Industry Master in Systems Engineering

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Abstract

The Systems Engineering Master education in Kongsberg requires from students that they work part-time. This document describes ideas behind the educational model with the part-time job where students build up engineering experience. This experience helps to appreciate Systems Engineering teaching, it facilitates their further personal development in becoming broader engineers.

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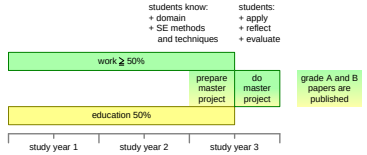
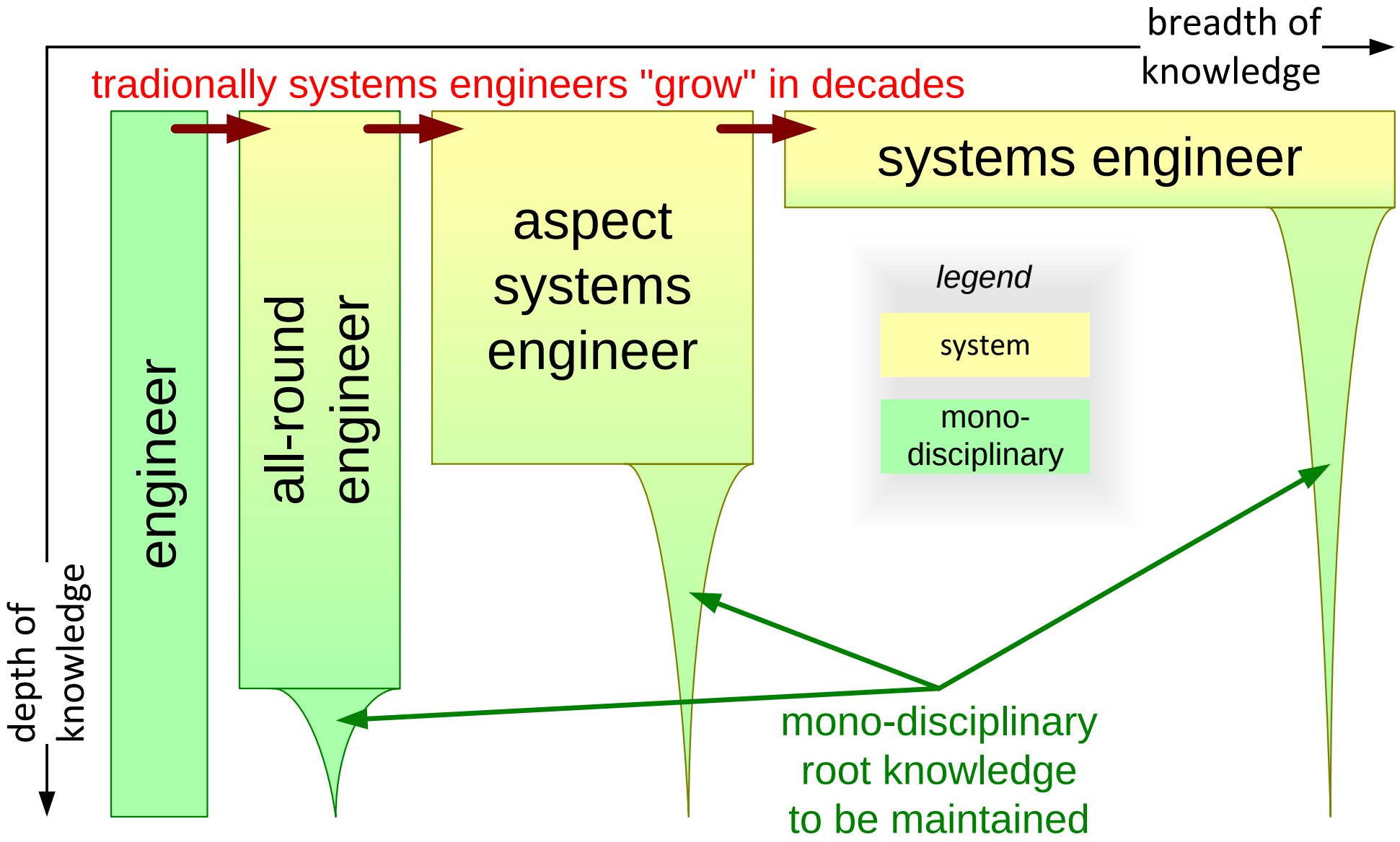


Vision behind the Industry Master

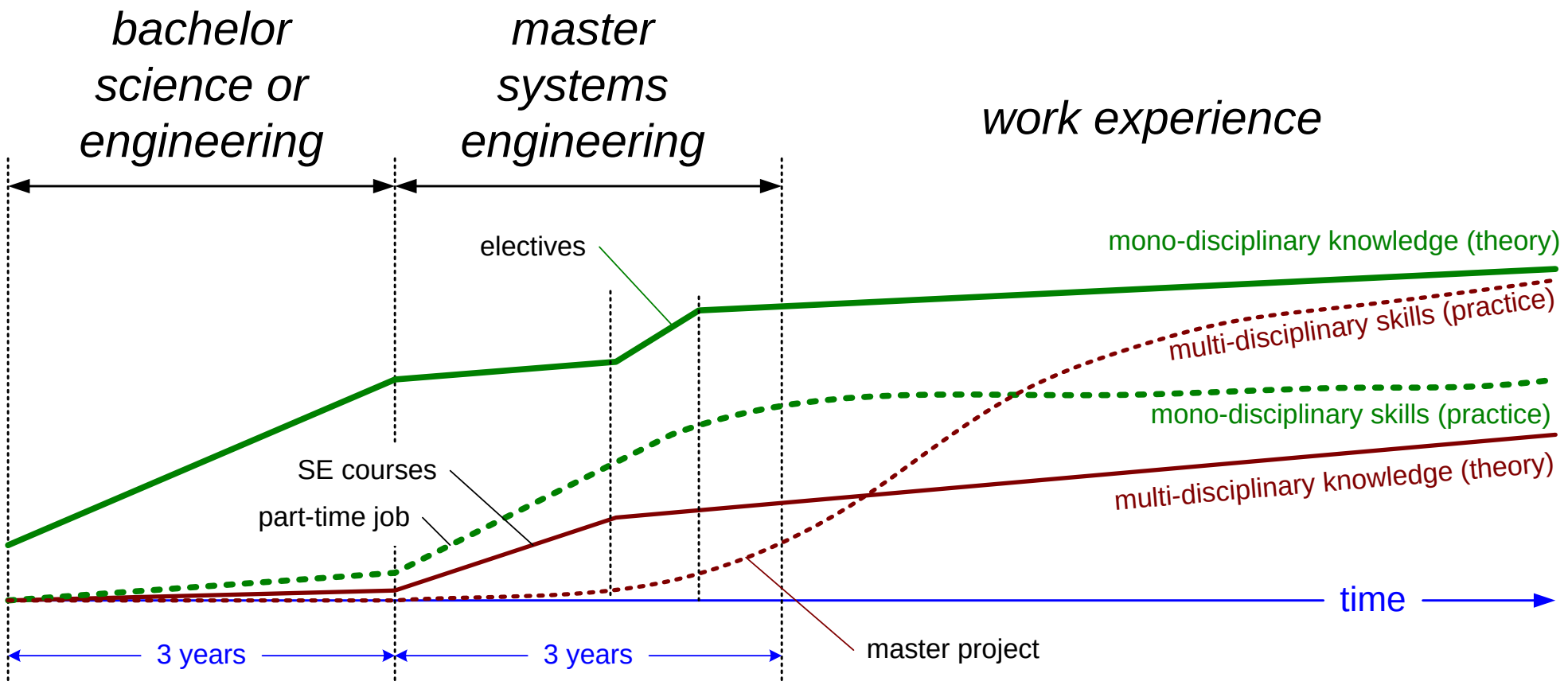
The objective of the industry master in systems engineering is to **accelerate** the **competence development** of new systems engineers, from e.g. 10..20 years in the past to 5..10 years.

