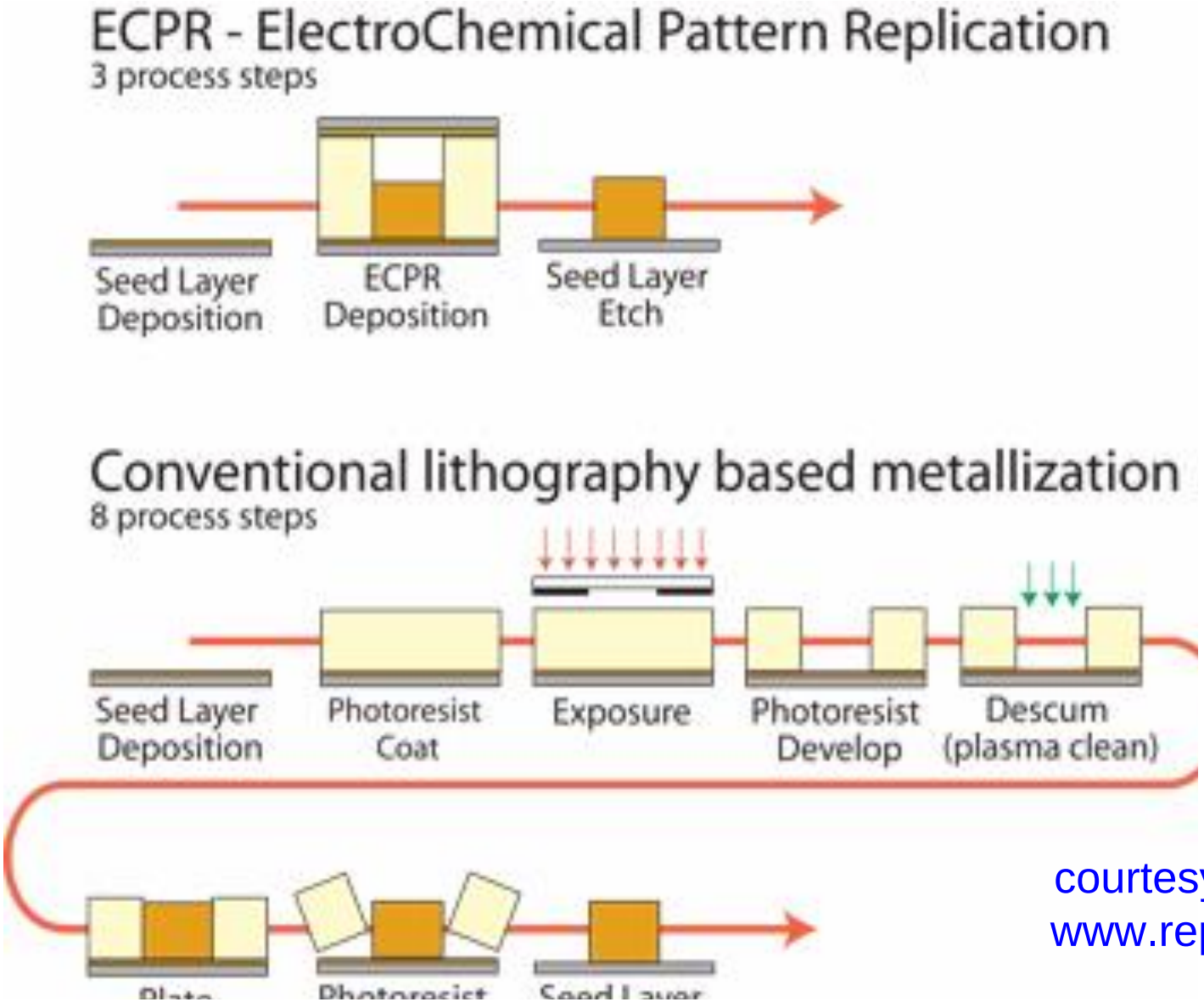


Example of printed copper structures



