Peer Learning in Systems Engineering

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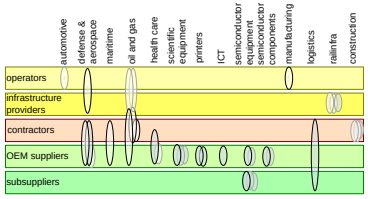
Abstract

Systems engineering is a transdisciplinary field that facilitates developing of complicated and complex systems throughout a wide variety of applications domains. Developing as a systems engineer requires on the job practice and life-long learning. How can we facilitate peer learning for peers from widely different domains?

November 20, 2023
status: concept
version: 0.1



Gerrit's 44 Year Career

manager system engineering

Gaudí

Systems Architecting research close to industrial companies

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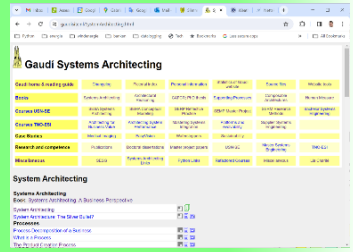


Philips HealthCare | ASML | Philips Research | ESI | Buskerud University College | HBV | HSN | University of South-Eastern Norway

1980 1990 2000 2010 TNO 2020

industrial experience
in Product Development

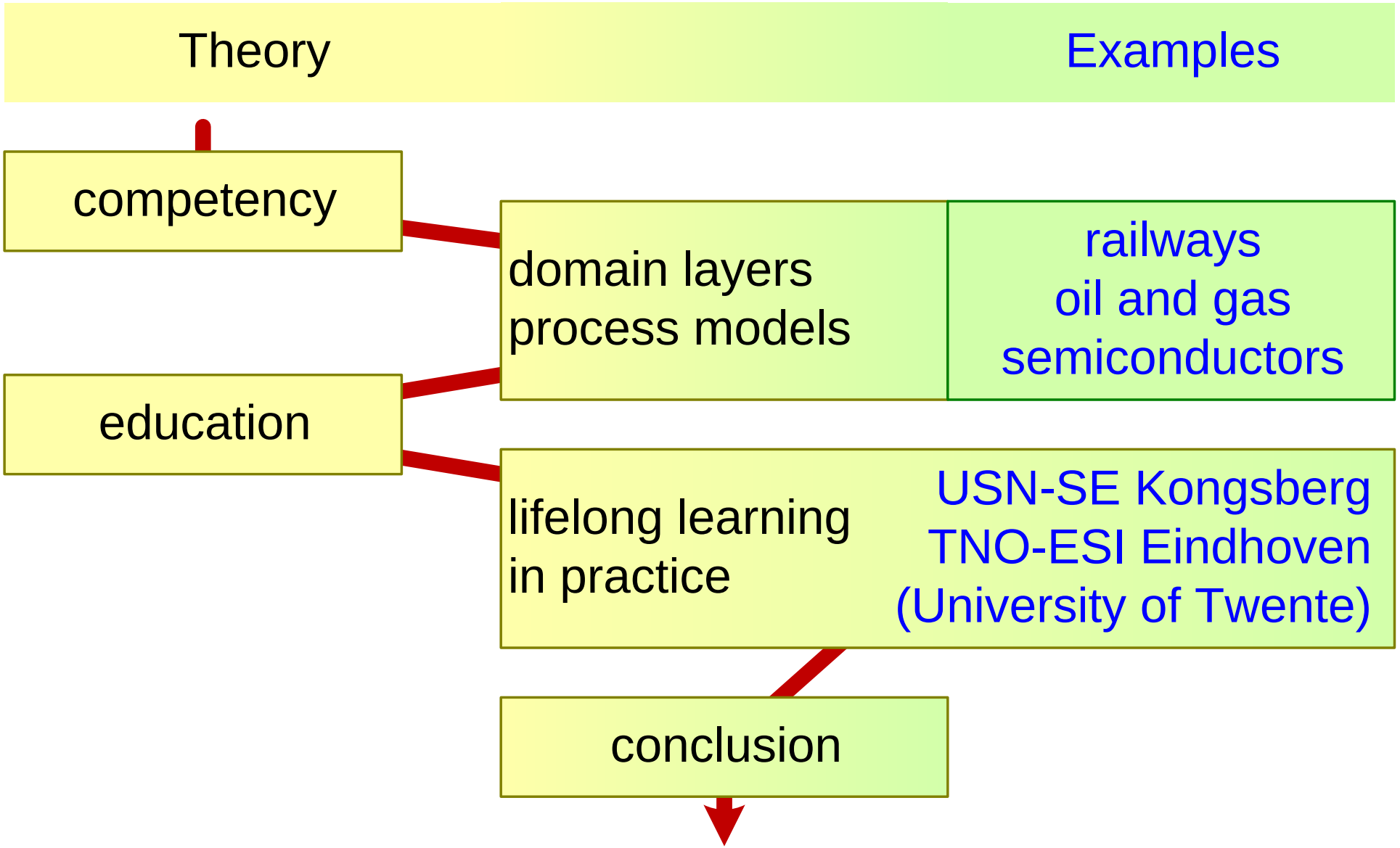
time pressure pragmatics sales
cost constraints products
lots of people

research academic

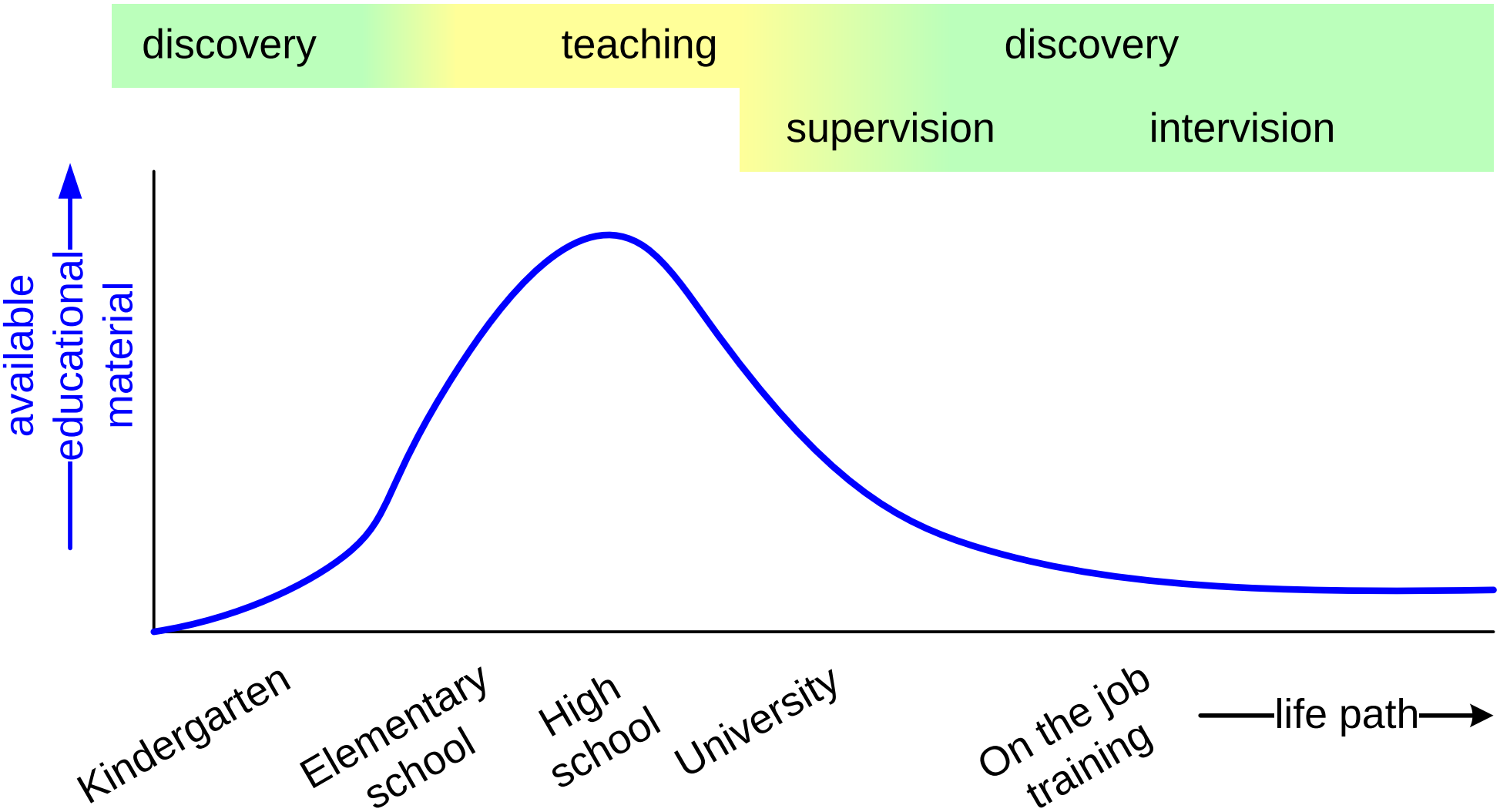
reflection
evidence
exposure
education

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

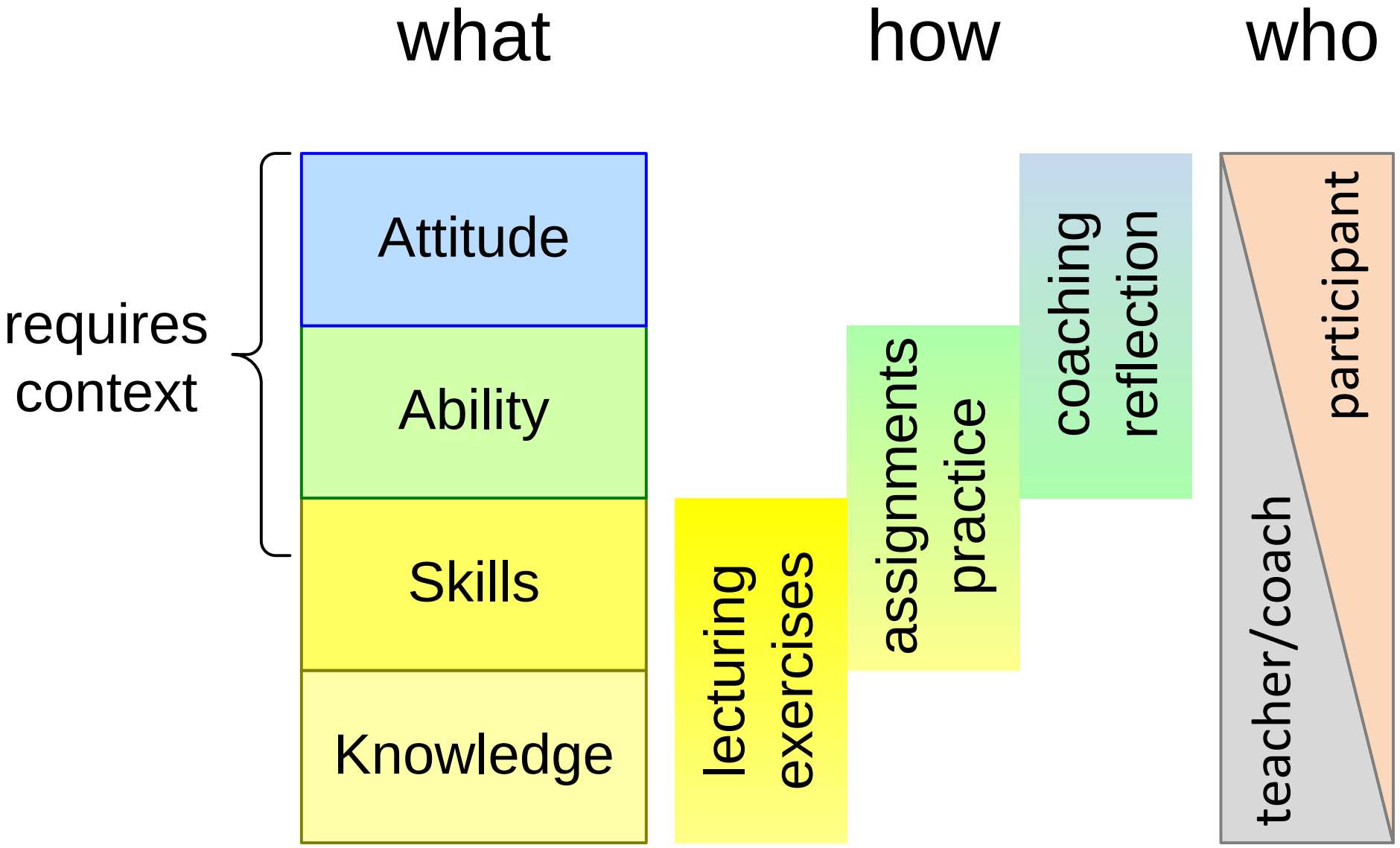
Figure to Help You with Viewpoint Hopping