Core of the acceleration is **experiential learning**, where offering **theory** and building up **experience** happens **concurrently** and is used to **reinforce learning**.

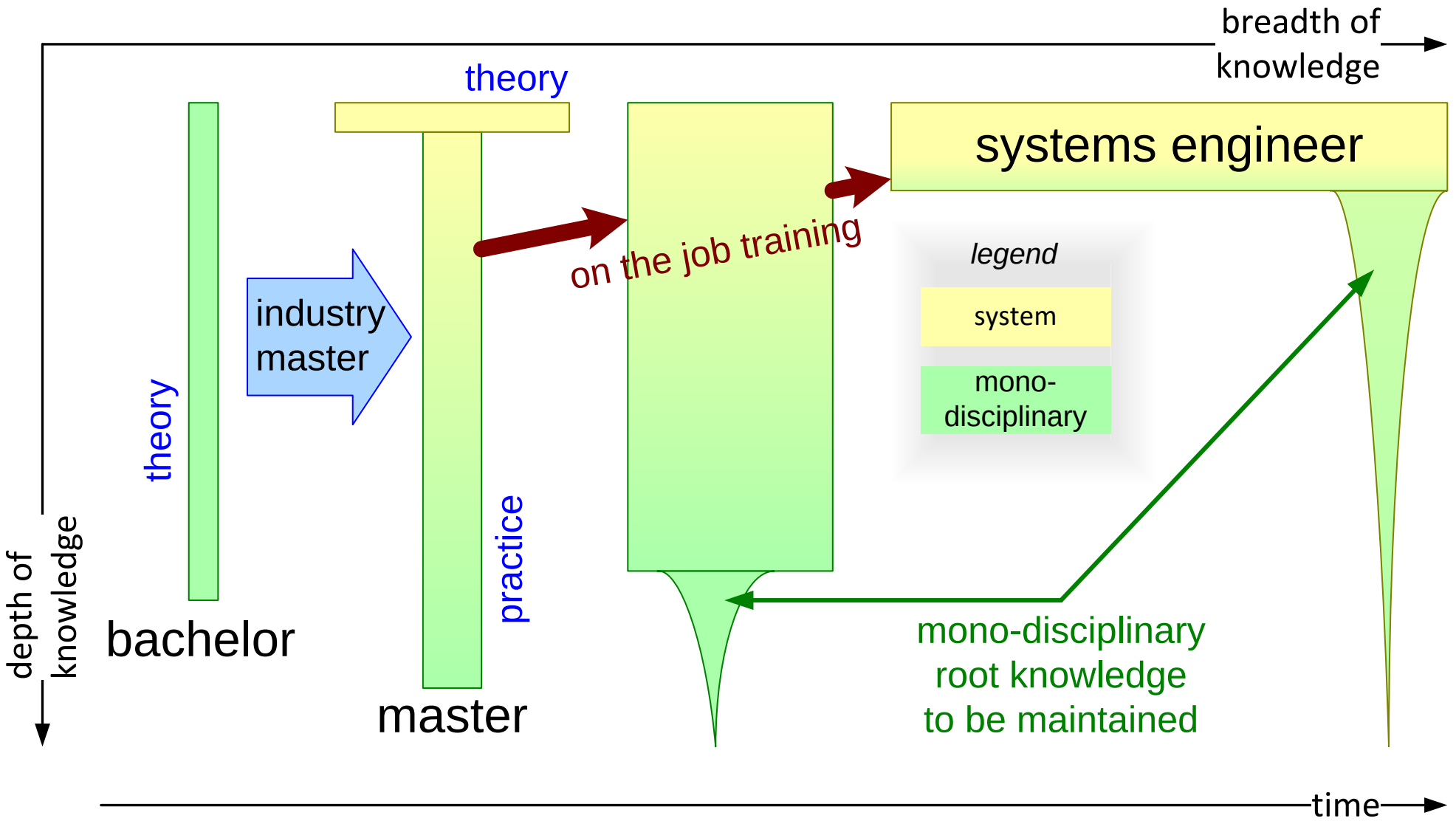
Evolution from Engineer to Systems Engineer



Industry Master time line



Intended growth of Industry Master students



Mandatory Core of the Program

theory oriented (with practice woven in)

