

# 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.

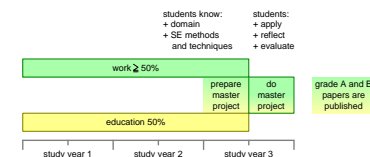
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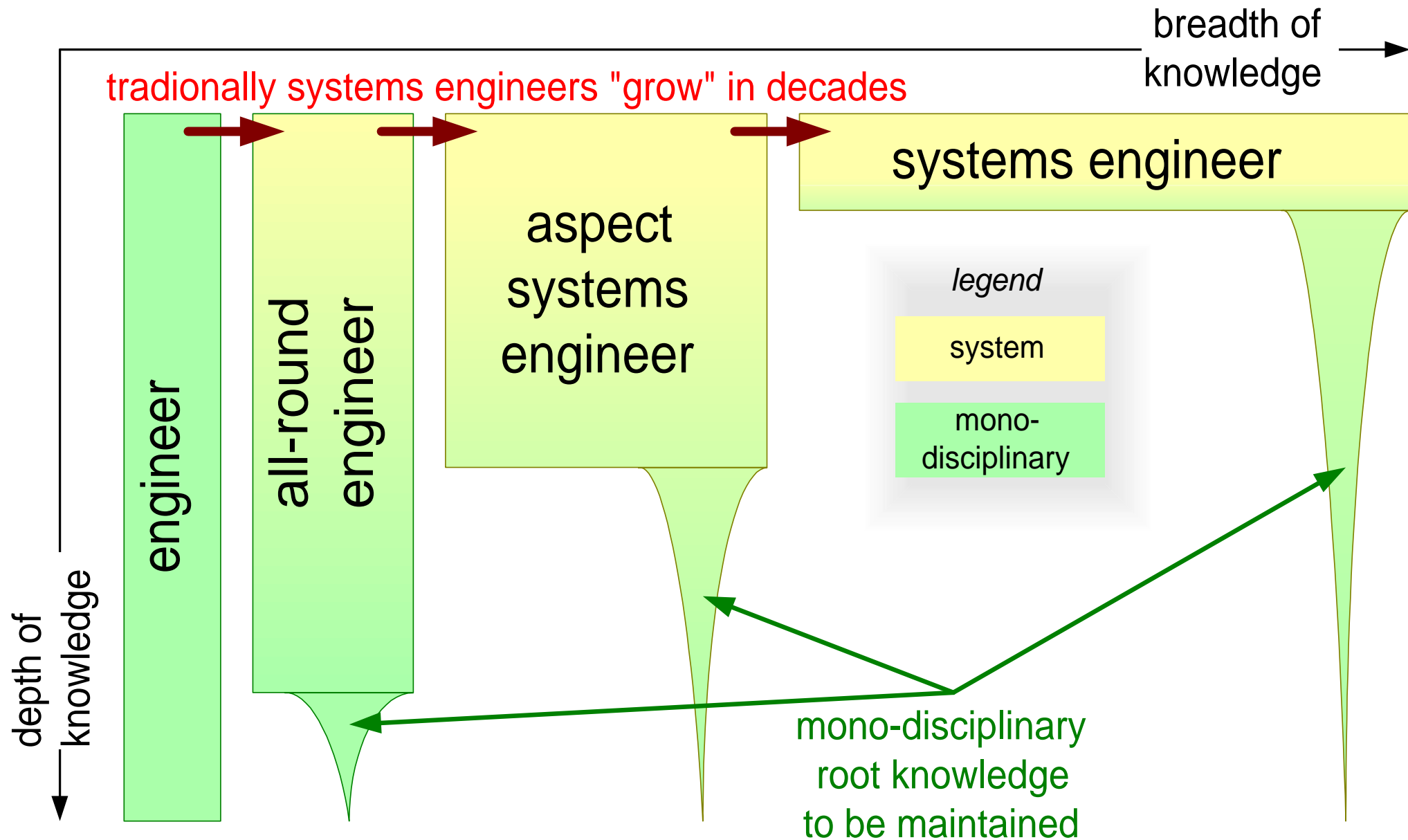
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