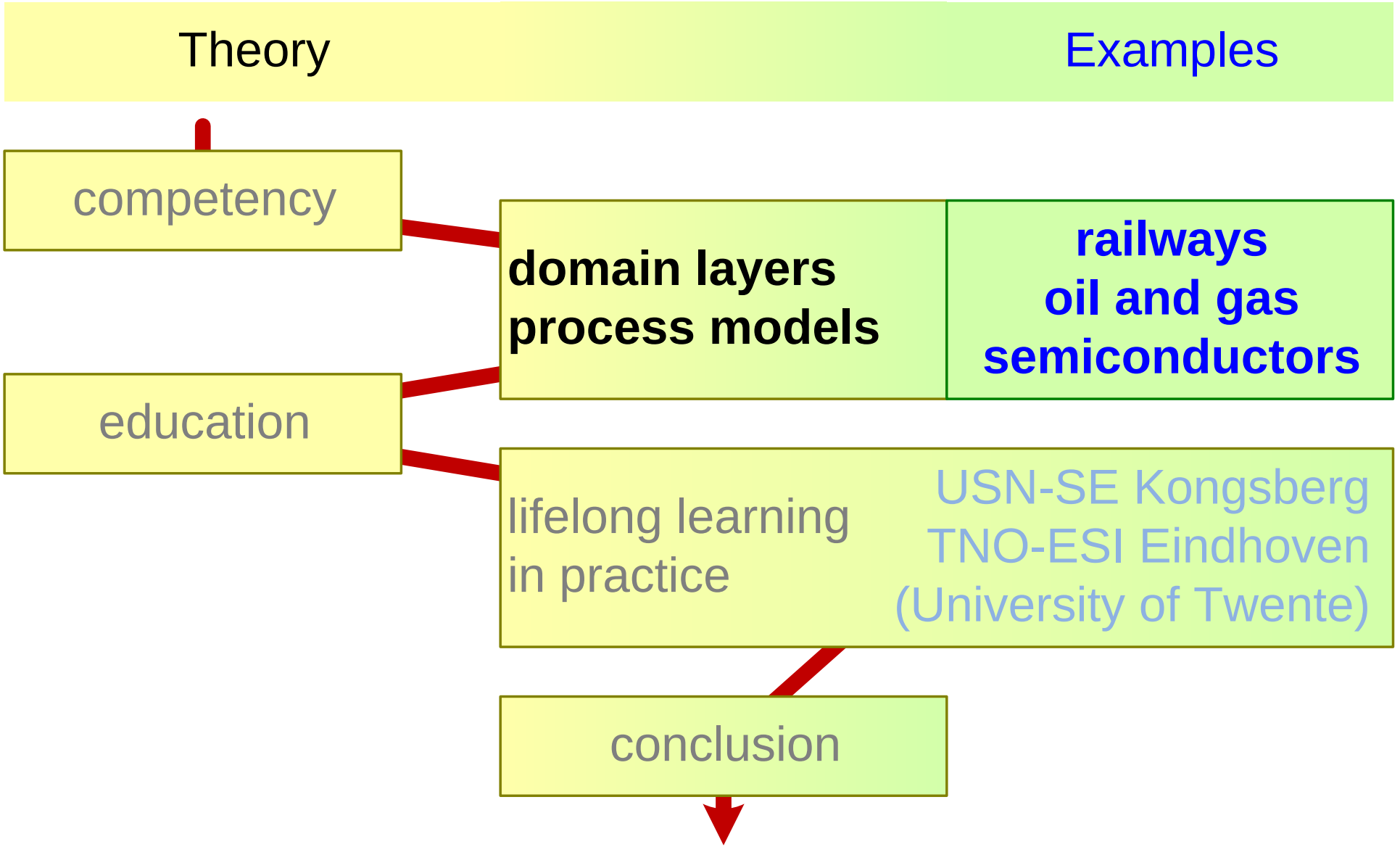
After Formal Education, Learning Depends More on Discovery



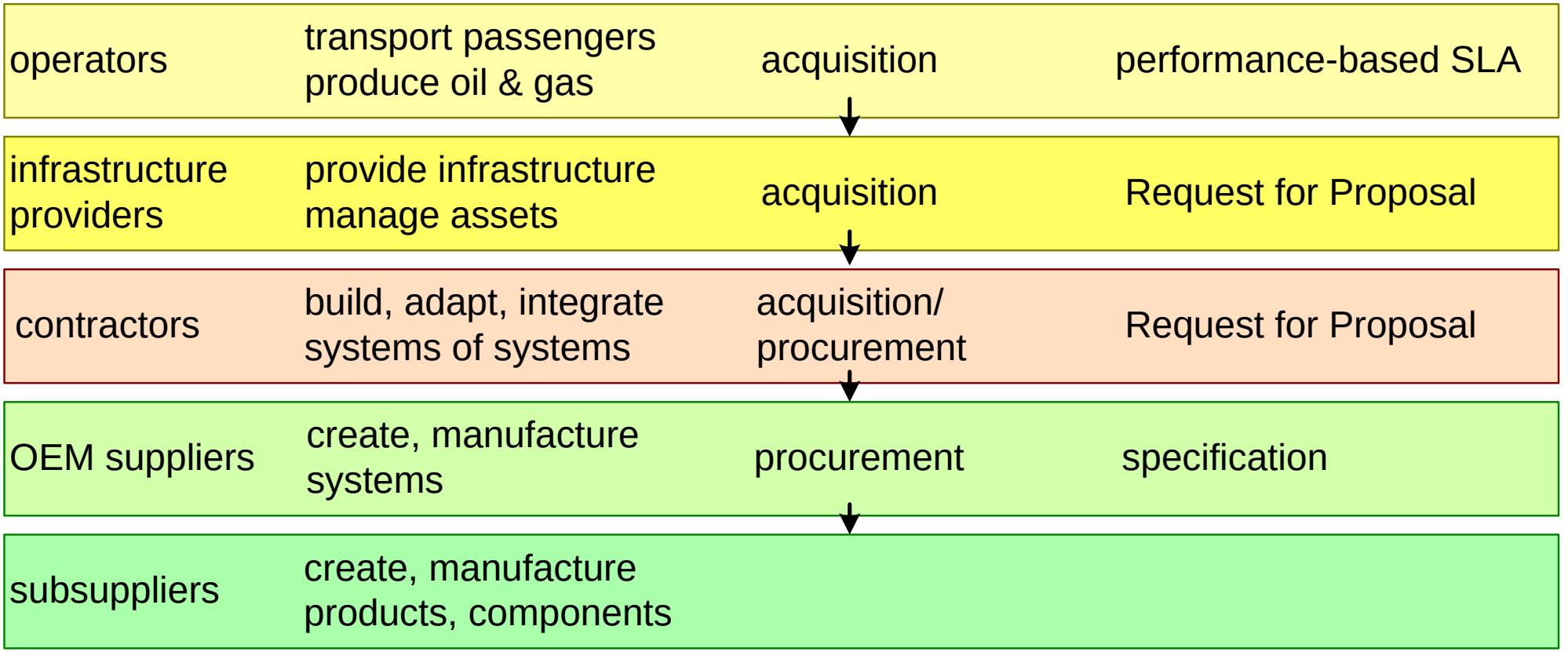
Life-Long Learning of SE Focuses on Attitude and Ability