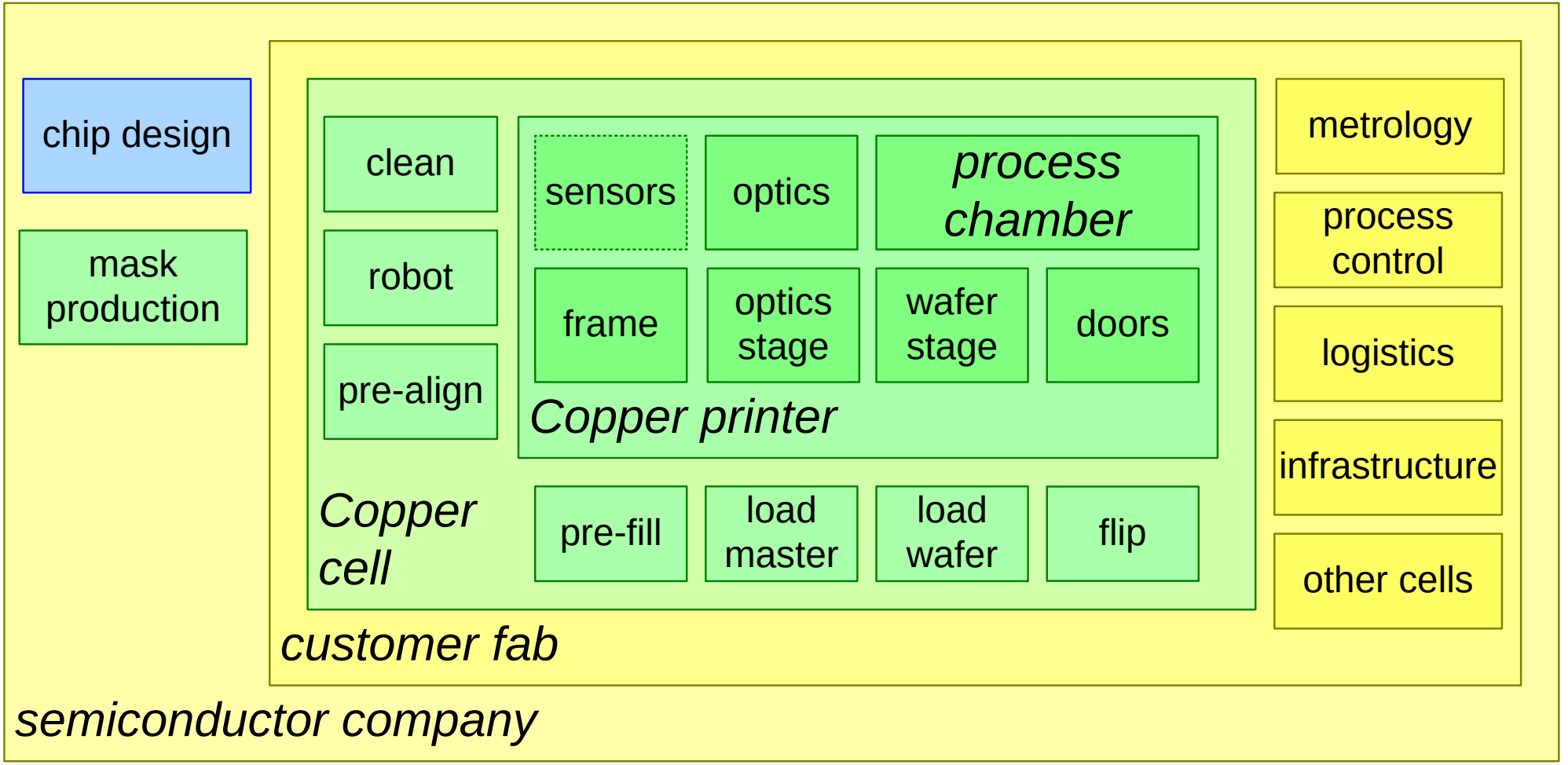
courtesy Replisaurus
www.replisaurus.com