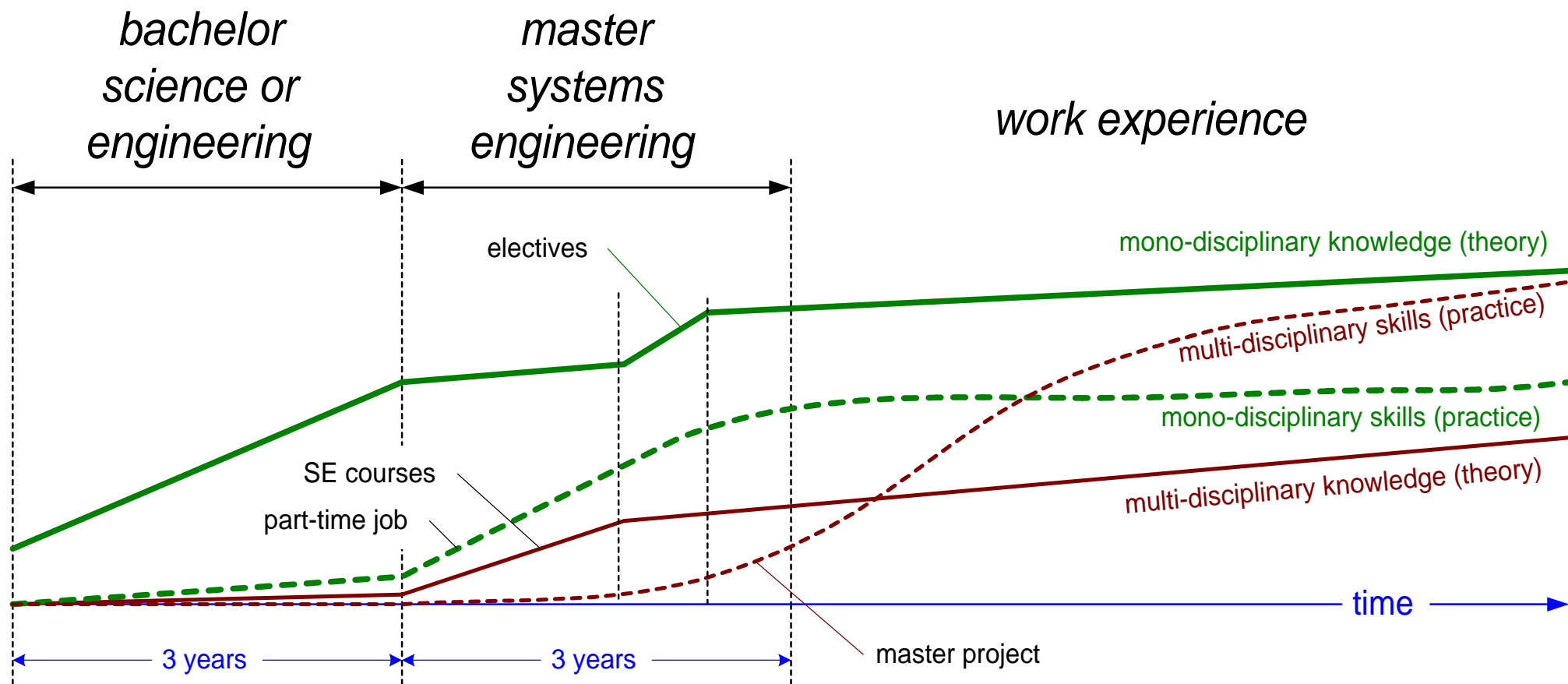
The objective of the industry master in systems engineering is to **accelerate** the **competence development** of new systems engineers, from e.g. 10..20 years in the past to 5..10 years.