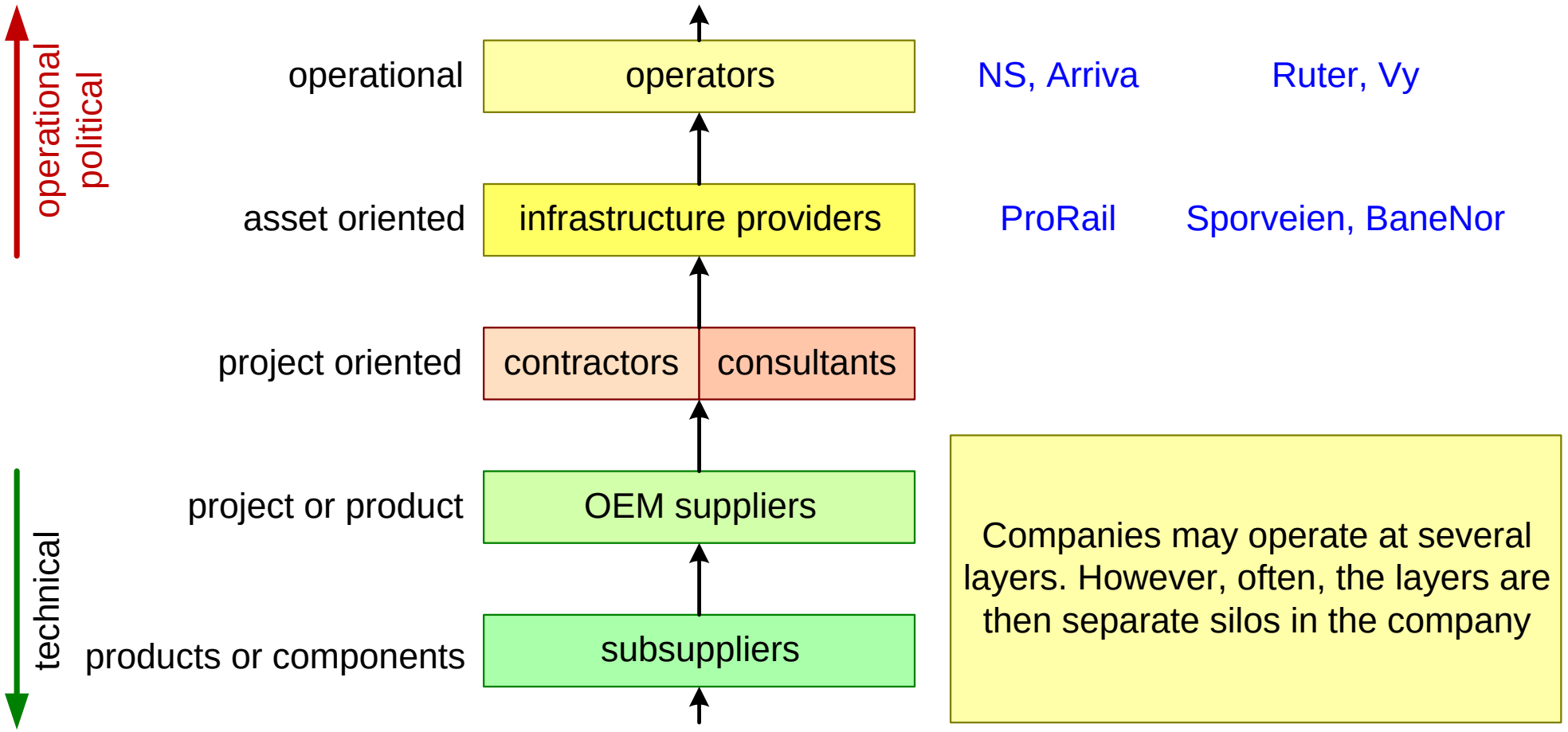
Layers of Domains and Their Processes



Characterization of Domain Layers



Positions in the Value Network Differ in Nature

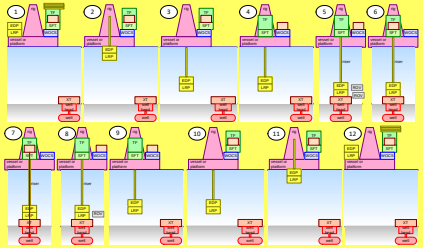


Example in Oil and Gas Offshore

oil and gas production

operational

Equinor, Shell

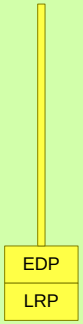


workover operation

asset oriented

Equinor, Shell

TechnipFMC



workover stack

project or product

TechnipFMC

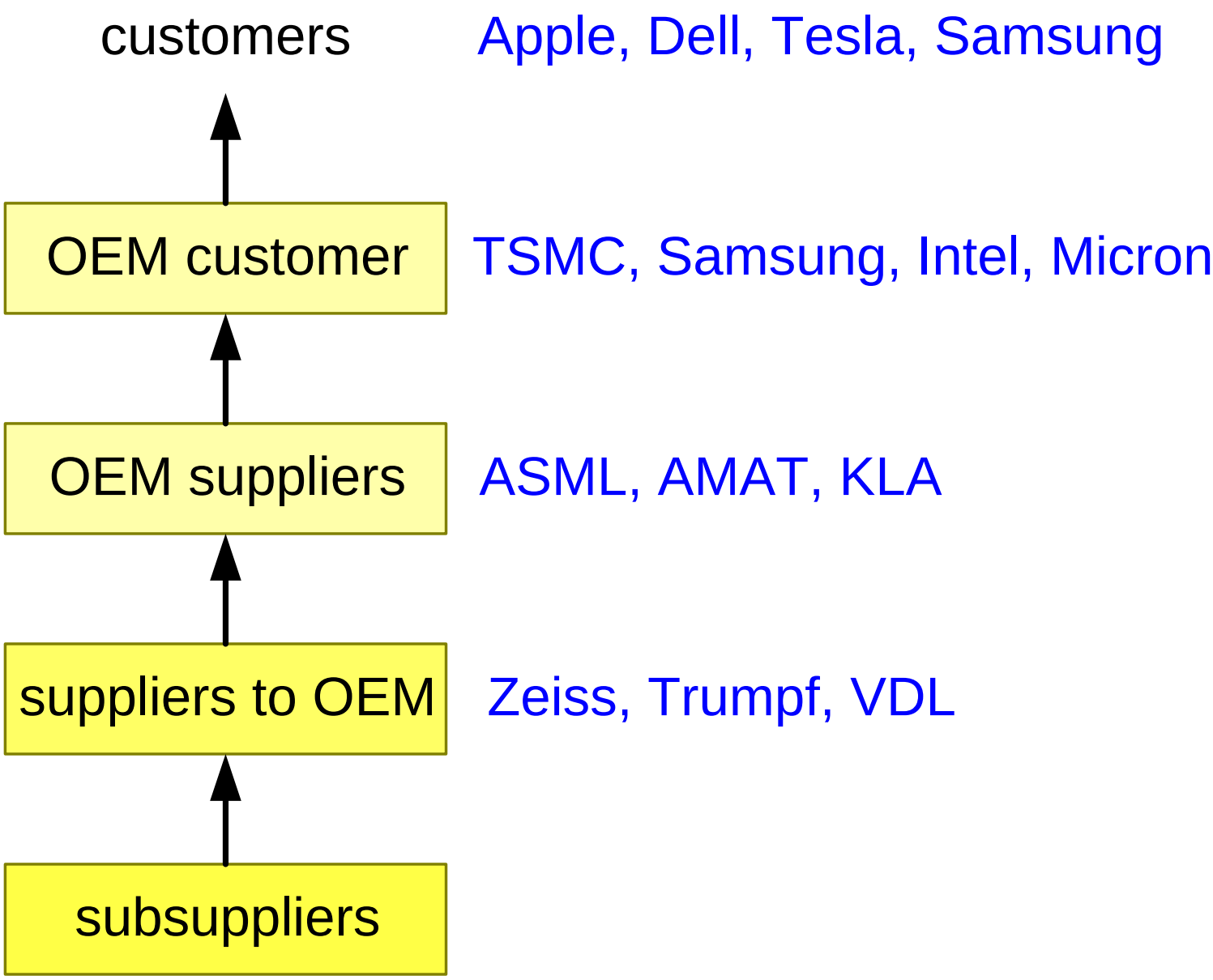
EDP

emergency disconnect package

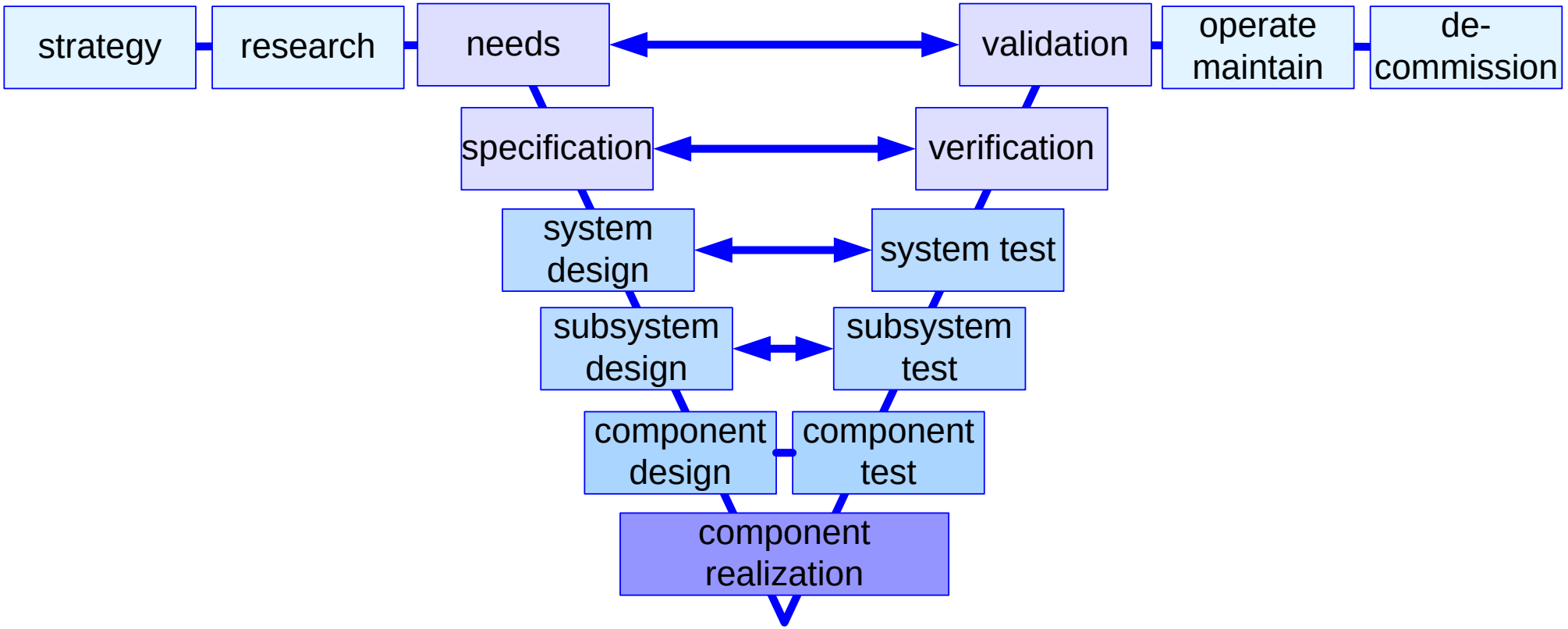
product

TechnipFMC

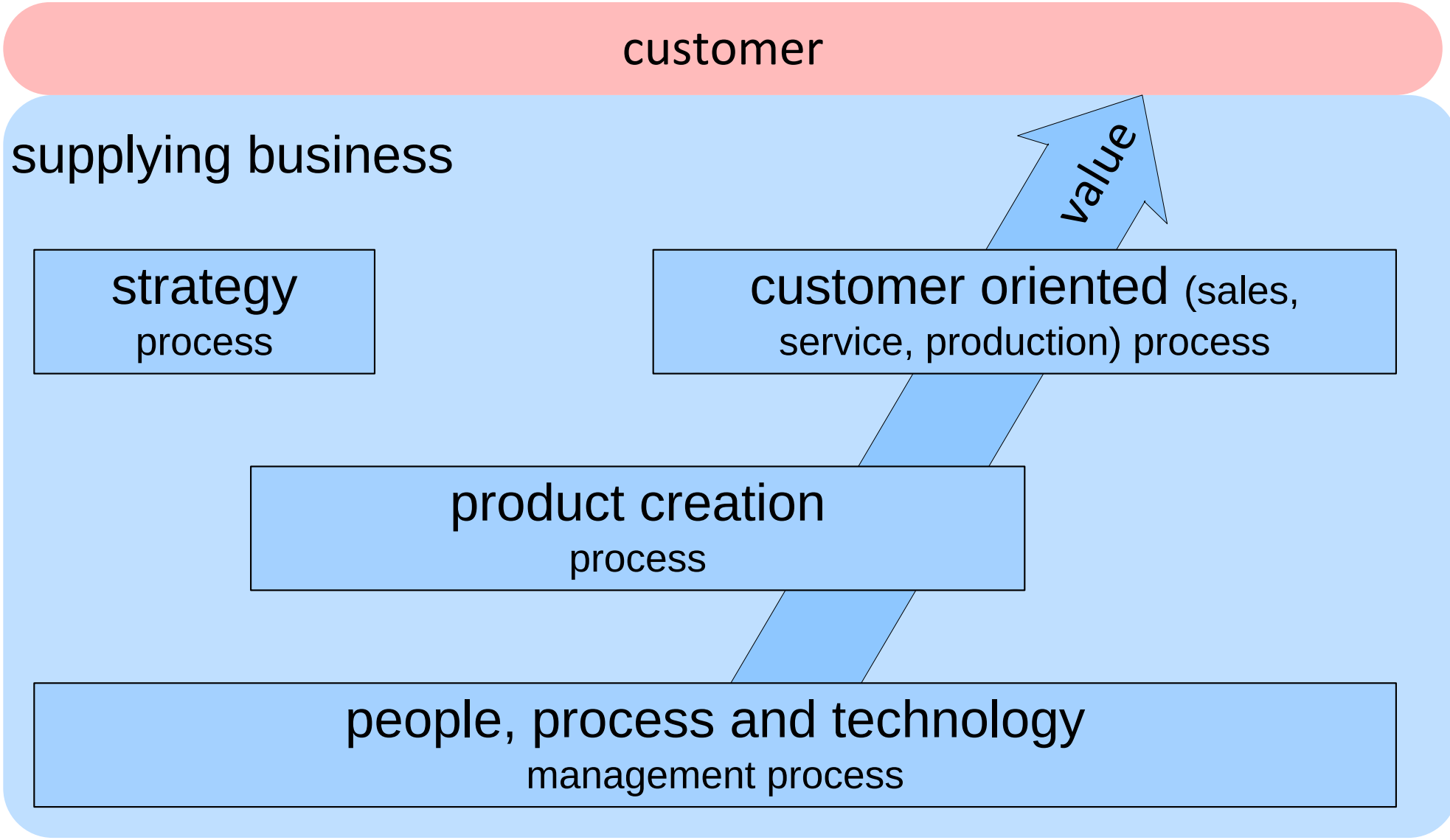
Example in Semiconductor Industry



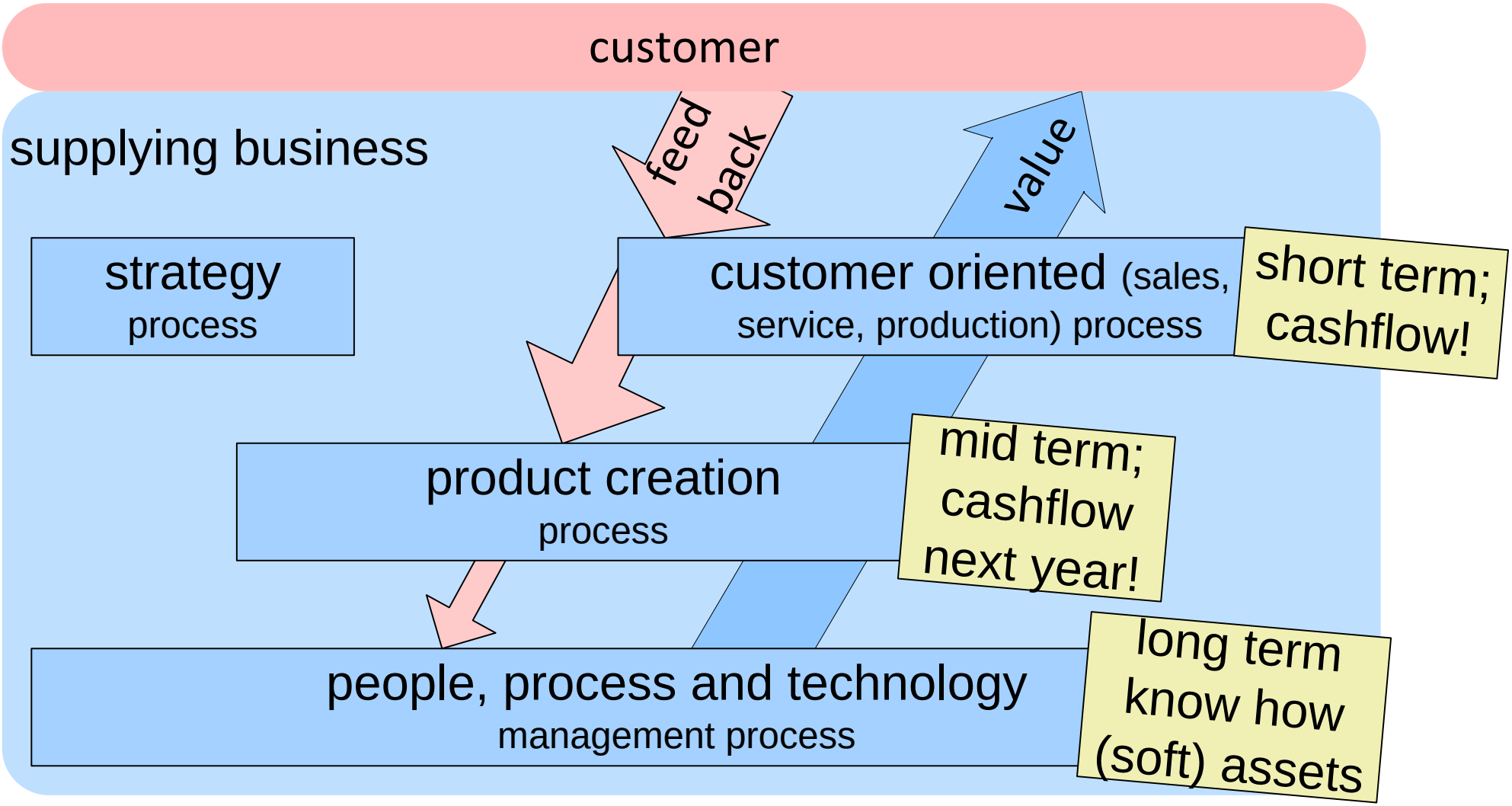
Most Organizations are Familiar with the V-Model



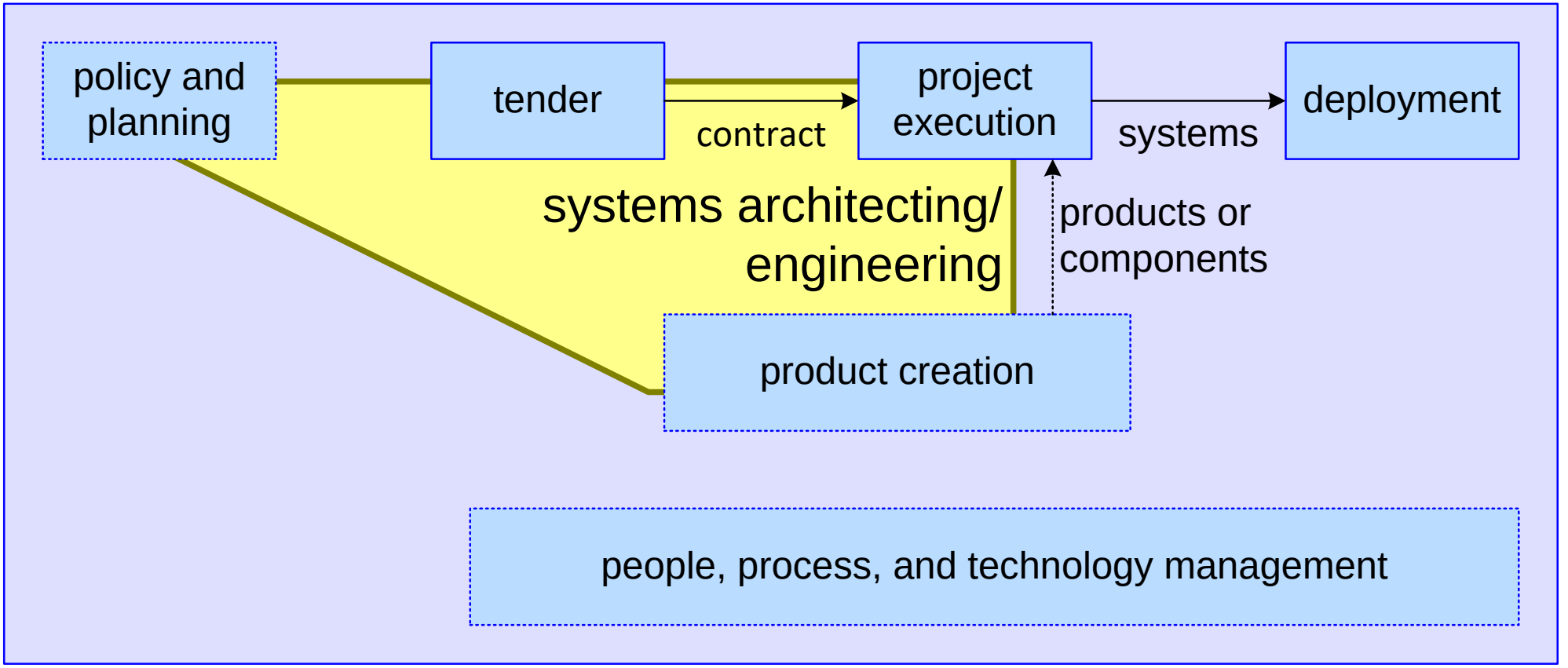
Simplified Process View Products to Gain Insight