ECPR technology replaces 6 process steps by 1 step

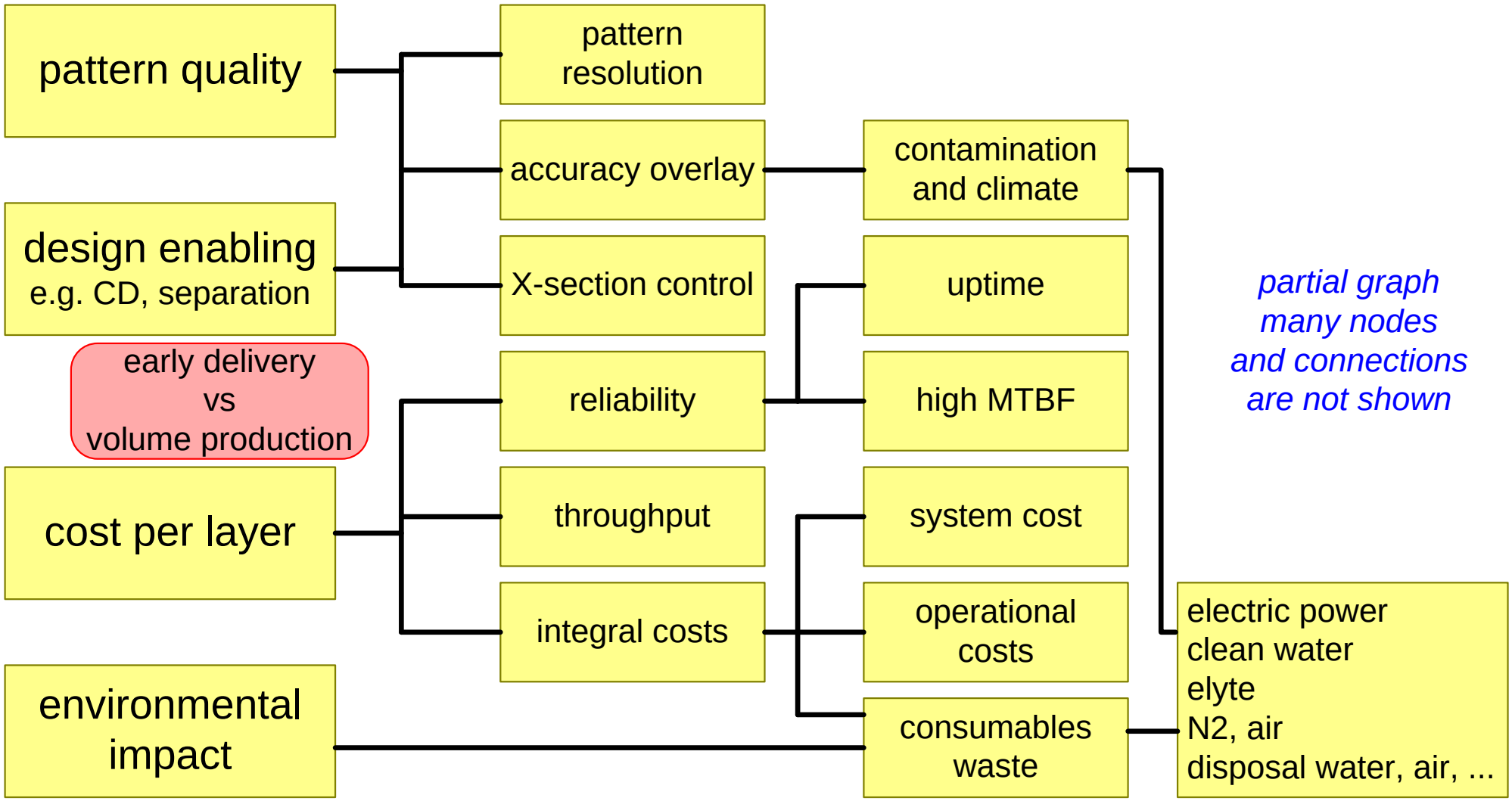


courtesy Replisaurus
www.replisaurus.com

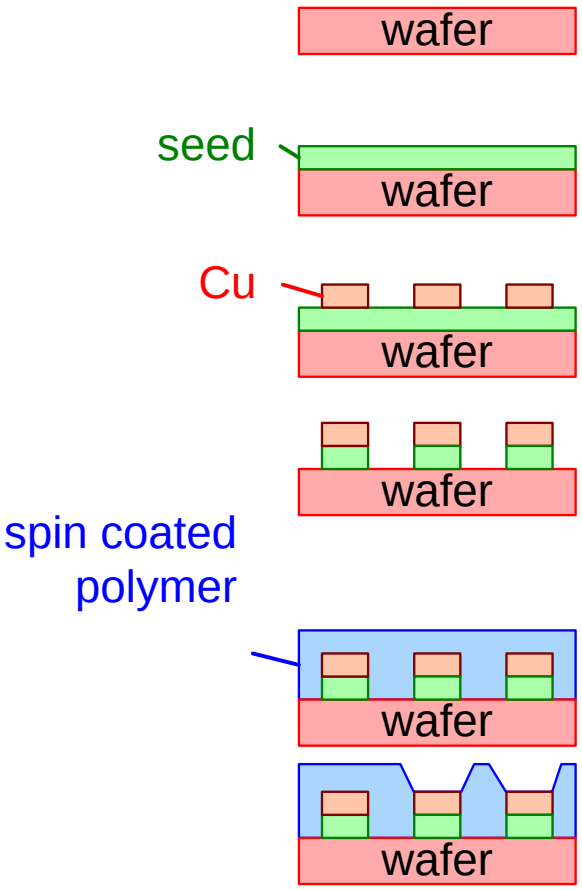
Overview of the different scopes



Customer key driver graph



Process flow at fab level, from inspection until testing



	throughput in minutes	wafer	FOUP	
1.	inspection			
2.	seed sputter	1	25	