SEFS Fundamentals of Systems Engineering

SEAD Architecture and Design

SEPM Project Management of Complex Systems

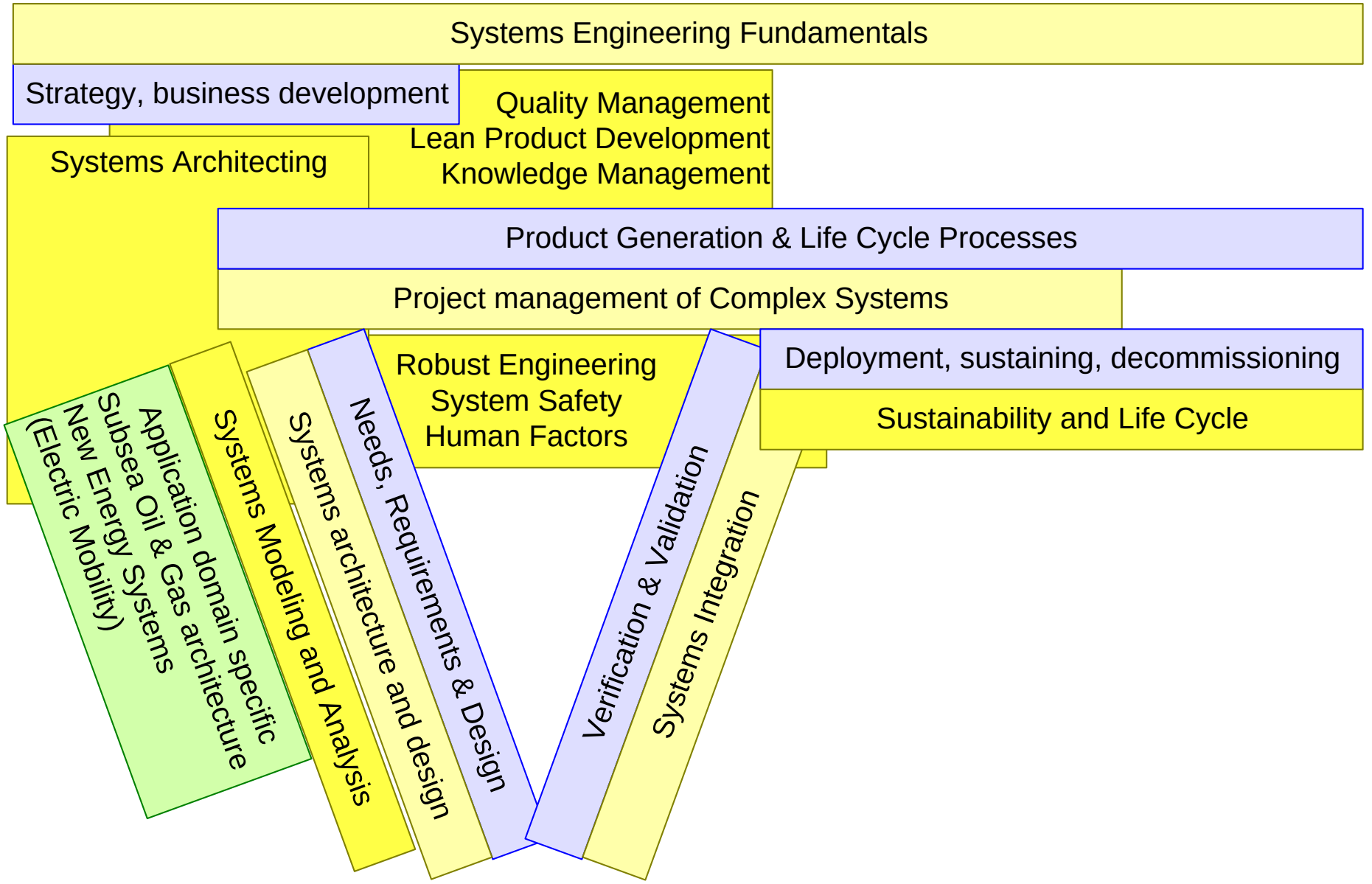
SESI Systems Integration

facilitating experiential learning

SERP Reflective Practice (9 workshops over 3 years)

SEMP Master Project (6 month full-time)

Courses mapped on the V-model



The Value propostion of the Master Program

Candidates can **focus** the development of solutions on **fitness-for-purpose** through applying **systems thinking**, **architecting**, and **engineering**, and **program** and **project management**

USN-SE offers a program that covers the systems field, allowing for **customization** through electives for **individual needs**, **specific domains**, and **applications**.

The IMSE and EMSE programs focus on **competence development**, e.g. beyond knowledge and skills: developing people that can (contribute to) **solve real-world problems** for their employers

Program Structure; Electives

Master programme in Systems Engineering 120 ECTS
- Mandatory courses 7,5 ECTS each*

SEFS 6102 - Fundamentals of Systems Engineering
SEPM 6102 - Project Management of Complex Systems
SEMP 6301 - Master project *(*30 ECTS)*
SEAD 6102 - System Architecture and Design
SESI 6202 - Systems Integration
SERP6102 - Reflective Practices

Elective courses

52.5 ECTS in elective courses:
1: Minimum 22.5 ECTS in Systems Engineering courses = 3 courses
2: Maximum 30 ECTS from *Depth courses *industrial domain courses *business and management courses = 4 courses

Systems Engineering courses:

SERE 6302 – Robust Engineering
SEMA 6202 – System Modeling and Analysis
SESL 6202 – System Supportability and Logistics
SESA 6202 – Advanced System Architecting
SELD 6202 – Lean Product Development
SEKD 6202 – Knowledge Management
SEHF 6202 – Human Centered Systems Design

Industrial Domain courses:

SSOP 6202 – Production Technology & Application
SSSA 6202 – Production Systems Architecture
SSTS 6202 – Production System Technical Safety (TBC)
SEEM 6202 – Electric and Hybrid Vehicles Systems

For electives from other universities or for a course program deviating from our standard requirements – permission is required from the Institute. Please contact Beate Calleja for more information. bc@usn.no

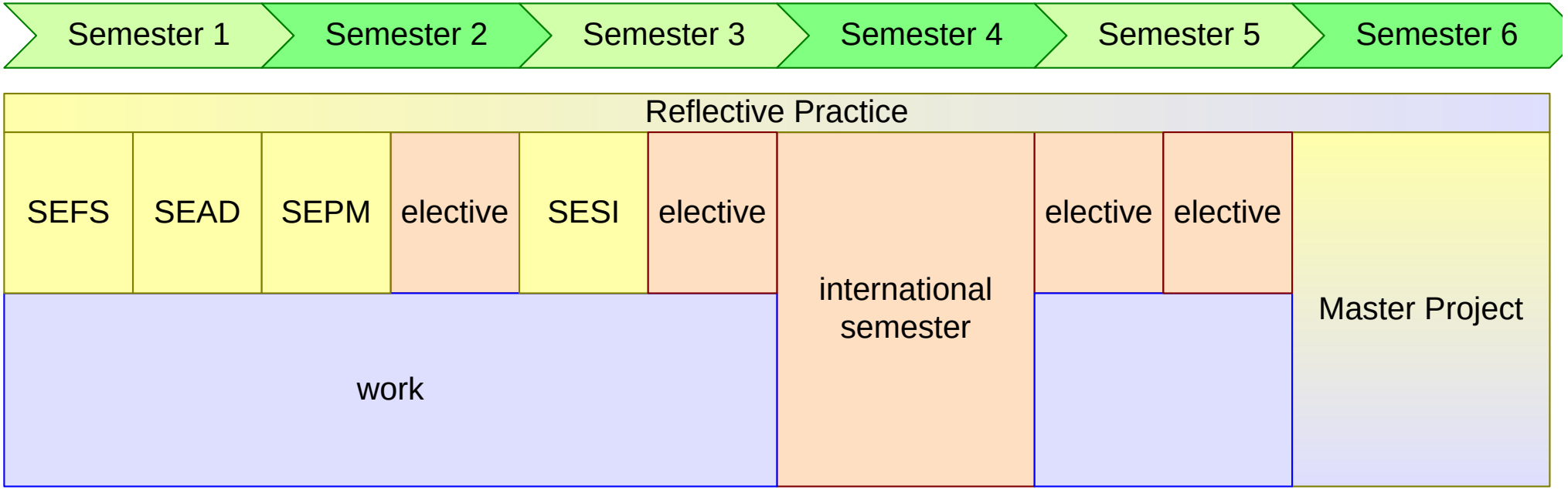
Stevens Institute of Technology - Course choice pack = 30 ECTS:

Systems Engineering Courses - **Systems Engineering**
Business and management Courses - **Management and Leadership**
Industrial Domain Courses - **Manufacturing**
Industrial Domain Courses - **Maritime Systems**
Depth Courses - **Data Exploration & Visualization for Risk & Decision Making**
Depth Courses - **Embedded Systems**
Depth Courses - **Robotics and Controls**
Depth Courses - **Modeling and Optimization**

Depth courses:
SEPD 6202 – Advanced Materials
SEAM 6202 – Advanced Mechanical Engineering
Courses from the Embedded Systems Program – see website for details.
Courses from the Industrial IT and Automation Program – see website for details.