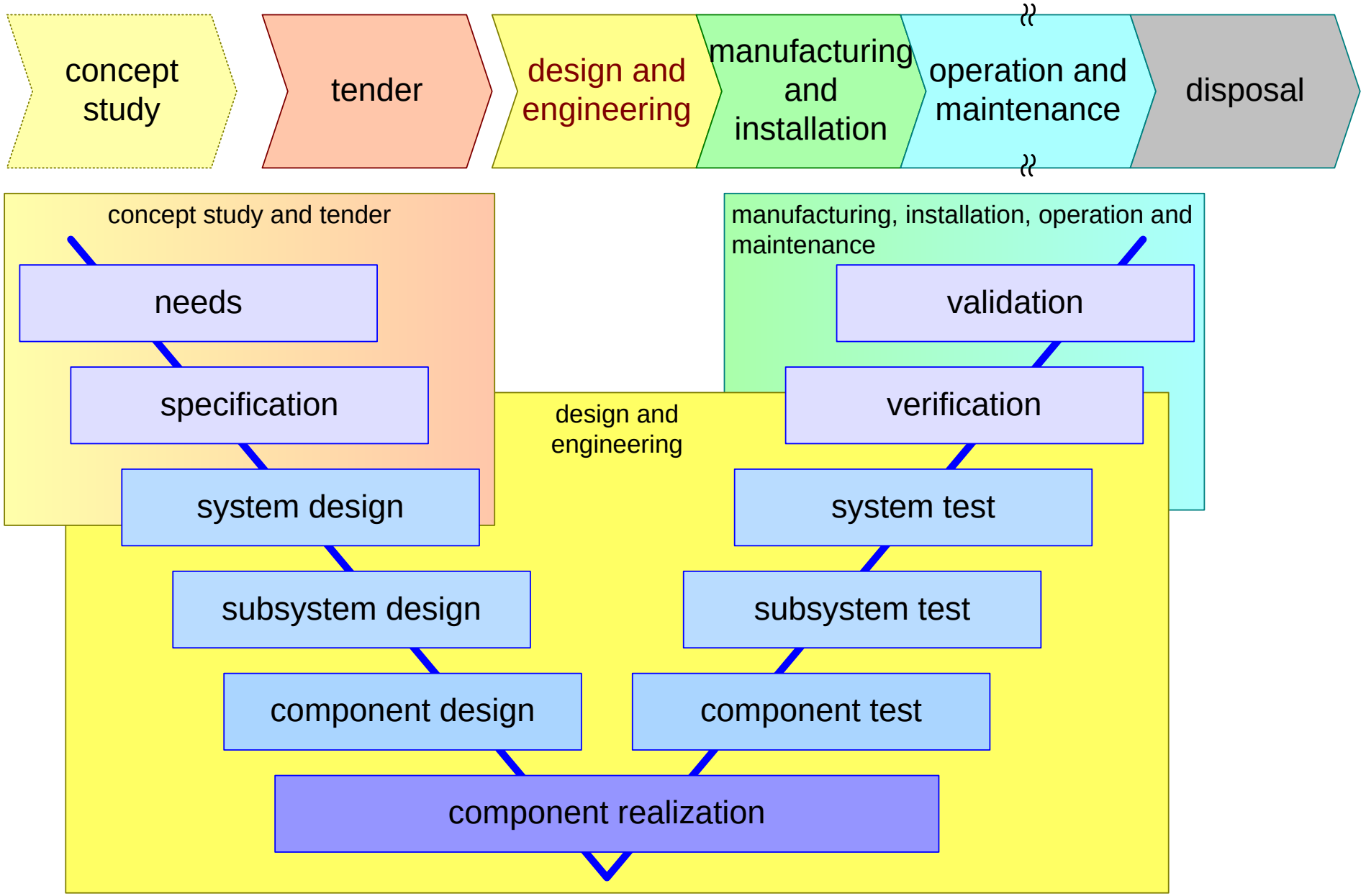
Healthy Tension between Processes and Time Scales



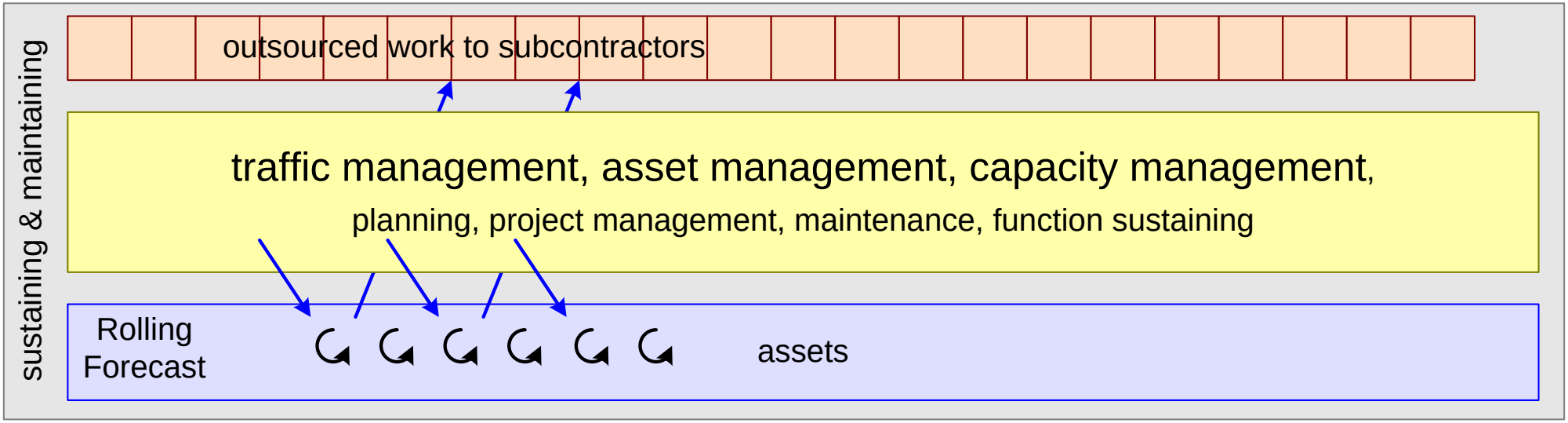
Projects Split Tendering and Project Execution



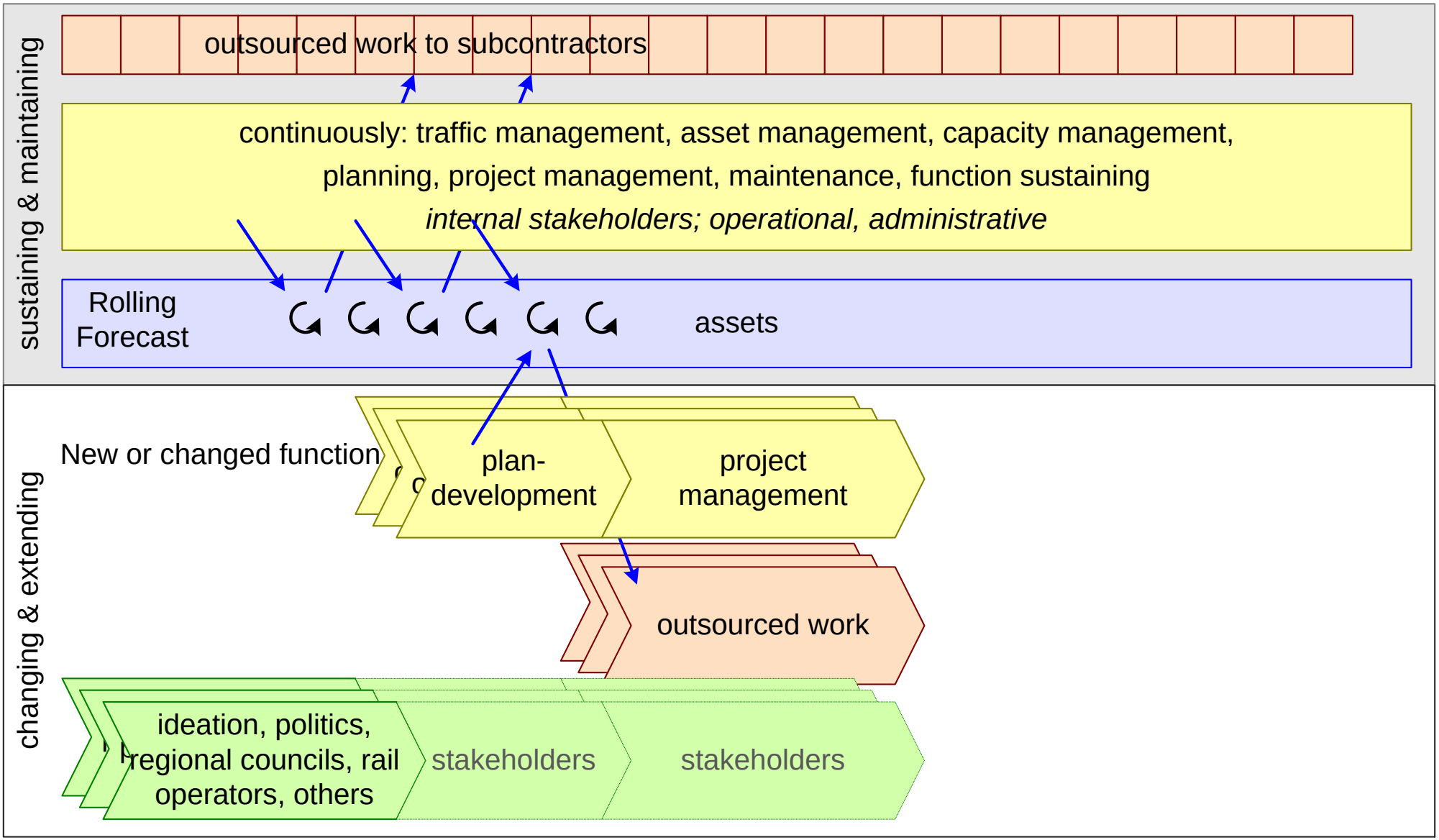
Tendering Limits Crucial Feedback



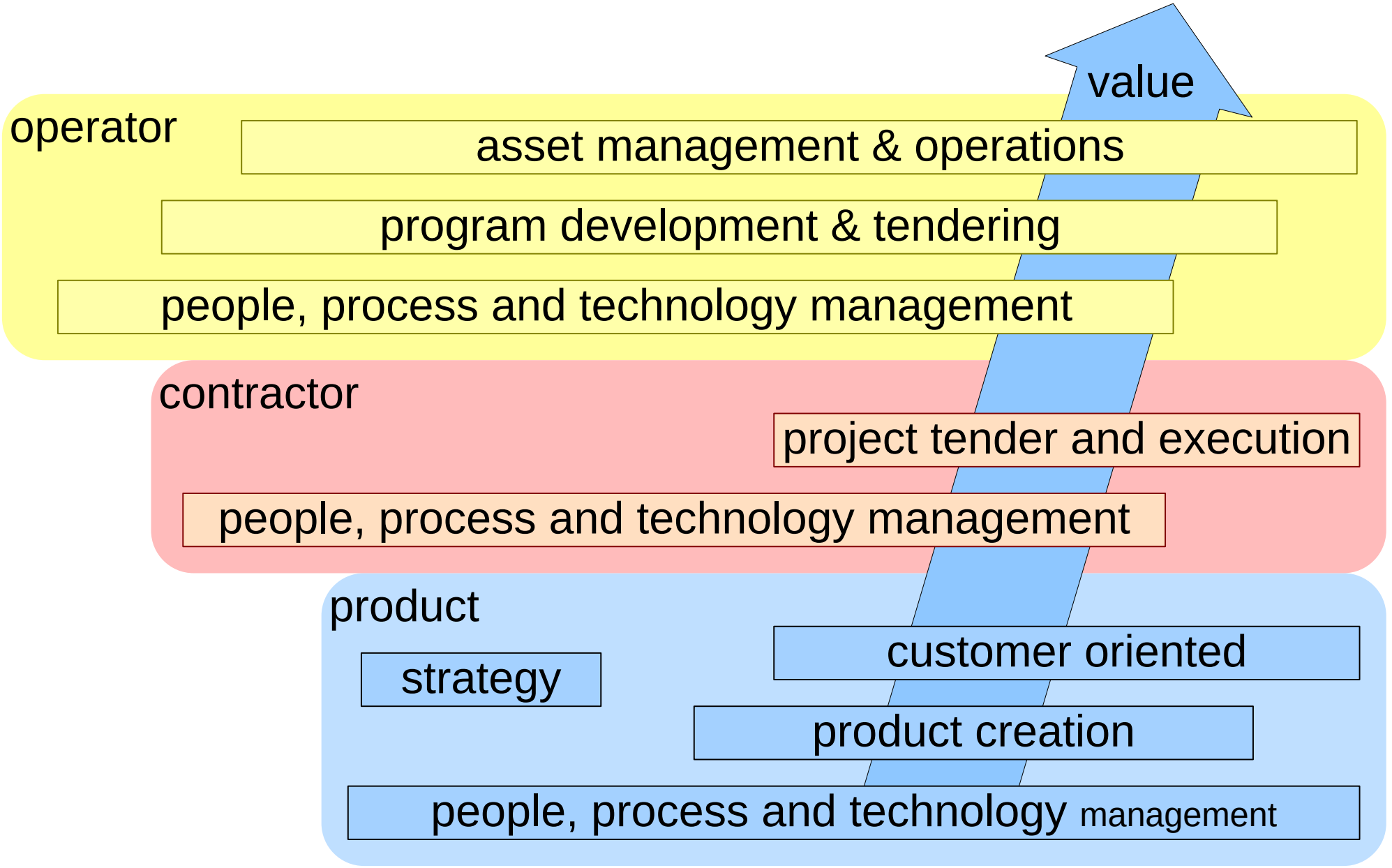
Railways Provider: Focus on Assets and Traffic