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

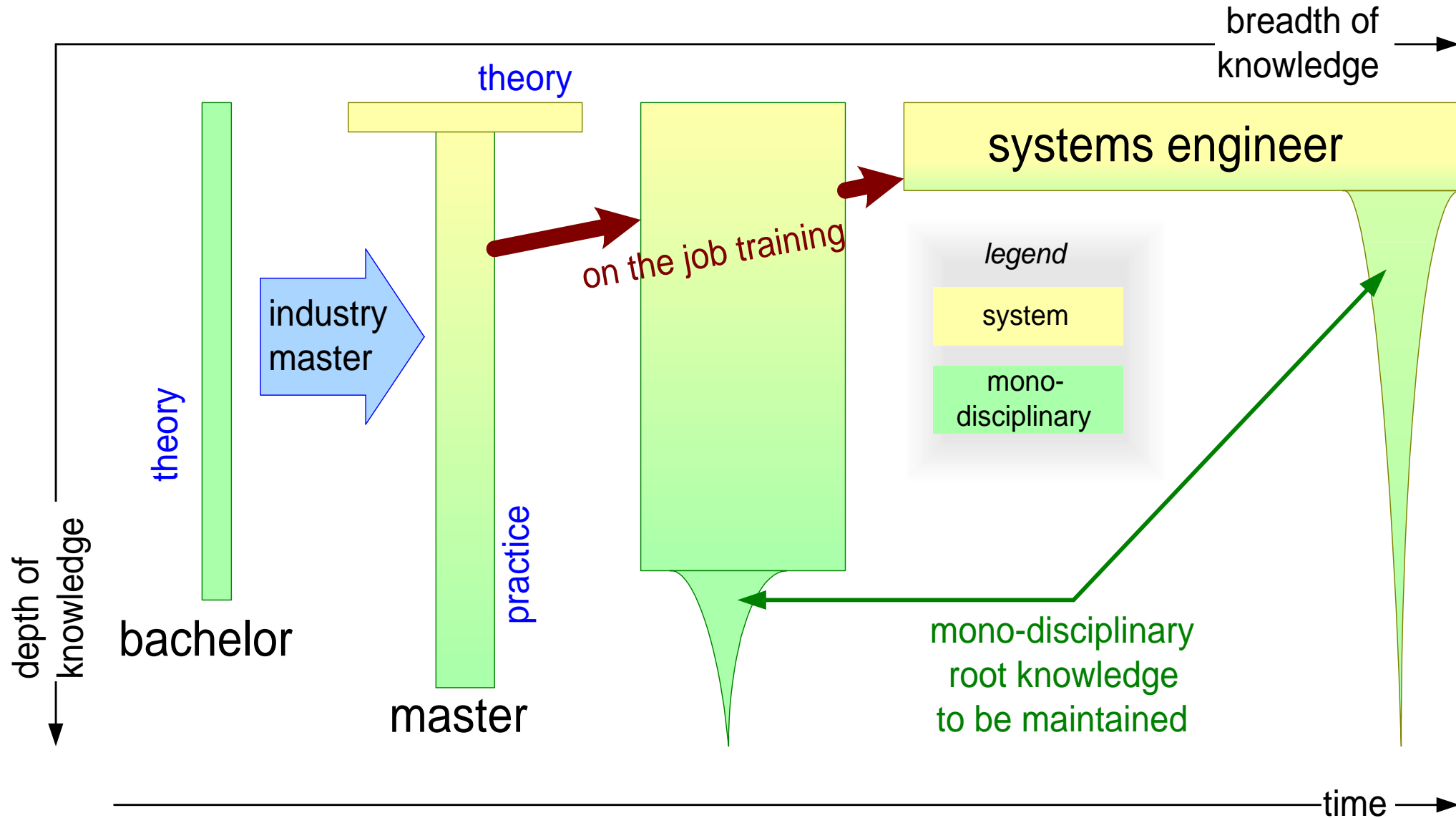
# Evolution from Engineer to Systems Engineer



# Industry Master time line



# Intended growth of Industry Master students



# Mandatory Core of the Program

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*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)

# 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

Semester 1		Semester 2		Semester 3		Semester 4		Semester 5		Semester 6	
SERP											
SEFS		SEAD	SEPM	SESI	elective	international semester	elective	elective	SEMP		
work											