Business and management courses:
Courses chosen from the Systems Engineering with Industrial Economy Programme – see website for details.
**Please note that courses from both the Embedded Systems and Industrial Economy programmes are presented over a whole semester.*

Typical Industry Master Program Time Line



Typical Course Schedule

week	course	
3	SERE	Robust Engineering
5	SEAM	Advanced Mechanical Engineering
6	SEAD	Architecture and Design
7	SSSA	Subsea Production System Architecture
8	SESA	Advanced Architecting
9	SERP	Reflective Practice
11	SESL	System Supportability and Logistics
12	SEAD	Architecture and Design
15	SEHF	Human Centered Design
16	SEEM	Electric and Hybrid Vehicles Systems
22	SEST	Systems Thinking
24	SEMP	Master Project preparation

week	course	
33	SERP	Reflective Practice
33	SEMP	Master Project preparation
35	SESI	Systems Integration
36	SEFS	Fundamentals of Systems Engineering
37	SEMA	Architectural Reasoning Using Conceptual Modeling
37	SEMP	Master Project preparation
38	SESI	Systems Integration
39	SELD	Lean product Development
41	SEFS	Fundamentals of Systems Engineering
41	SEKD	Systems Engineering Knowledge Management
42	SEPM	Project Management of Complex Systems
44	SSTS	System Technical Safety
47	SERP	Reflective Practice

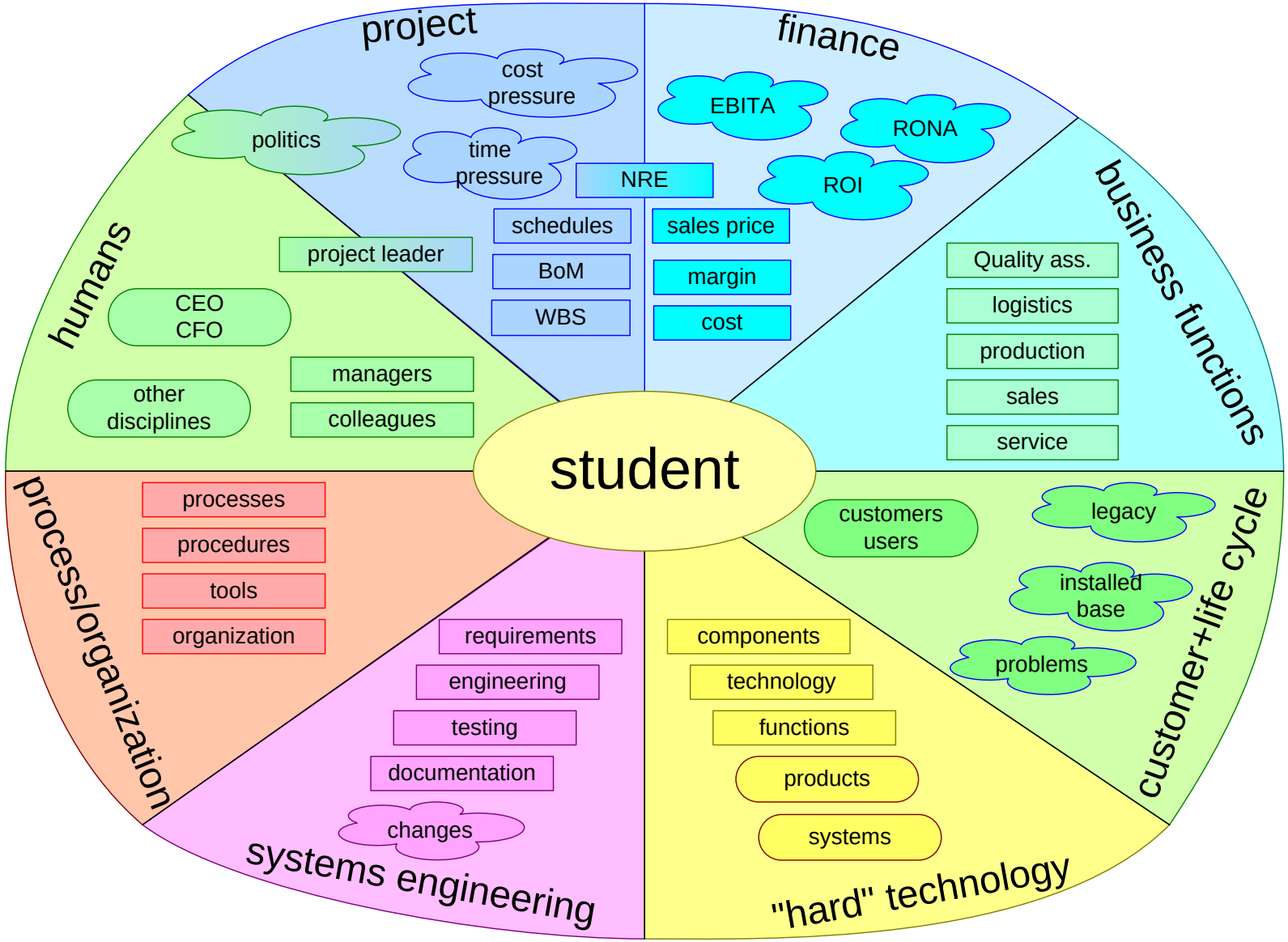
Standard Norwegian Master Program Outcomes

Knowledge	Skills	General Competence
The candidate... • has advanced knowledge within the academic field and specialized insight in a limited area • has thorough knowledge of the scholarly or artistic theories and methods in the field • can apply knowledge to new areas within the academic field • can analyze academic problems on the basis of the history, traditions, distinctive character and place in society of the academic field	The candidate... • can analyze and deal critically with various sources of information and use them to structure and formulate scholarly arguments • can analyze existing theories, methods and interpretations in the field and work independently on practical and theoretical problems • can use relevant methods for research and scholarly and /or artistic development work in an independent manner • can carry out an independent, limited research or development project under supervision and in accordance with applicable norms for research ethics	The candidate... • can analyze relevant academic, professional and research ethical problems • can apply his/her knowledge and skills in new areas in order to carry out advanced assignments and projects • can communicate extensive independent work and masters language and terminology of the academic field • can communicate about academic issues, analyses and conclusions in the field, both with specialists and the general public • can contribute to new thinking and innovation processes