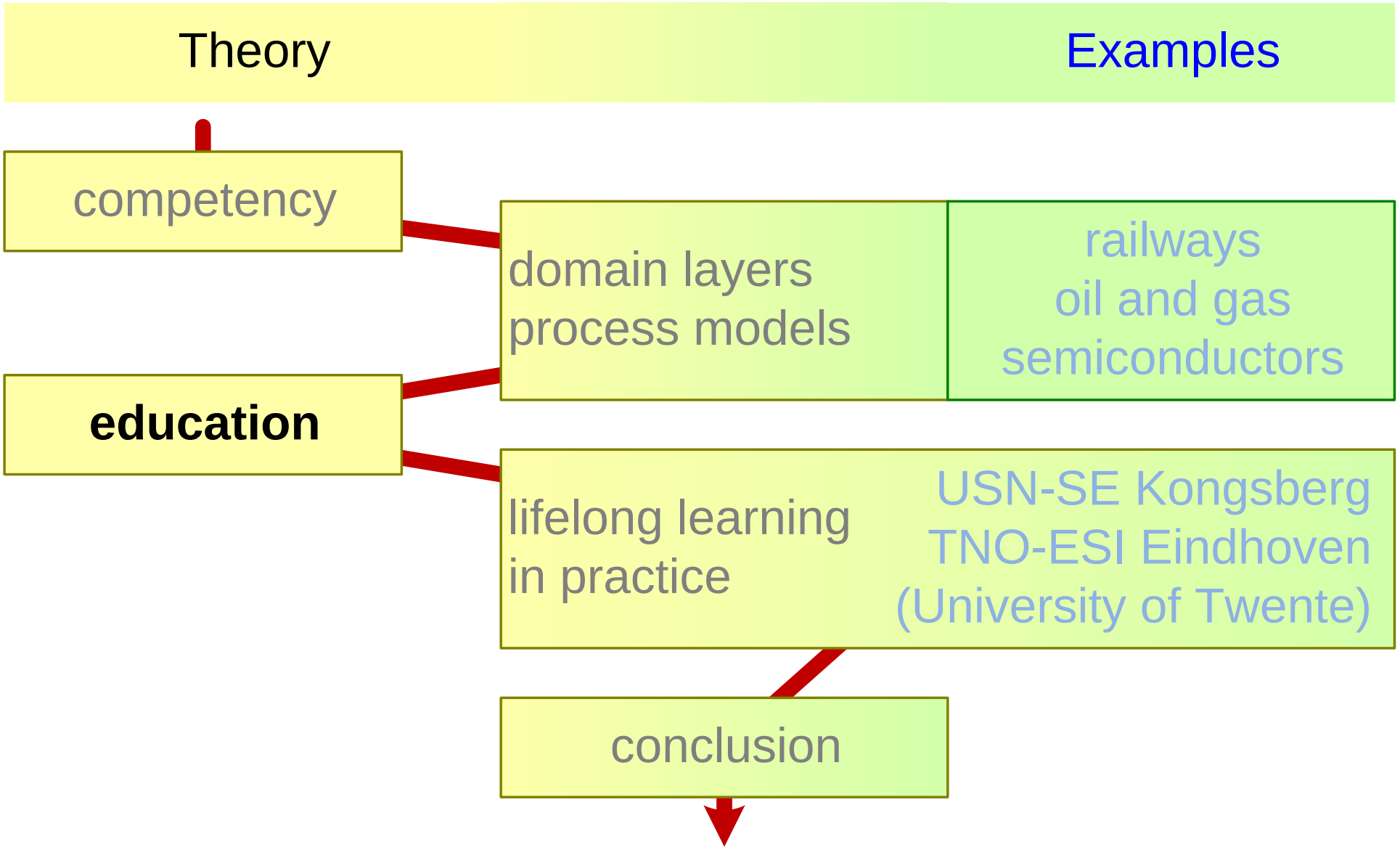
Railways Provider: Program Development



The Value Chain across the Layers



Education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domain layers
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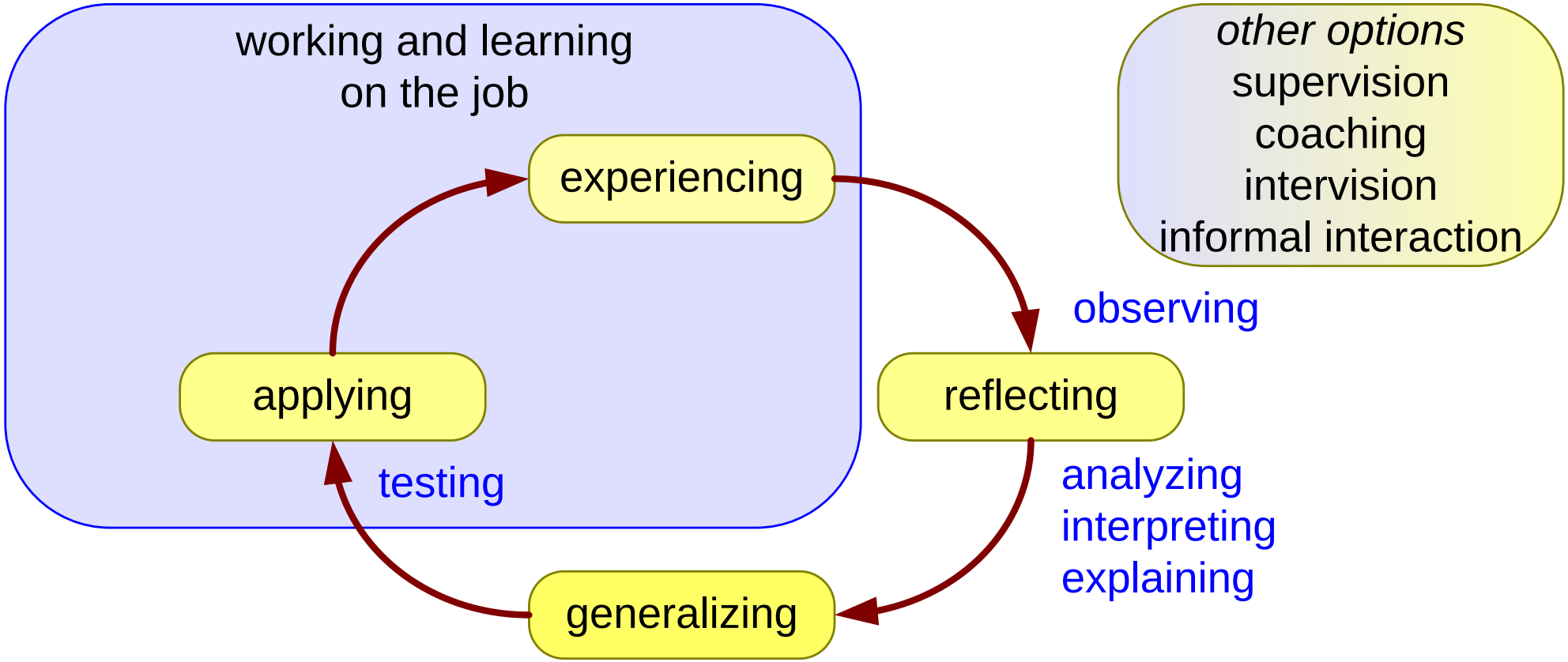
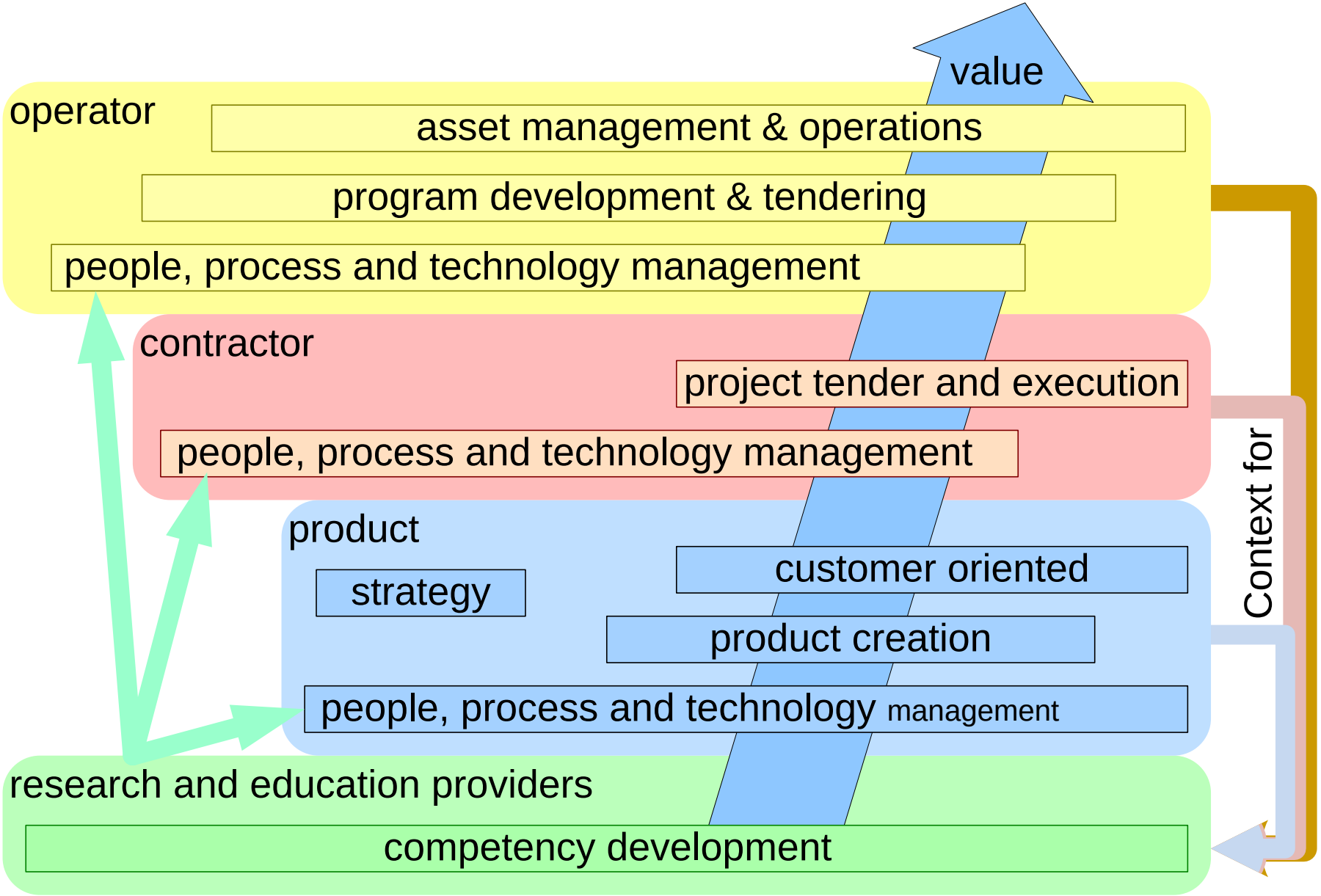
education
lifelong learning
in practice
USN-SE Kongsberg
TNO-ESI Eindhoven
(University of Twente)
conclusion

On the Job Learning is Most Effective, If ...



source: Kolb's learning cycle
http://www.infed.org/biblio/b-explrn.htm

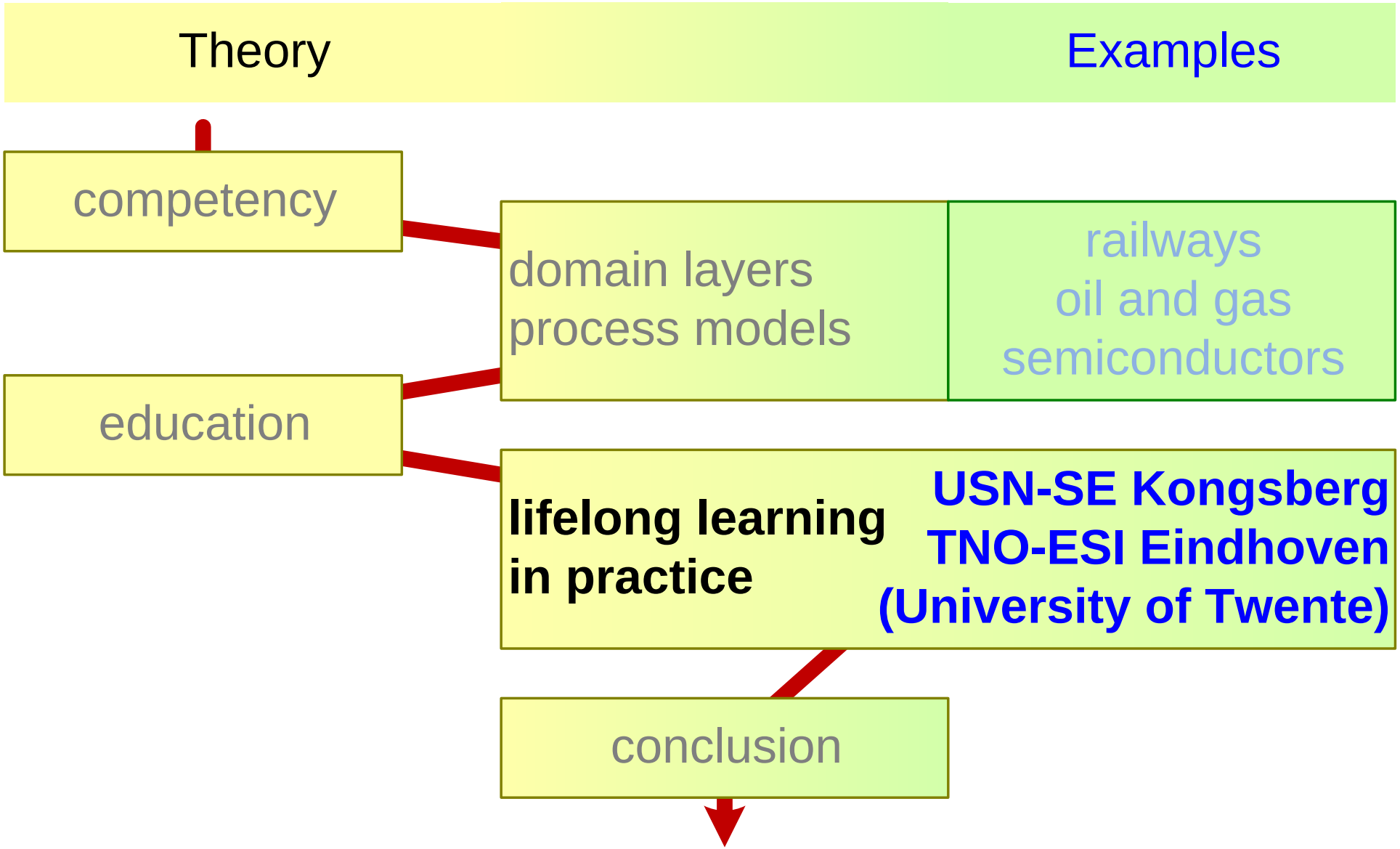
Research and Education as Long-Long-Term Process