# Typical Course Schedule

week	course	week	course
3	SERE Robust Engineering	33	SERP Reflective Practice
5	SEAM Advanced Mechanical Engineering	33	SEMP Master Project preparation
6	SEAD Architecture and Design	35	SESI Systems Integration
7	SSSA Subsea Production System Architecture	36	SEFS Fundamentals of Systems Engineering
8	SESA Advanced Architecting	37	SEMA Architectural Reasoning Using Conceptual Modeling
9	SERP Reflective Practice	37	SEMP Master Project preparation
11	SESL System Supportability and Logistics	38	SESI Systems Integration
12	SEAD Architecture and Design	39	SELD Lean product Development
15	SEHF Human Centered Design	41	SEFS Fundamentals of Systems Engineering
16	SEEM Electric and Hybrid Vehicles Systems	41	SEKD Systems Engineering Knowledge Management
22	SEST Systems Thinking	42	SEPM Project Management of Complex Systems
24	SEMP Master Project preparation	44	SSTS System Technical Safety
		47	SERP Reflective Practice

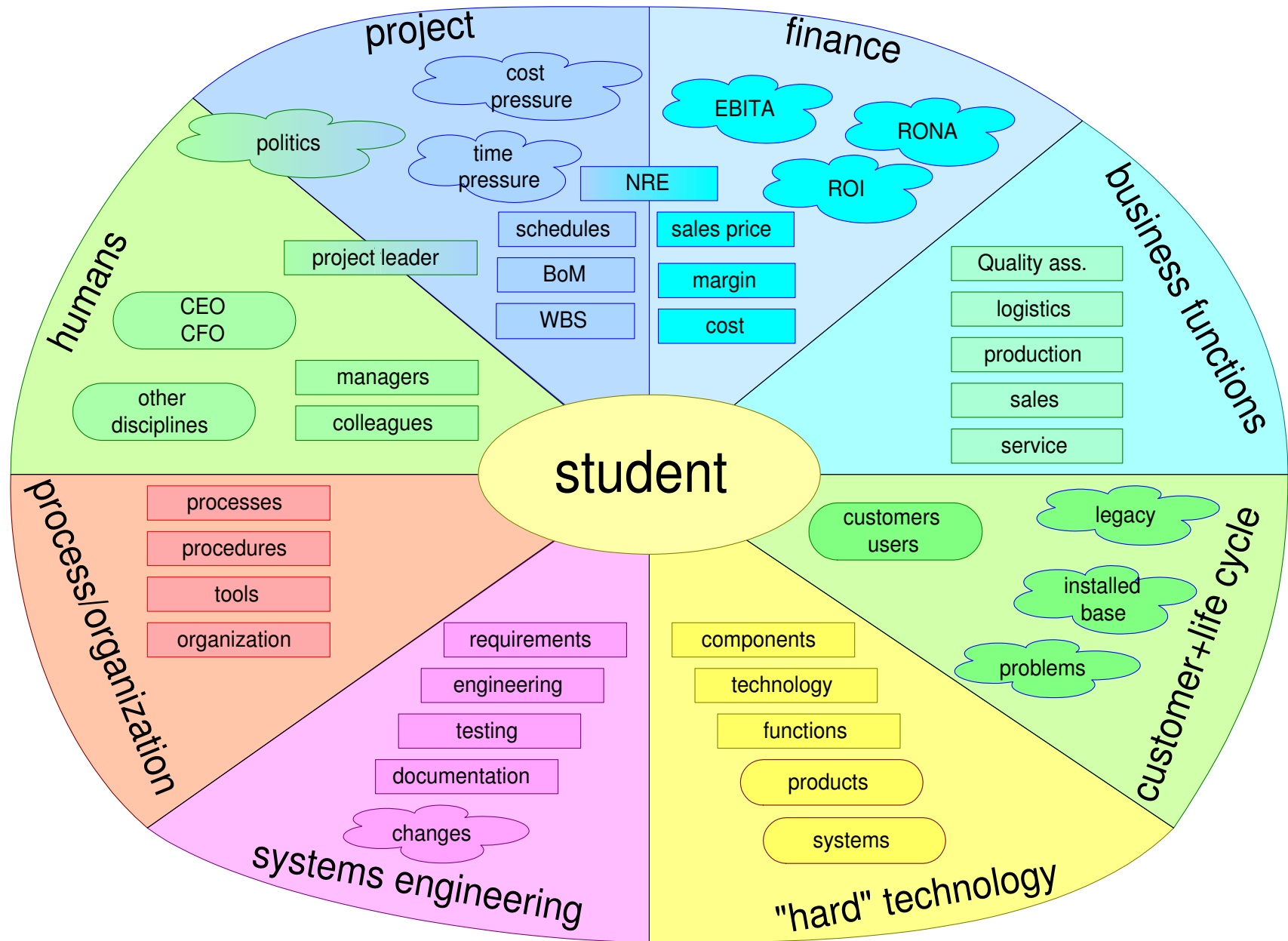
# Standard Norwegian Master Program Outcomes