Industry Master Program Learning Outcomes

Knowledge	Skills	General Competence
The candidate... • has advanced knowledge within the interdisciplinary field of systems engineering and specialized insight in engineering, and innovation management and leadership • has thorough knowledge of Systems Engineering and detailed knowledge of methods, techniques, and tools according to international standards and professional societies of systems engineering. • can apply systems engineering methods and techniques to new areas within innovation and systems development • has knowledge of fitness-for-purpose, stakeholders satisfaction, and mindset of holistic view, human-centered, and continuous improvement • has knowledge of relevant methods for research of the innovation and systems engineering body of knowledge	The candidate... • can analyze and deal critically with various sources of information and use them to structure and formulate Systems Engineering arguments • can analyze existing theories, methods and interpretations in the interdisciplinary field of systems engineering and work independently on practical and theoretical problems • can apply theoretical knowledge of Systems Engineering to problems encountered in his work independently and as part of an engineering team • can use Systems Engineering methods and techniques to make system designs with fitness-for-purpose and stakeholders satisfaction • can carry out an independent, limited research of the systems engineering body of knowledge or innovation and systems development project under supervision and in accordance with applicable norms for research ethics • can apply the mindset of holistic view, human-centered, continuous improvement and leadership in systems development	The candidate... • can analyze and synthesize systems engineering problems in the broader social, ethical, economical, industrial context • can apply his/her knowledge and skills in new areas in order to carry out advanced innovation and systems development assignments and projects • can communicate extensive independent work and master's language and terminology of the interdisciplinary field of systems engineering • can communicate, as a broad technical engineer, systems engineering related issues, analyses and conclusions with a broad variety of stakeholders • can contribute to new thinking and innovation processes in innovation and systems development • can use his insights in the fields of ethics, work-life, business, market, applications, processes, and organizations • can develop into a full systems engineer within five to ten years. • can be qualified to embark on the road to becoming a highly qualified systems engineer, with the capability of supervising complex endeavors in private or public enterprises.

Overload of Impressions for Fresh Bachelors



What is Competence?

Attitude (perseverance, faith, critical, constructive, etc.)

train

Ability (know when to use what skill and knowledge)

apply/use often, experience

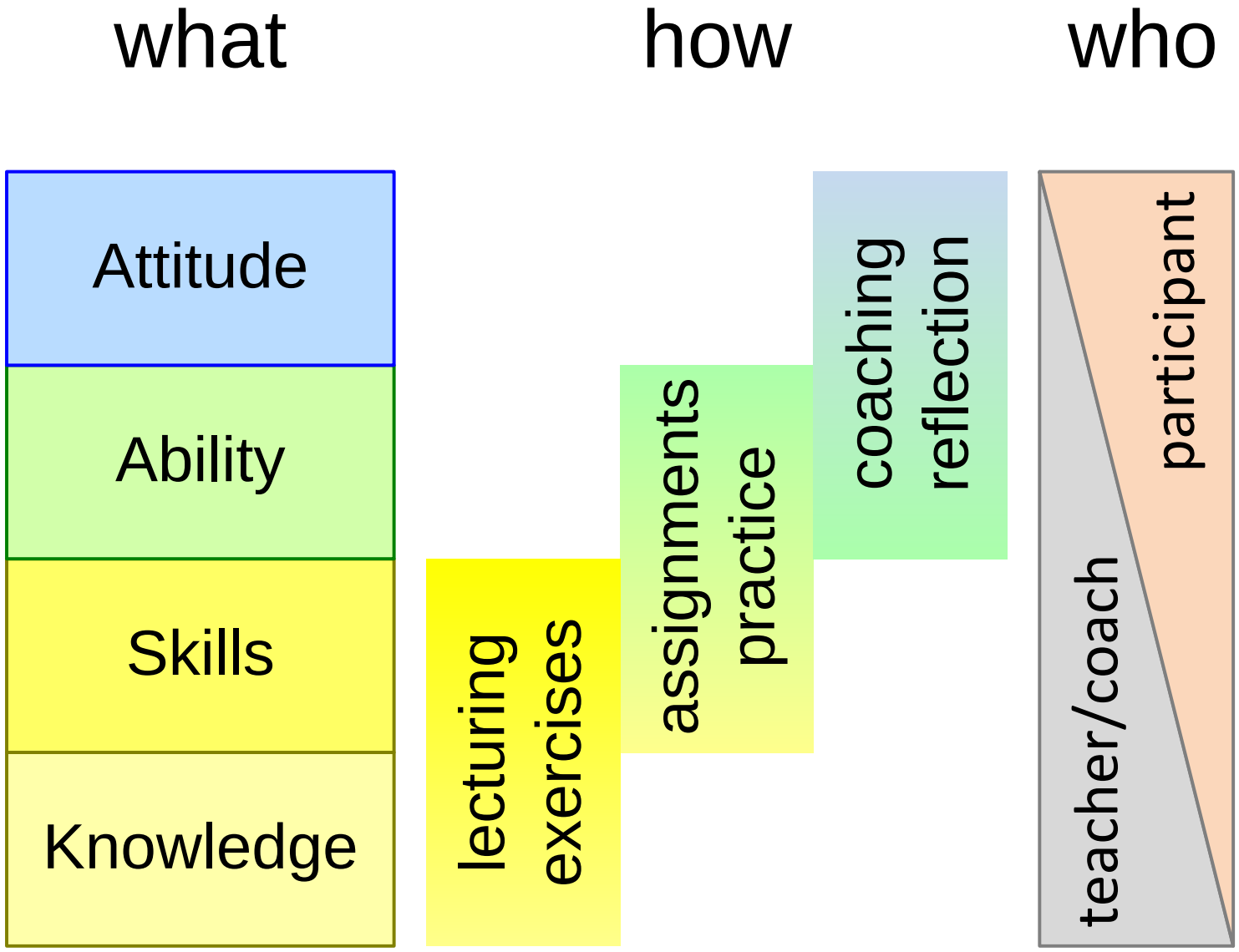
Skills (calculate missing angle, calculate hypothenusa)

exercise

Knowledge (triangle has 3 corners, sum of angles is 180 degrees, Pythagoras $c^2 = a^2 + b^2$)
learn