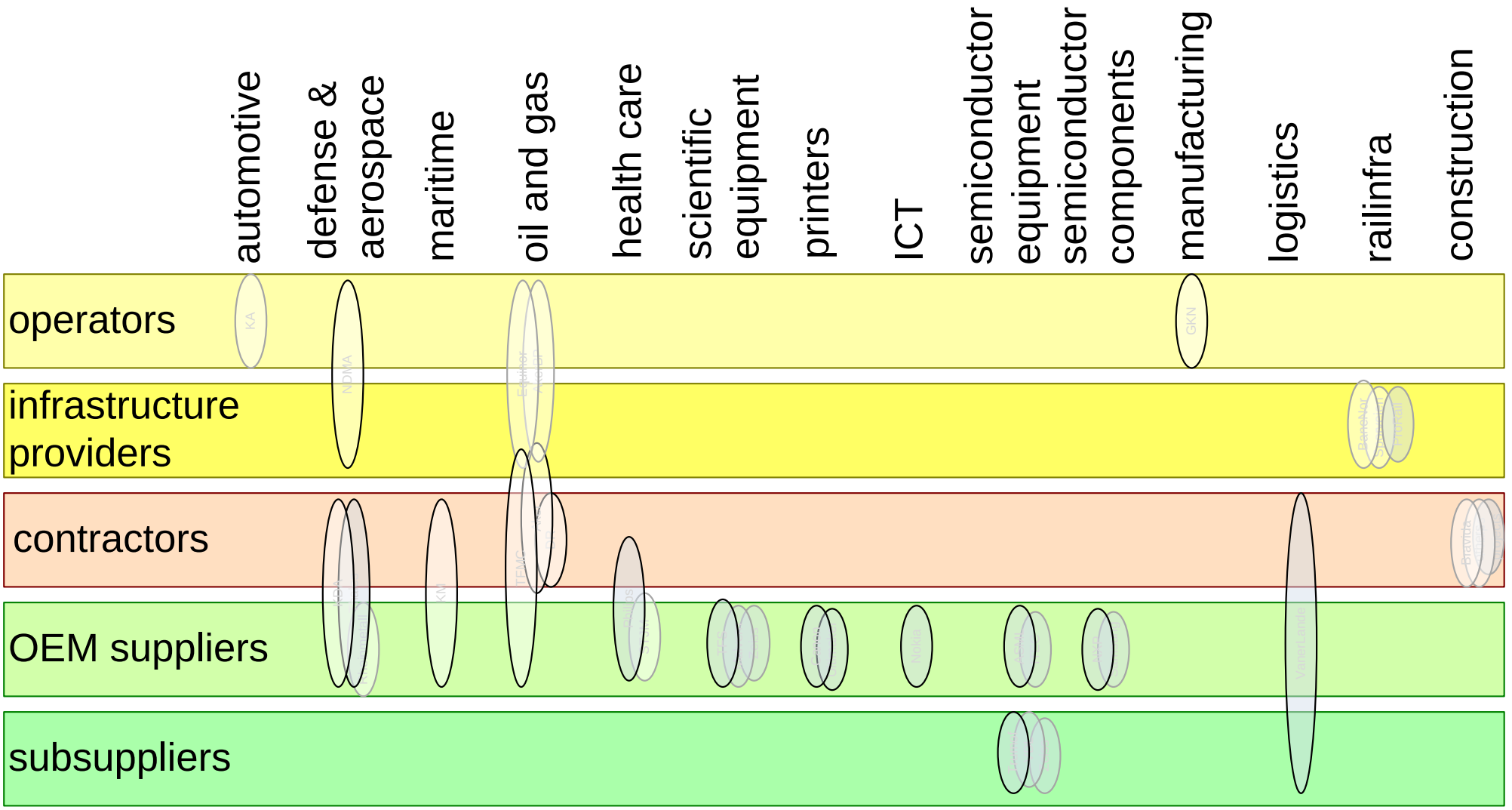
Types of Education Vary in Study Load and Impact

education type	study load	duration	learning outcome	when applicable
intervision	1..2 hrs	1..2 hrs	learning	all career
supervision	1..2 hrs	1..2 hrs	learning	early career
event	1..8 hrs	1..8 hrs	refresh	all career
course	2..5 days	2..7 days	expand knowledge or skills	early & mid career
program	20..40 days	6..12 months	boost competence	mid career
bachelor study	3..4 years	3..5 years	lay foundation	before career
master study	1.5..2 years	2..6 years	expand foundation	before or during career
PDeng	2 years	2 years	change mindset	before or during career
industrial PhD	3..4 years	4..6 years	change mindset	before or during career

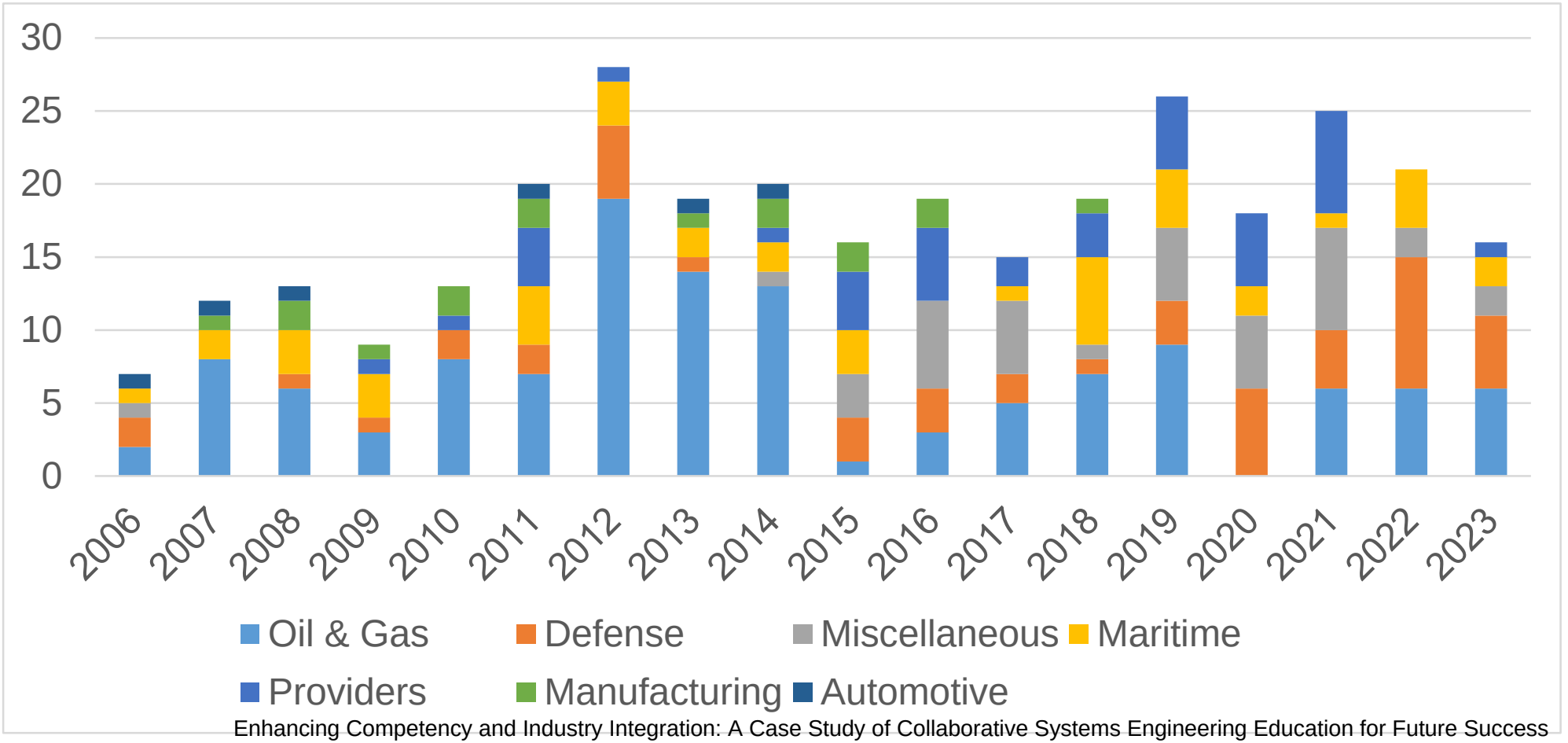
Lifelong Learning in Practice



USN-SE and TNO-ESI Experience past 24 Years

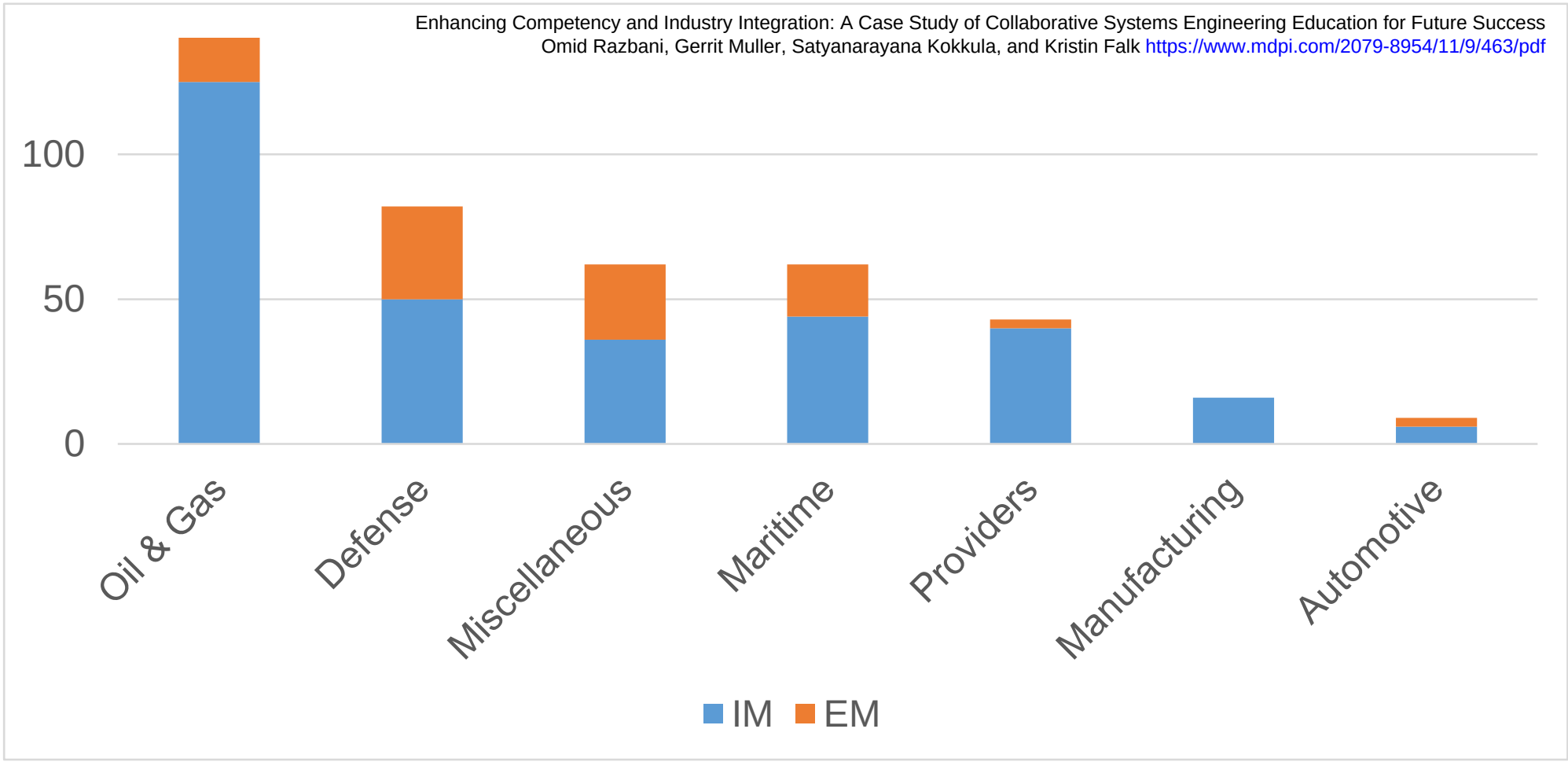


Number of Starting Industry Master Students per Domain

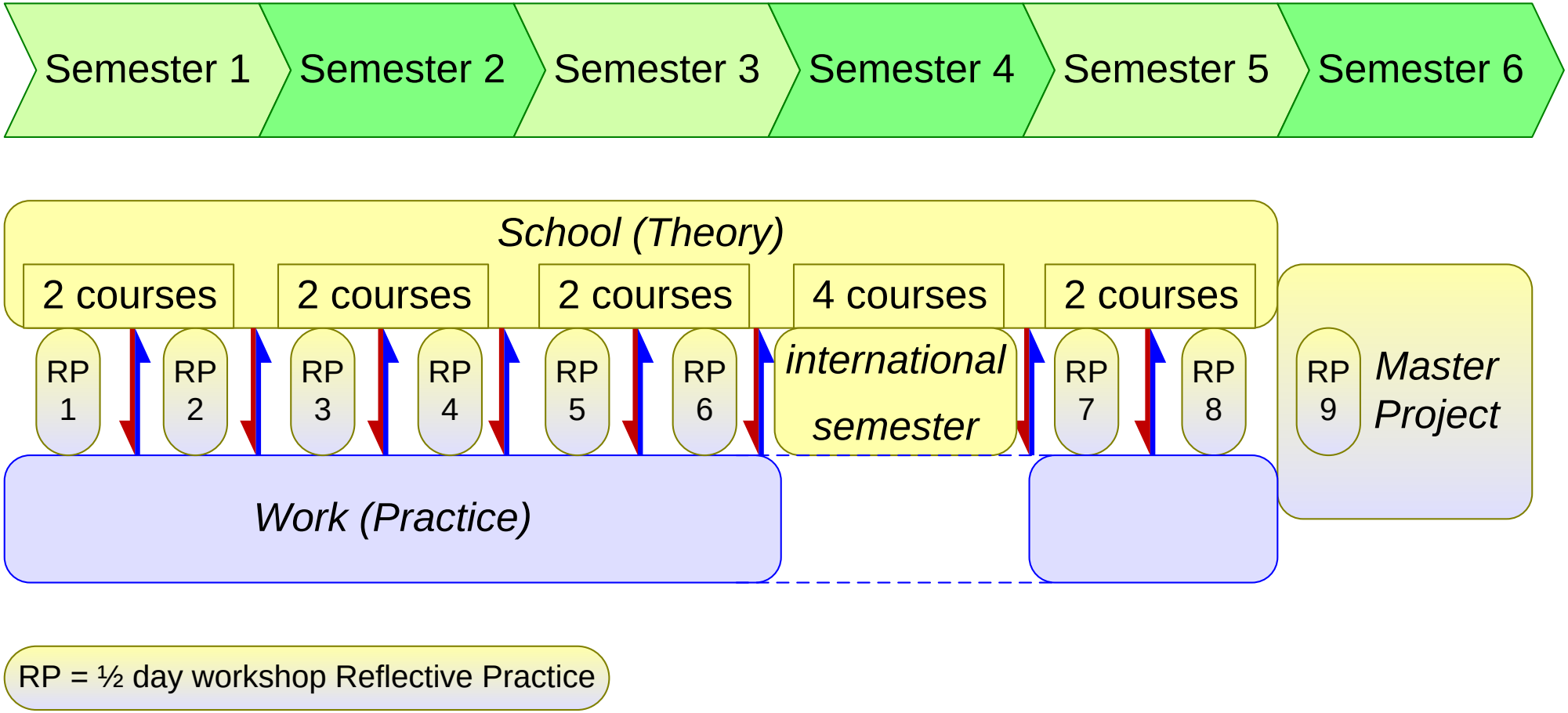


Enhancing Competency and Industry Integration: A Case Study of Collaborative Systems Engineering Education for Future Success
Omid Razbani, Gerrit Muller, Satyanarayana Kokkula, and Kristin Falk https://www.mdpi.com/2079-8954/11/9/463/pdf