<p><b>Knowledge</b> The candidate...</p> <ul style="list-style-type: none"><li>• has advanced knowledge within the academic field and specialized insight in a limited area</li><li>• has thorough knowledge of the scholarly or artistic theories and methods in the field</li><li>• can apply knowledge to new areas within the academic field</li><li>• can analyze academic problems on the basis of the history, traditions, distinctive character and place in society of the academic field</li></ul>	<p><b>Skills</b> The candidate...</p> <ul style="list-style-type: none"><li>• can analyze and deal critically with various sources of information and use them to structure and formulate scholarly arguments</li><li>• can analyze existing theories, methods and interpretations in the field and work independently on practical and theoretical problems</li><li>• can use relevant methods for research and scholarly and /or artistic development work in an independent manner</li><li>• can carry out an independent, limited research or development project under supervision and in accordance with applicable norms for research ethics</li></ul>	<p><b>General Competence</b> The candidate...</p> <ul style="list-style-type: none"><li>• can analyze relevant academic, professional and research ethical problems</li><li>• can apply his/her knowledge and skills in new areas in order to carry out advanced assignments and projects</li><li>• can communicate extensive independent work and masters language and terminology of the academic field</li><li>• can communicate about academic issues, analyses and conclusions in the field, both with specialists and the general public</li><li>• can contribute to new thinking and innovation processes</li></ul>
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# Industry Master Program Learning Outcomes

Knowledge	Skills	General Competence
<p>The candidate...</p> <ul style="list-style-type: none"><li>• has advanced knowledge within the interdisciplinary field of systems engineering and specialized insight in engineering, and innovation management and leadership</li><li>• has thorough knowledge of Systems Engineering and detailed knowledge of methods, techniques, and tools according to international standards and professional societies of systems engineering.</li><li>• can apply systems engineering methods and techniques to new areas within innovation and systems development</li><li>• has knowledge of fitness-for-purpose, stakeholders satisfaction, and mindset of holistic view, human-centered, and continuous improvement</li><li>• has knowledge of relevant methods for research of the innovation and systems engineering body of knowledge</li></ul>	<p>The candidate...</p> <ul style="list-style-type: none"><li>• can analyze and deal critically with various sources of information and use them to structure and formulate Systems Engineering arguments</li><li>• can analyze existing theories, methods and interpretations in the interdisciplinary field of systems engineering and work independently on practical and theoretical problems</li><li>• can apply theoretical knowledge of Systems Engineering to problems encountered in his work independently and as part of an engineering team</li><li>• can use Systems Engineering methods and techniques to make system designs with fitness-for-purpose and stakeholders satisfaction</li><li>• 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</li><li>• can apply the mindset of holistic view, human-centered, continuous improvement and leadership in systems development</li></ul>	<p>The candidate...</p> <ul style="list-style-type: none"><li>• can analyze and synthesize systems engineering problems in the broader social, ethical, economical, industrial context</li><li>• can apply his/her knowledge and skills in new areas in order to carry out advanced innovation and systems development assignments and projects</li><li>• can communicate extensive independent work and master's language and terminology of the interdisciplinary field of systems engineering</li><li>• can communicate, as a broad technical engineer, systems engineering related issues, analyses and conclusions with a broad variety of stakeholders</li><li>• can contribute to new thinking and innovation processes in innovation and systems development</li><li>• can use his insights in the fields of ethics, work-life, business, market, applications, processes, and organizations</li><li>• can develop into a full systems engineer within five to ten years.</li><li>• 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.</li></ul>