Competence = Knowledge + Skills + Ability + Attitude

Competence Program Partitioning

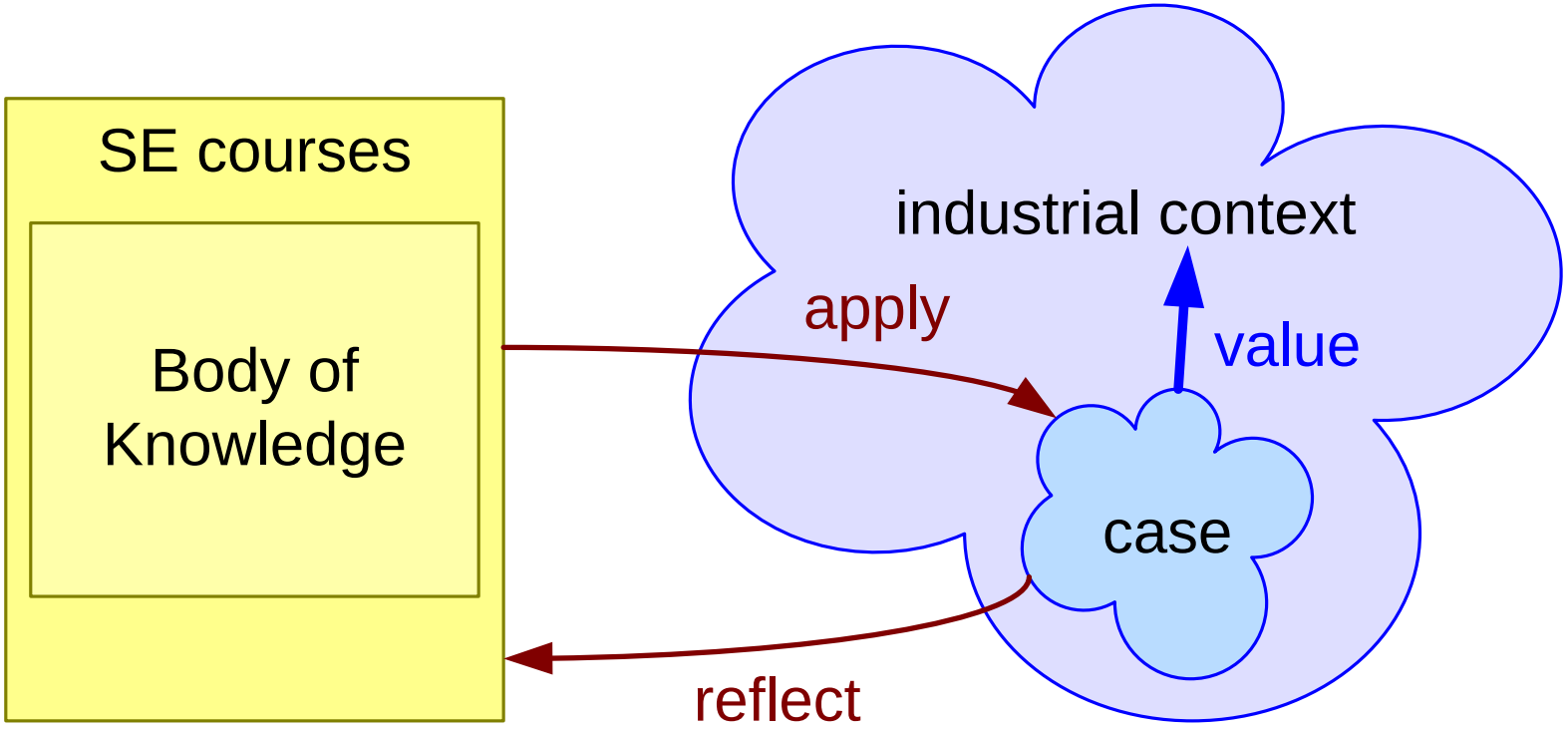


Course Format and Pedagogic

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

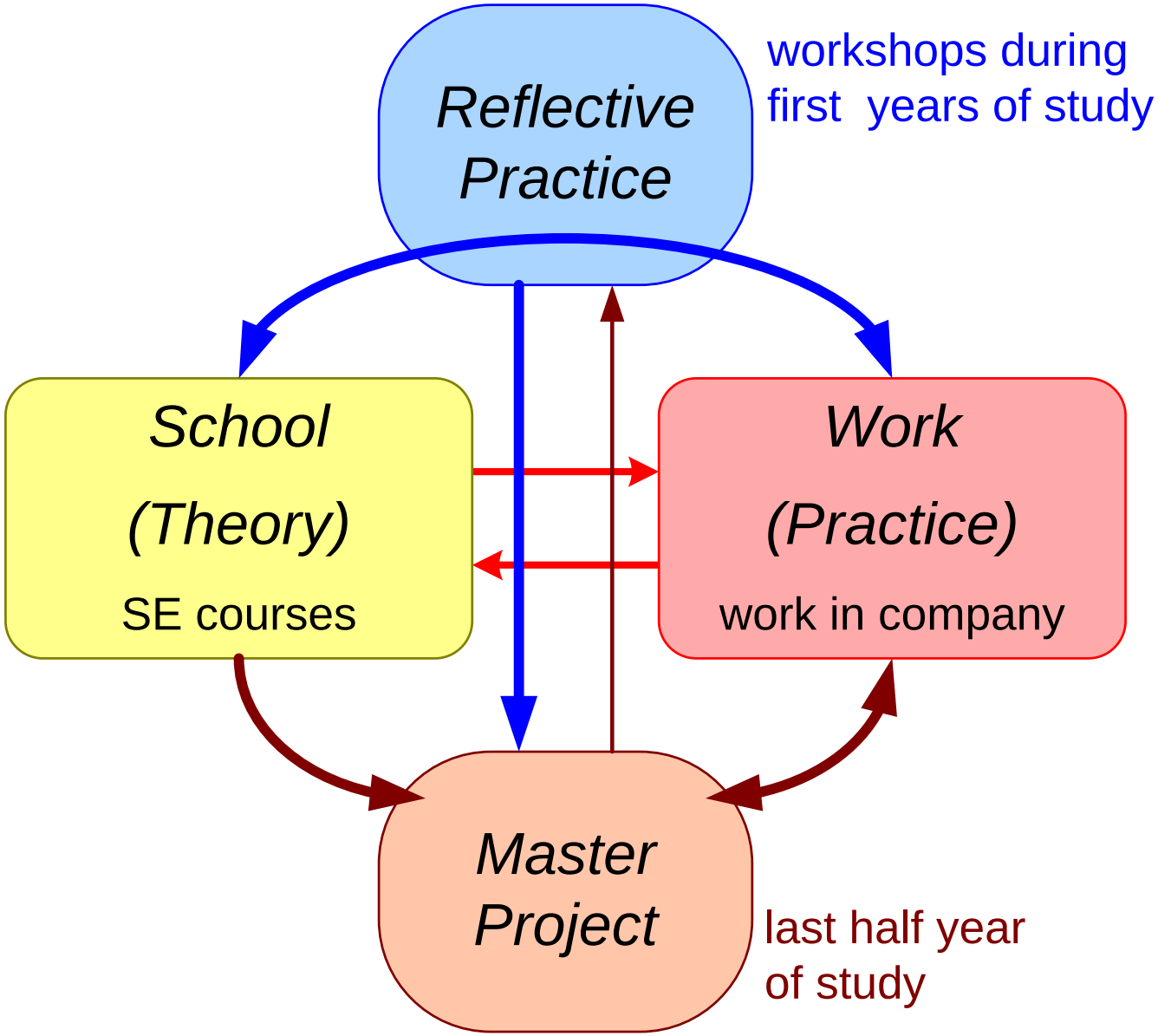
- Students travel 4 times per year
- Study and work planning is flexible
- Active learning, case-based
- Actual industry cases are possible (depends on course)