Distribution of Students over Domains



The USN-SE Industry Master Format Fits Industry Needs

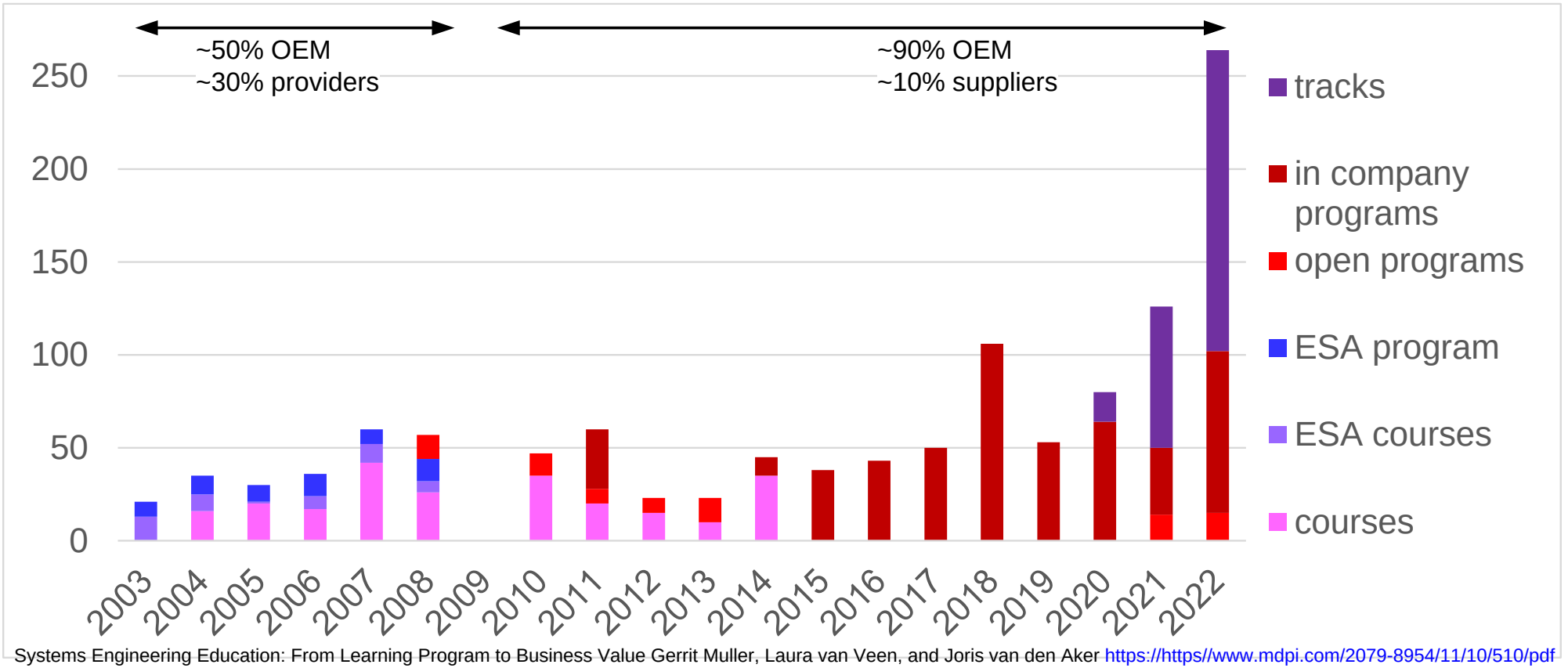


The Format Limits the Time that Employees are Absent

Prepare	*Intense course*	*10 week homework assignment*
e.g. reading or online 0 to 20 hrs.	lecturing, discussion, and in-class group work 40 hrs.	case-based, individual or group work, with supervision 140 to 160 hrs.

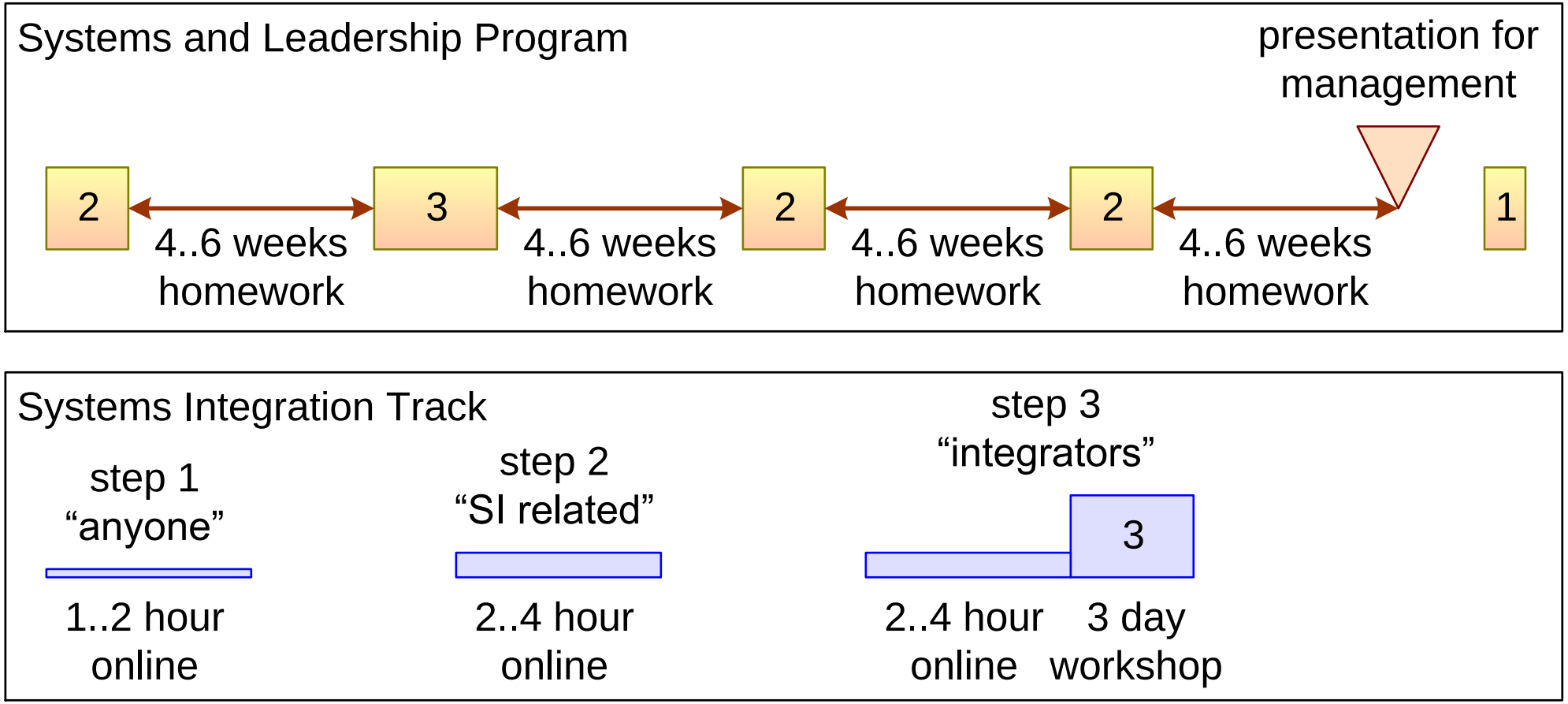
- Students travel 4 times per year
- Study and work planning is flexible
- Active learning, case-based
- Actual industry cases are possible (depends on course)

ESI Participants per Year

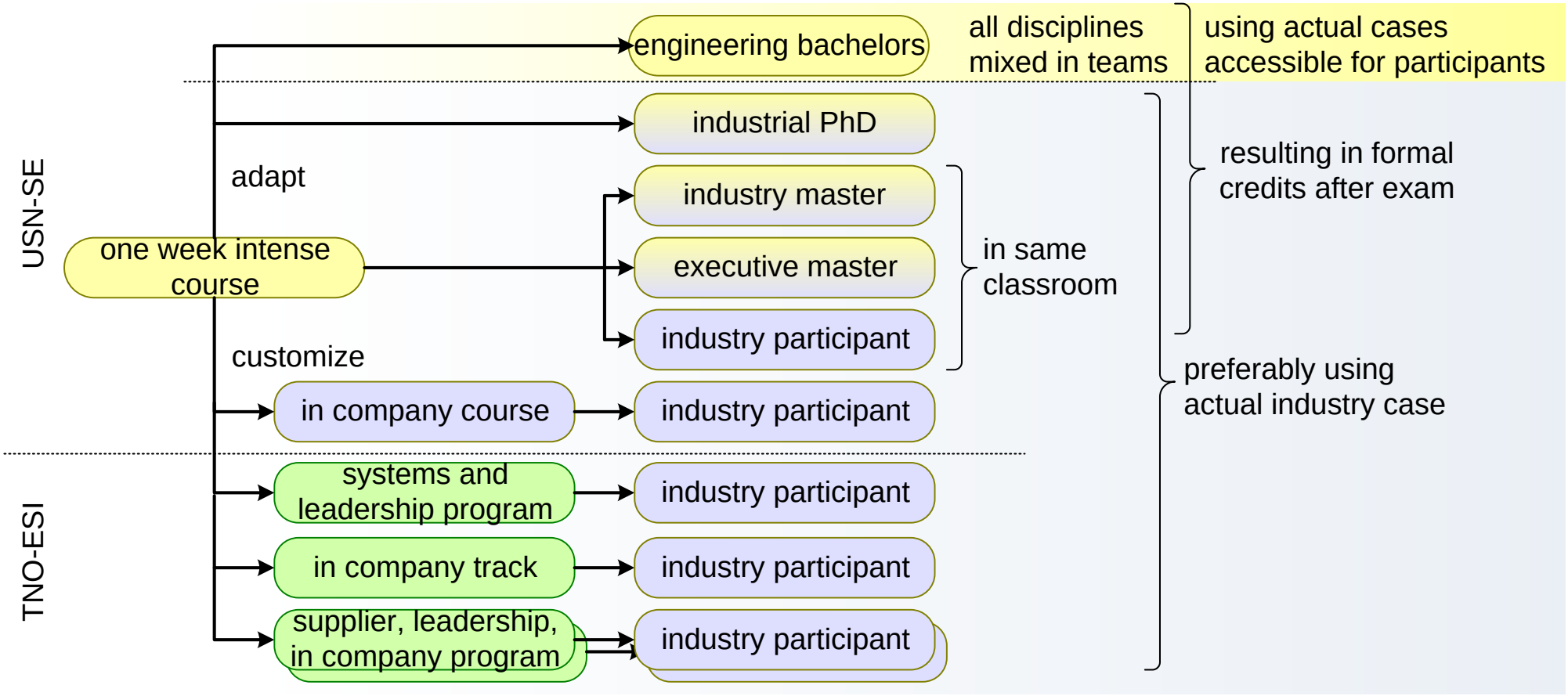


Systems Engineering Education: From Learning Program to Business Value Gerrit Muller, Laura van Veen, and Joris van den Aker https://https//www.mdpi.com/2079-8954/11/10/510/pdf