3.	Cu print	2	50	target spec
4.	seed etch	1	20	
	dual layer only			
5.	coat/develop dielectrics	3..4	50	75..100??
6.	exposure or CMP for polymer vias	1..2	30	
7.	E-test			

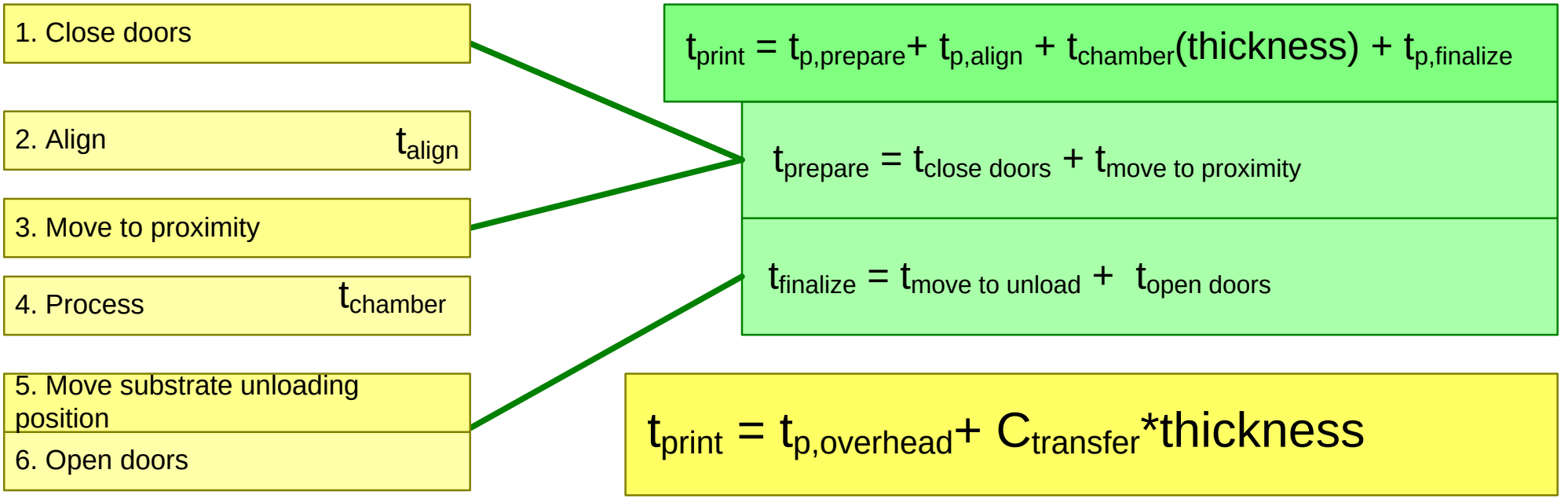
Work flow in the Copper Printer

0. Loading Master&substrate

1. Close doors
2. Align
3. Move to proximity
4. Process incl. rinse&dry
5. Move substrate unloading position
6. Open doors