Objectives of Master Project

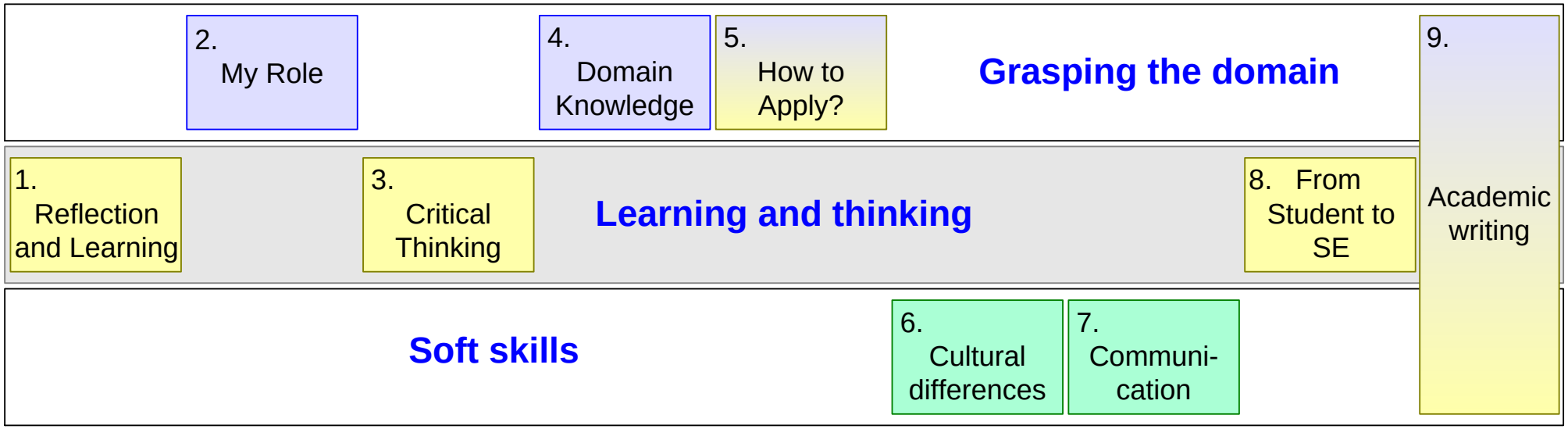


Apply part of the SE body of knowledge in practice and **evaluate** and **reflect** on its application, while **providing value** to the industrial sponsor

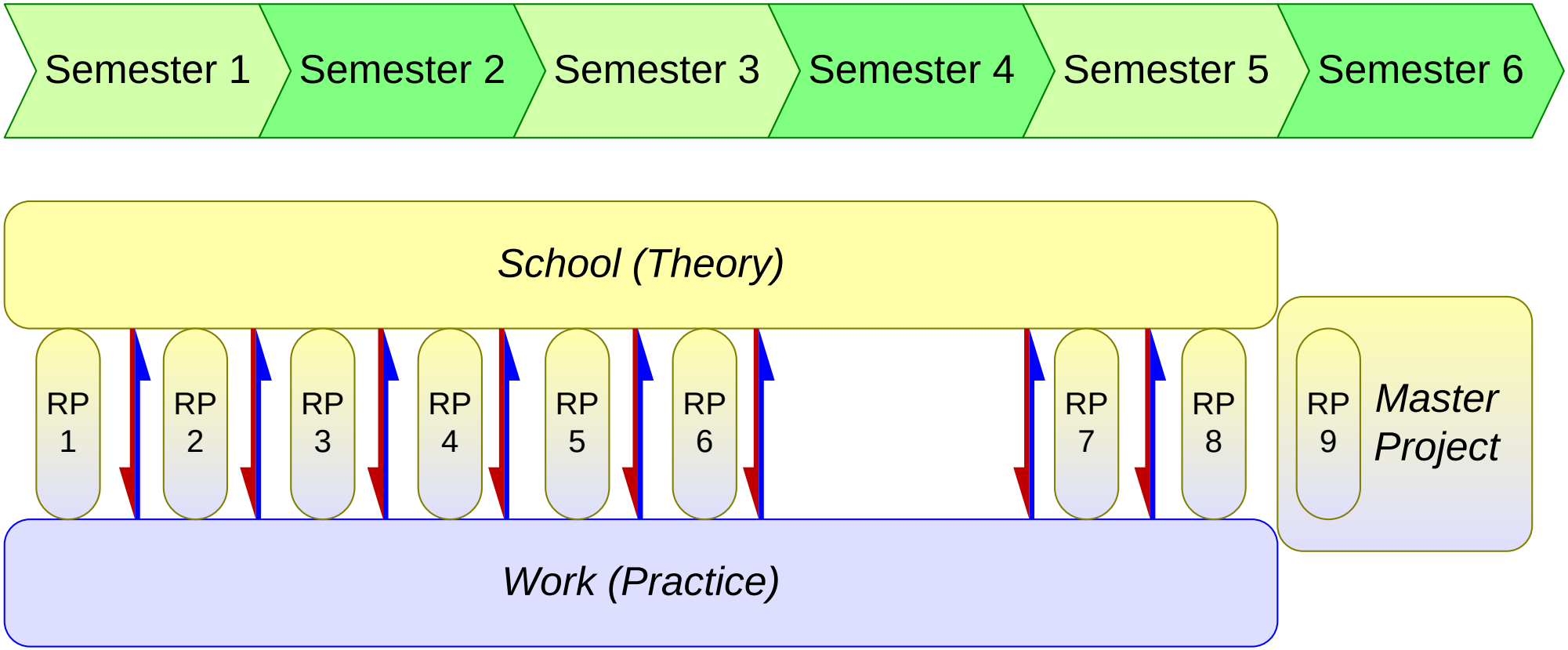
RP: Stimulate Students to Relate Theory and Practice