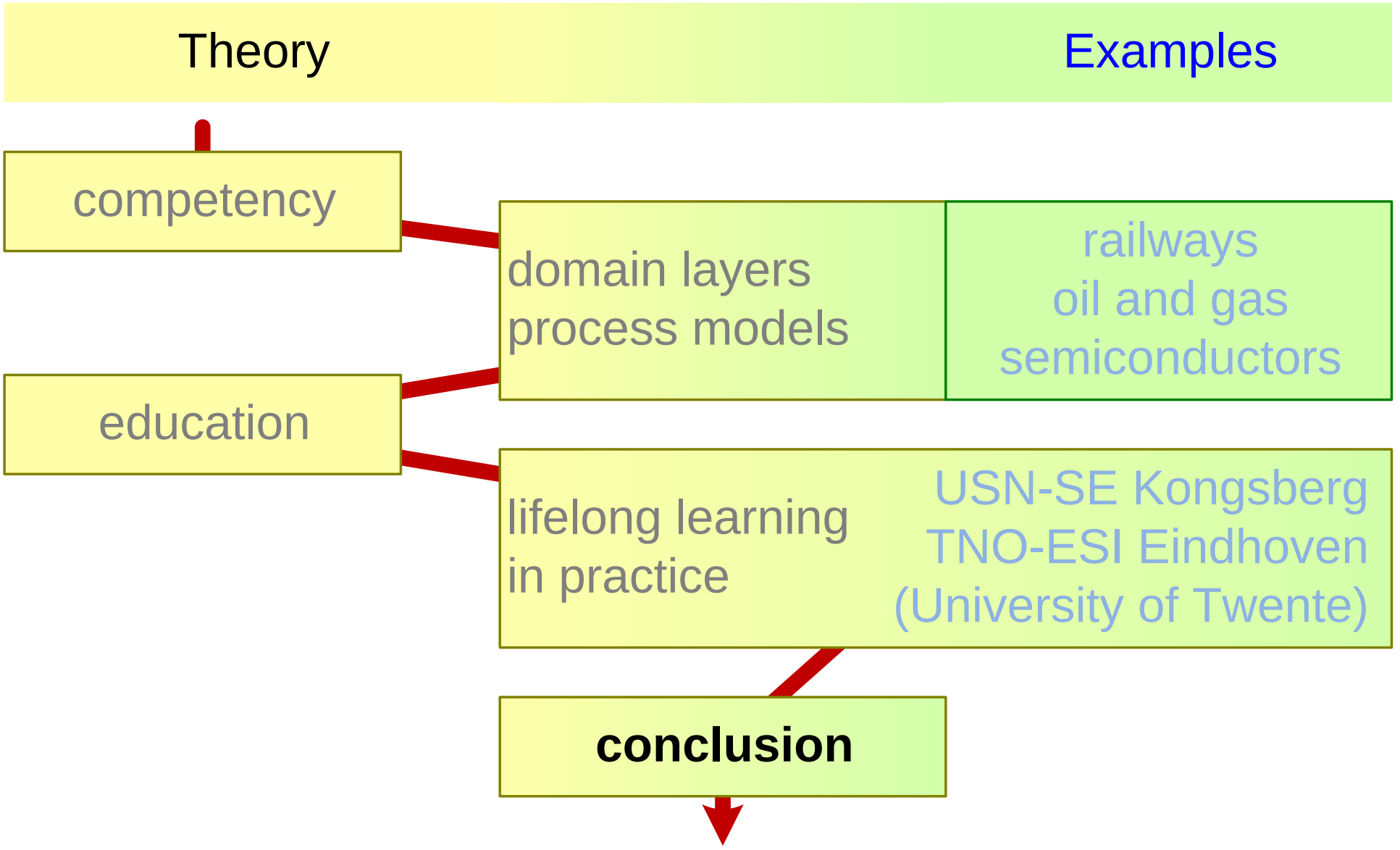
ESI Uses Programs and Tracks



There is Significant Synergy between the Education Types



Conclusion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Conclusion for Life-Long Learning

domains and layers

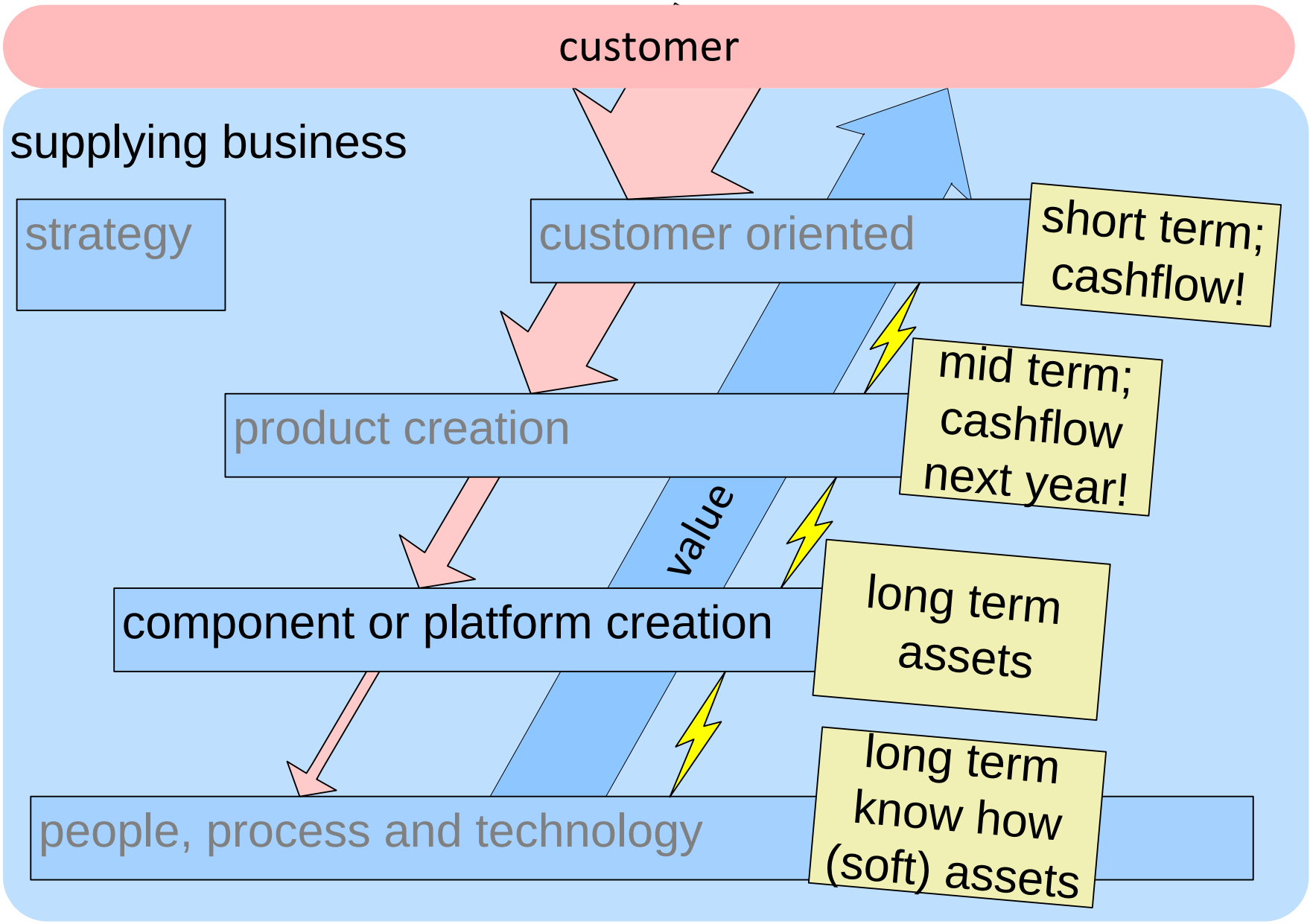
- share the same knowledge and skills
- differ in ability and attitude
- can learn from other domains and layers

education and research providers

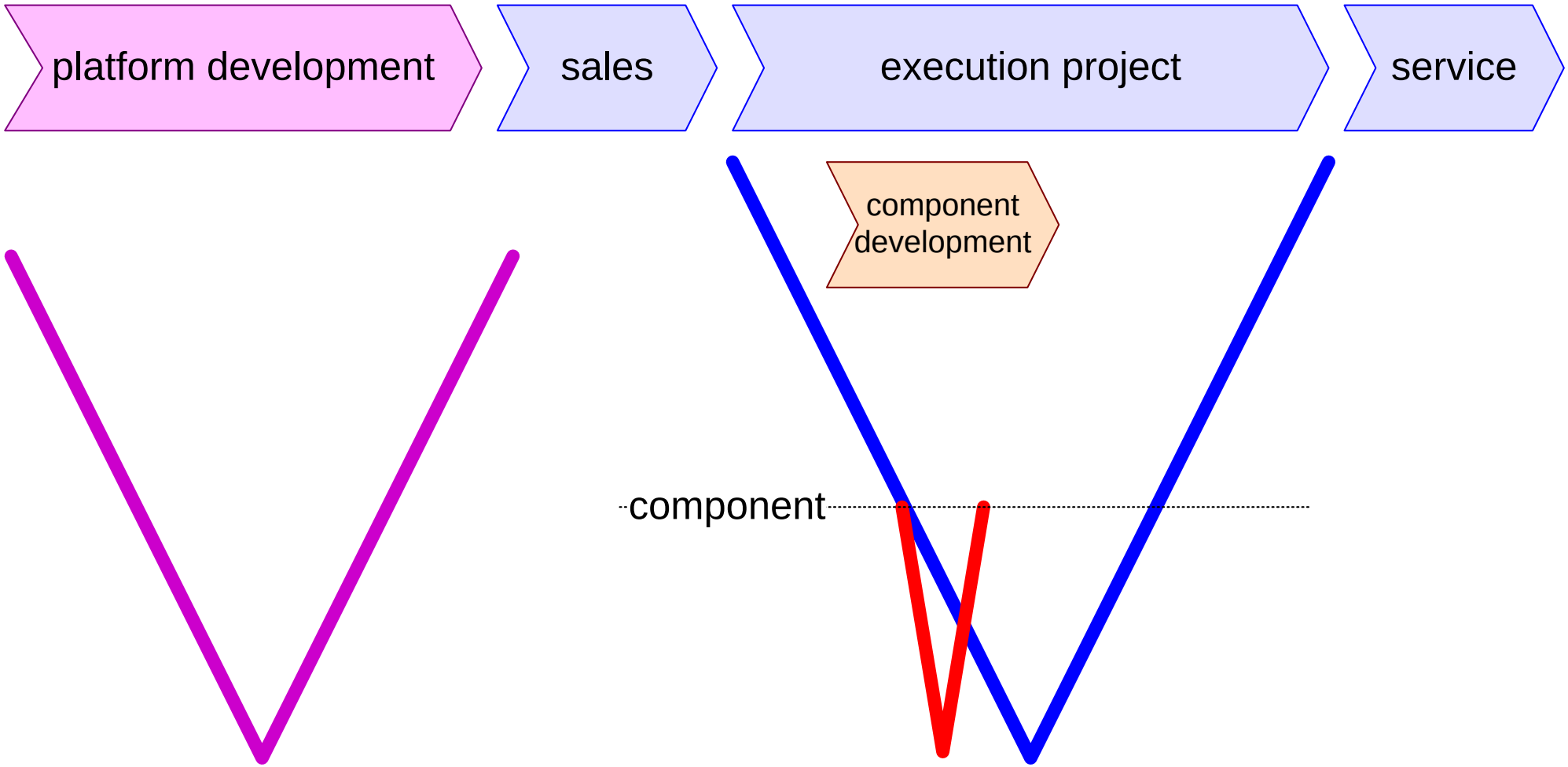
- must cooperate closely with industrial partners
- adapt each course to its participants and their context
- can learn much from teaching and closely cooperating

questions are welcome!

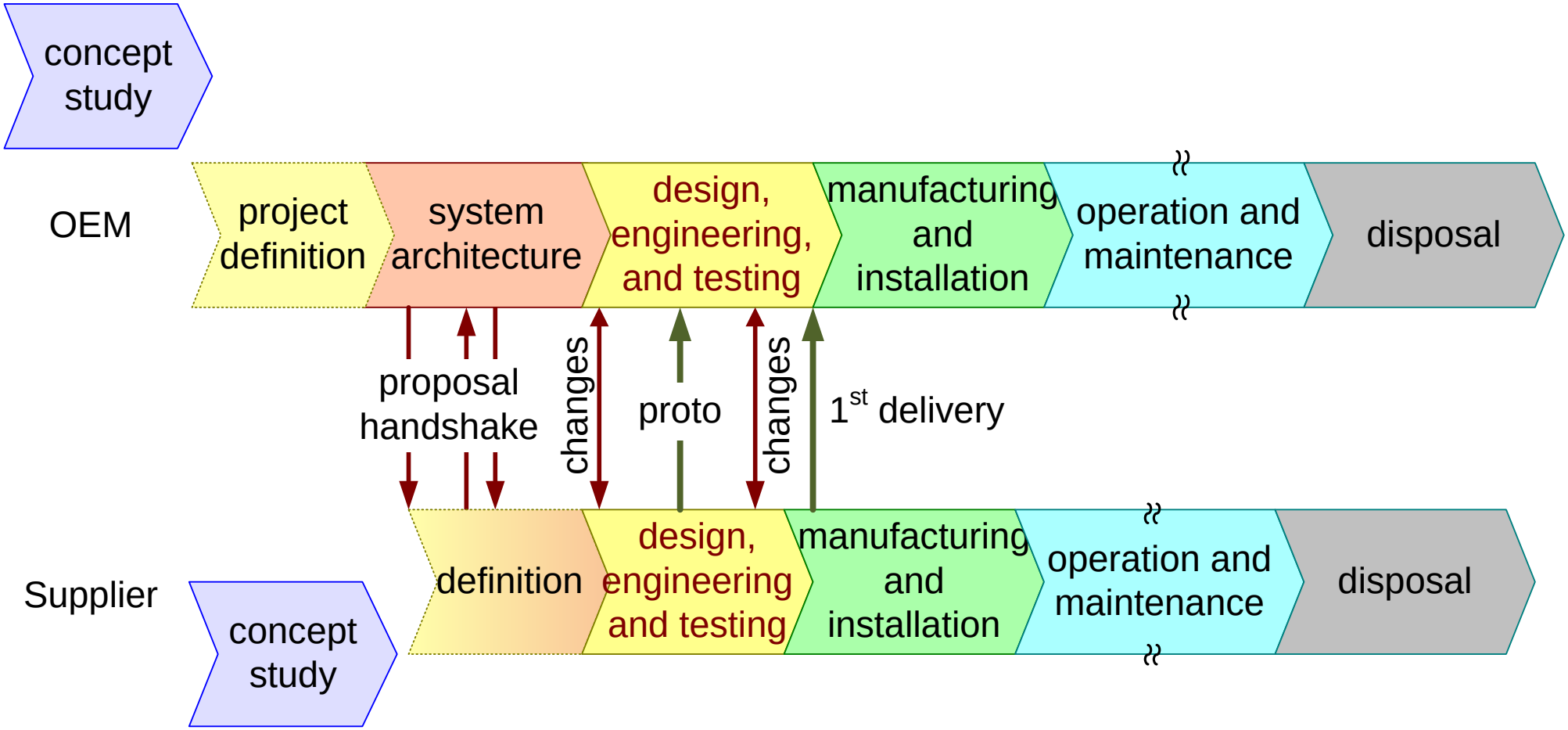
Platforms Increase Length of Value and Feedback Chain



Platform + Project -> 2.5 Vs



(Sub)suppliers in Tight Relation with Customer



Applying Systems Engineering on Education: Modularity