# 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 hypotenusa)

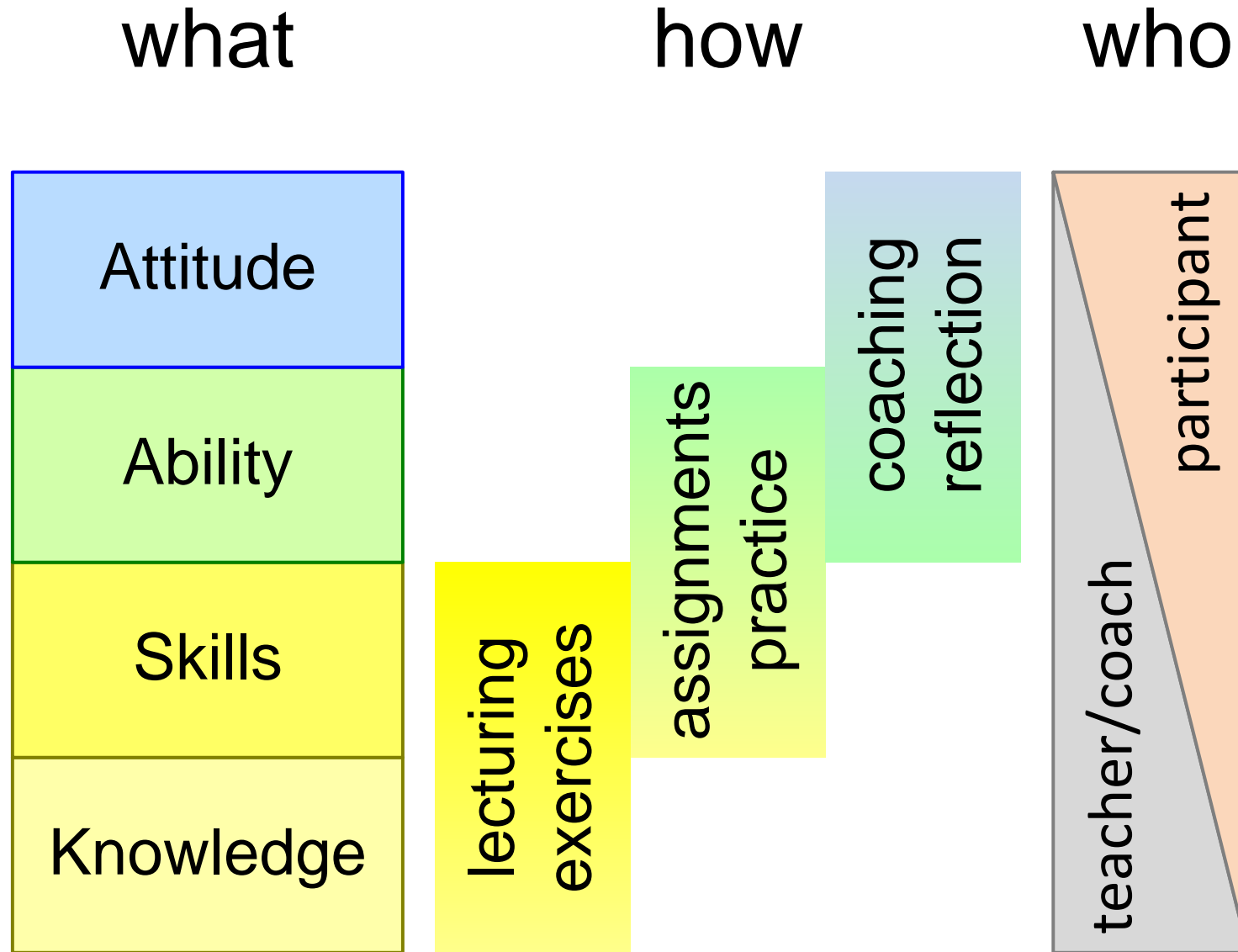
*exercise*

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



# RP: Stimulate Students to Relate Theory and Practice