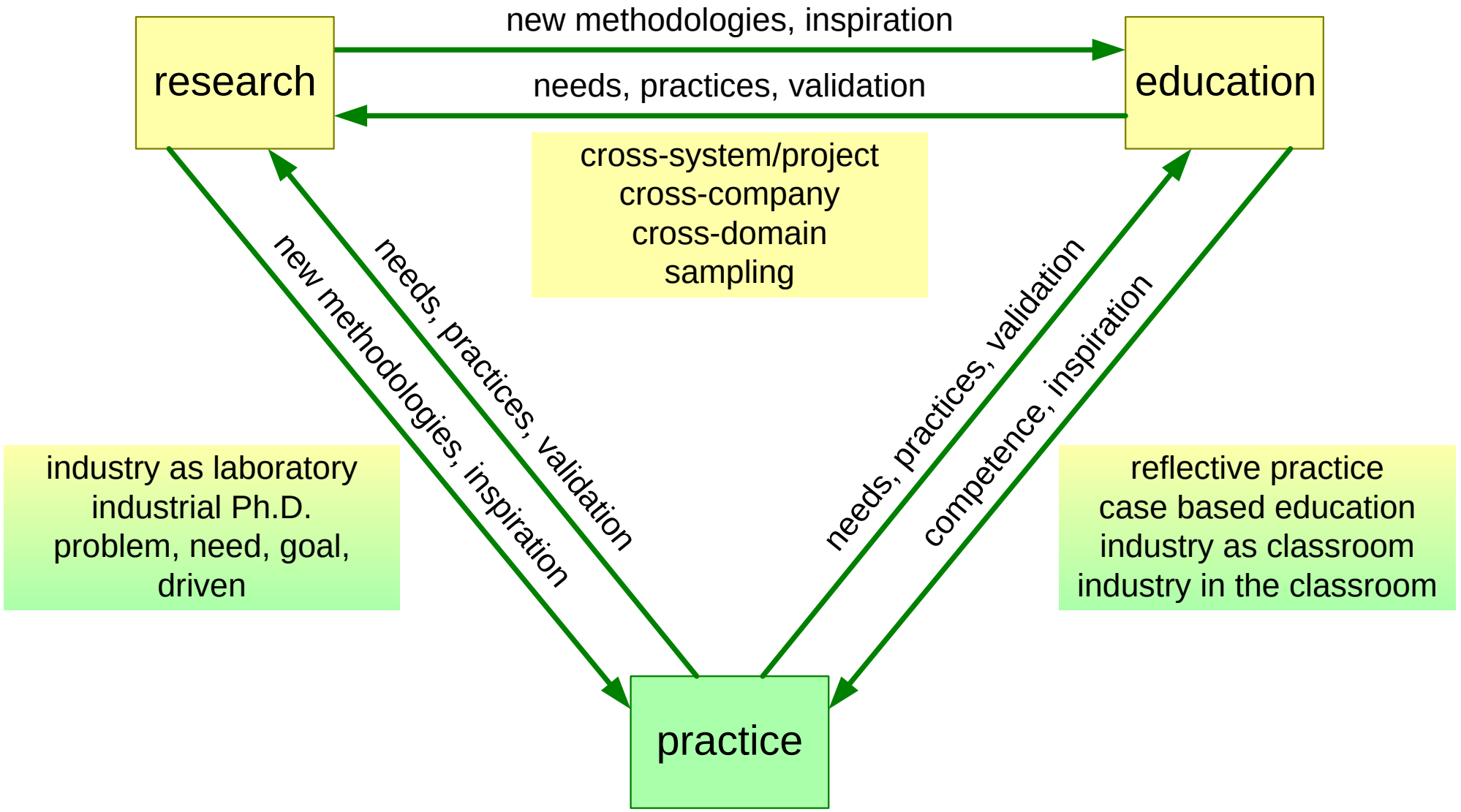
Reflective Practice; 9 Workshops in 3 Years



Reflective Practice Connects Study and Work



Connecting Practice, Education, and Research



Industrial Networking

formal boards

strategic decision makers

Industrial Advisory Board

tactical subject matter experts

Reference group

operational HRM

HR forum

events

KSEE
June

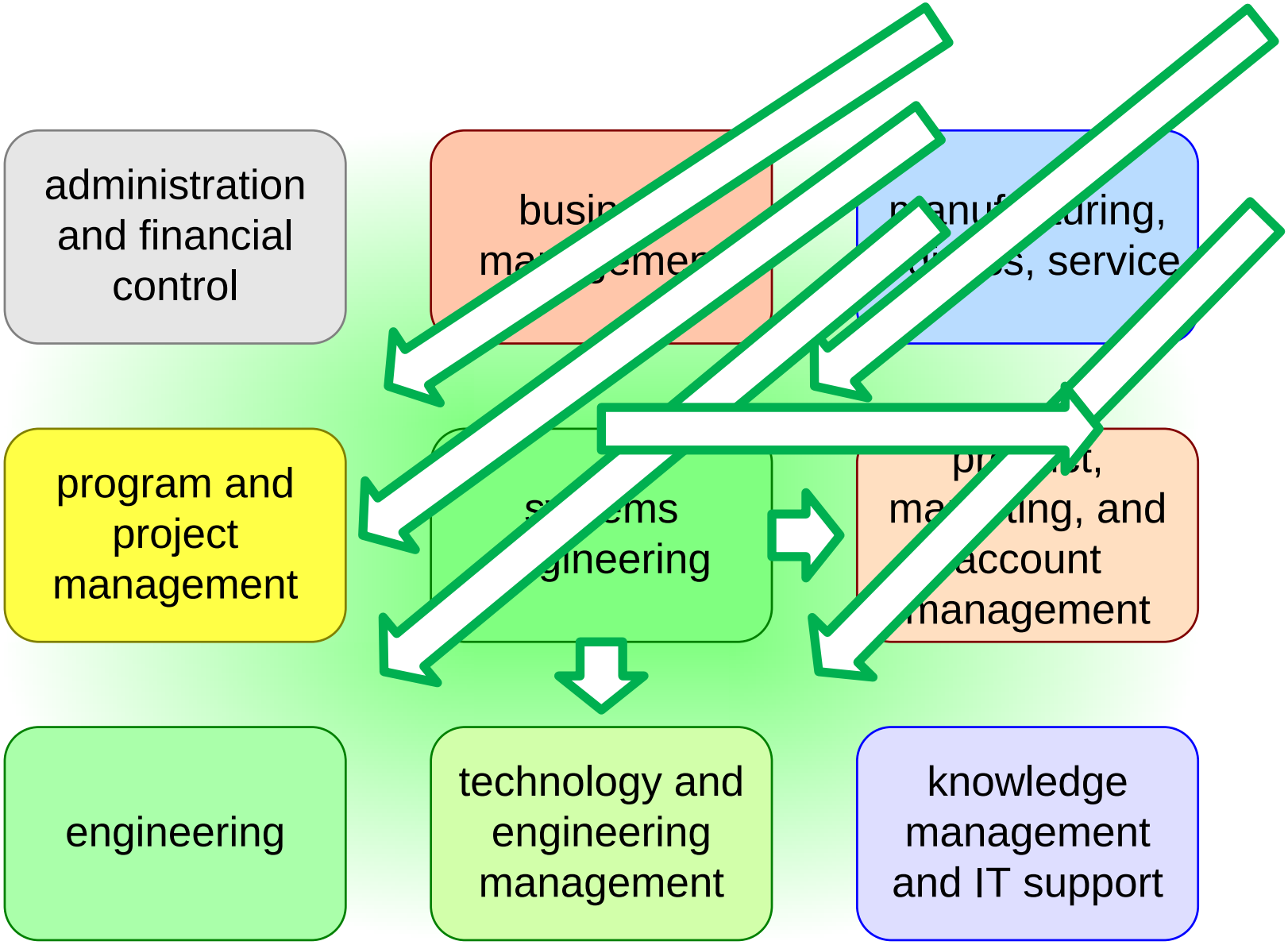
SESG
November, February

Xmas party

Research & Education

in-company courses

research

and a large amount of informal contacts

Neighboring Disciplines