7. Unloading Master&substrate

Formula of printer throughput time



note: original diagram was annotated with actual performance figures
for confidentiality reasons these numbers have been removed

Optical path to measure marker position

camera

#pixels ~= 5M

pixel resolution
versus
maximum Field of View
read-out and processing time

measurement accuracy
determines
required resolution

microscope

optical resolution
magnification

DoF

wafer

displacement
determines
required Field of View

Research Status as Buskerud University College

Introduction

1. SE research

   global SE trends

   research agenda

2. CAFCR

   example of an SE method

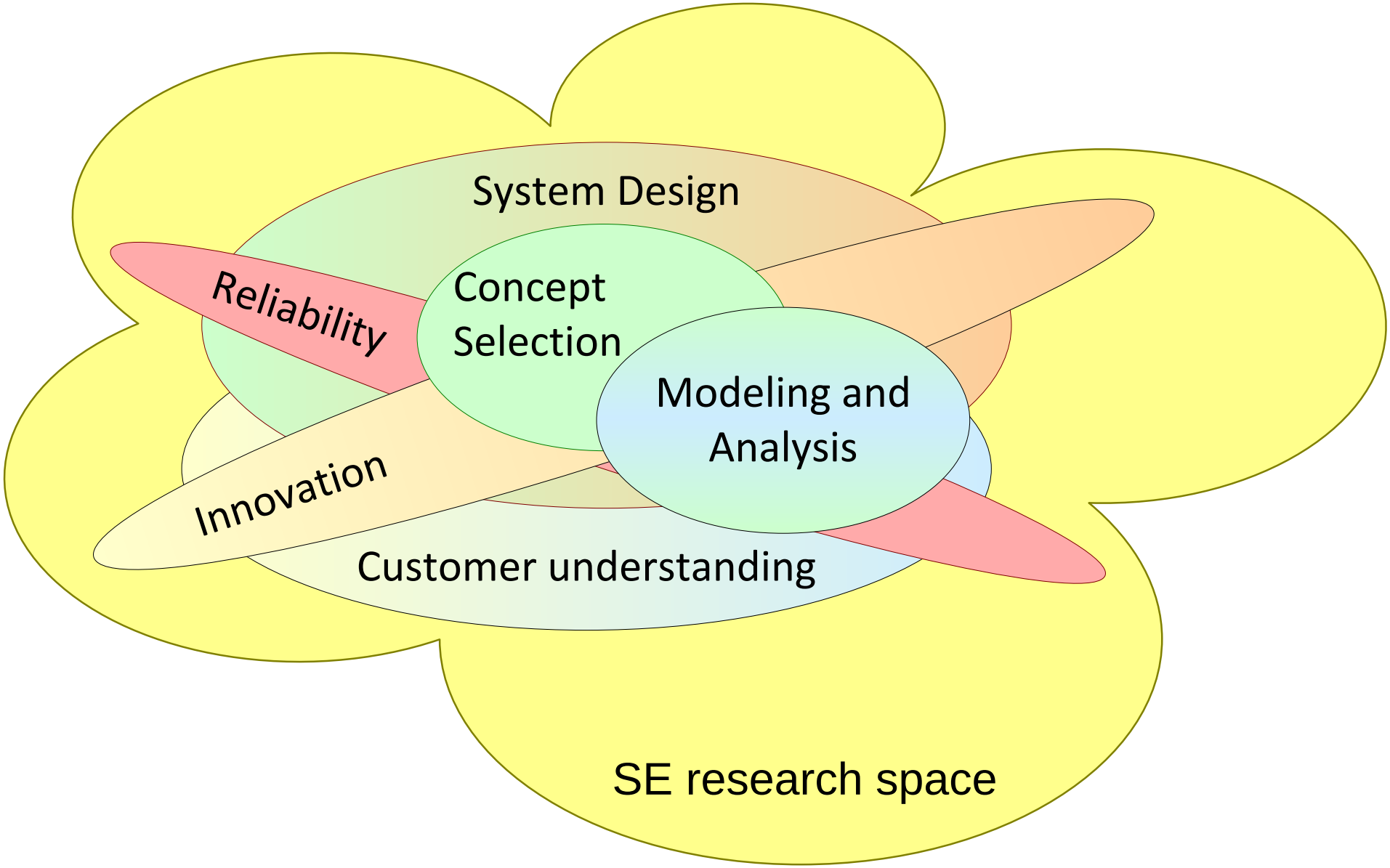
3. Replisaurus

4. Status

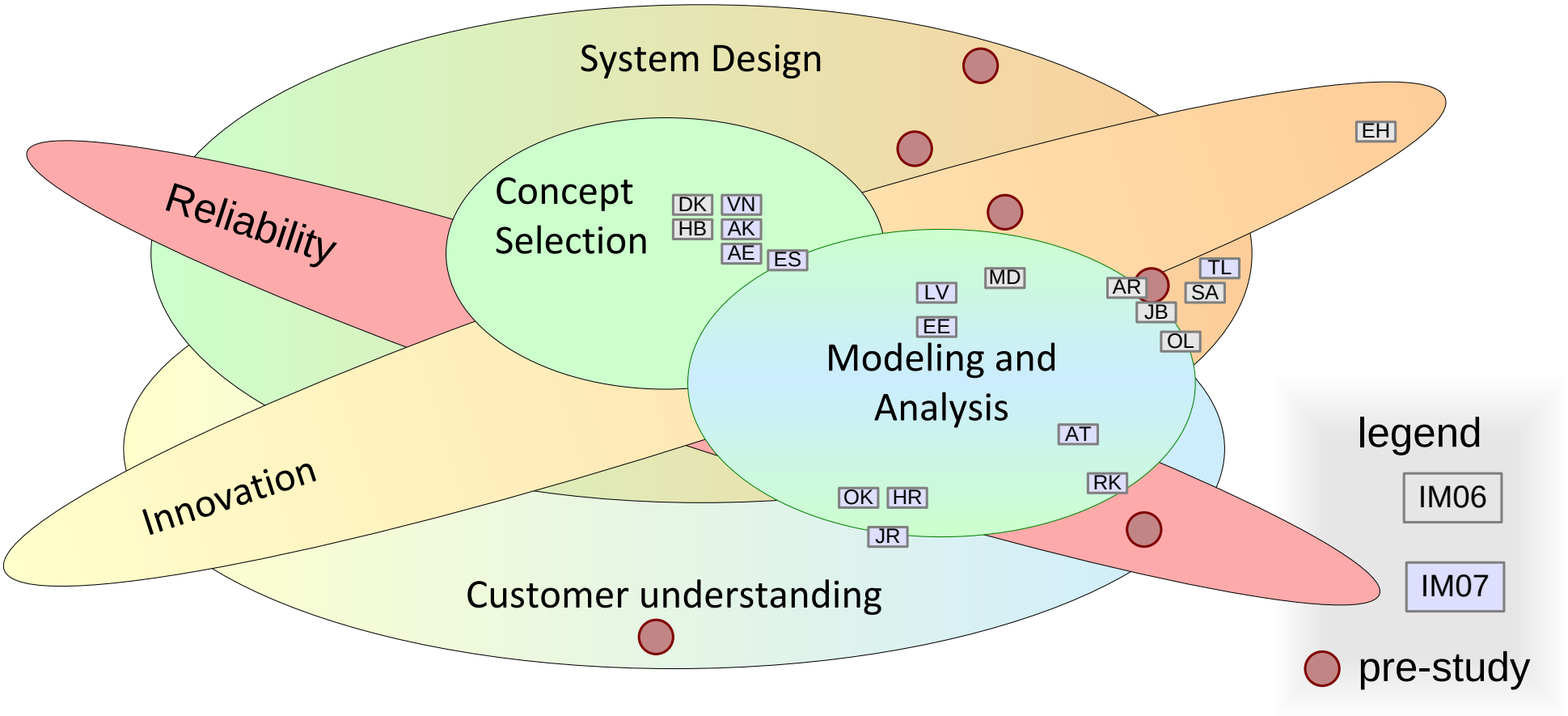
   SE research at BUC in Kongsberg

Summary

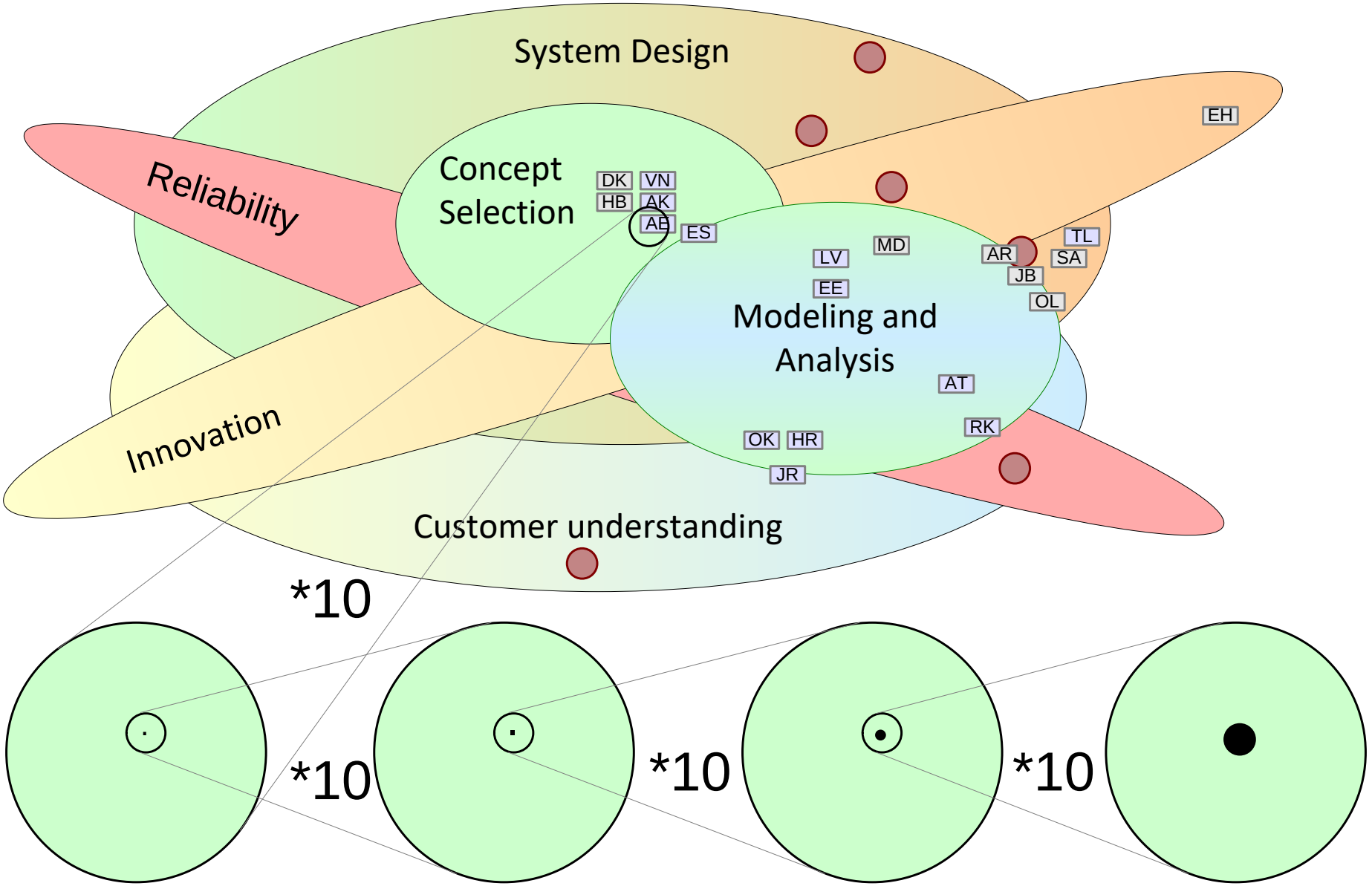
Alternate Research Agenda Visualization



Actual Projects 2008-2010



Small Dots in Huge Research Space



Summary

faster
more complex
more integration

modeling&analysis
robustness
innovation

small dots
in huge
research space

Introduction

1. SE research
   - global SE trends
   - research agenda
   - industry as laboratory

2. CAFCR
   - example of an SE method

multi-view
goals-means
iteration
recursion

3. Replisaurus

Cu printer:
understand
design in
fab context

4. Status
   - at BUC in Kongsberg

Summary