Abstract
The Systems Engineering Master education in Kongsberg requires from students that they work part-time. This document describes the needs and expectations for the part-time job. The main purpose of the part-time job is that the students build up engineering experience. This experience helps to appreciate Systems Engineering teaching, it facilitates their further personal development in becoming broader engineers.
Objectives of this Presentation

**company HR and supervisors**
- provide inspiration by examples
- provide background for part-time job
- to benefit the most as company from IM student-employee
- to get the most benefit for the competence development of the IM student

**student**
- provide background for part-time job
- provide support by examples
- to provide the most value to the company
- to achieve maximum personal growth

**Buskerud University College**
- share how to provide students with experience
- to ensure industry involvement
- to ensure industry value
Evolution from Engineer to Systems Engineer

Traditionally systems engineers "grow" in decades. Traditionally, systems engineers are expected to develop a broad range of knowledge and skills, which they acquire through years of experience. However, this growth is often met with a narrowing of expertise, as systems engineers specialize in specific areas.

In contrast, a systems engineer is expected to maintain a deep understanding of their primary discipline, while also having a deep understanding of related disciplines. This requires a balance between depth of knowledge and breadth of knowledge. A systems engineer is expected to have a broad understanding of the entire system they are working on, while maintaining a deep understanding of the specific area they are responsible for.

The diagram illustrates the evolution from an all-round engineer to a systems engineer, emphasizing the importance of maintaining both depth of knowledge and breadth of knowledge.
Industry Master time line

**Bachelor**

- Science or Engineering

**Master**

- Systems Engineering

**Work Experience**

- SE courses
- Electives
- Part-time job
- Master project

- Mono-disciplinary knowledge (theory)
- Multi-disciplinary skills (practice)
- Mono-disciplinary skills (practice)
- Multi-disciplinary knowledge (theory)

Time: 3 years 3 years
Intended growth of Industry Master students

- Bachelor
- Master
- On the job training
- Systems engineer

Theory → Practice

Mono-disciplinary root knowledge to be maintained

Depth of knowledge → Breadth of knowledge

Time

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IMWEfromBachelorToSE
Intended growth of Part-time student (1)

- Part-time systems engineer
- Mono-disciplinary root knowledge to be maintained
- Depth of knowledge
- Breadth of knowledge

On the job training

Legend:
- System
- Mono-disciplinary

Industry Master; Engineering Work Experience part-time Job

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Intended growth of Part-time student (2)

- All round engineer
- Part-time master

On the job training:
- Theory
- Practice

Systems engineer

Legend:
- System
- Mono-disciplinary

Depth of knowledge

Breadth of knowledge

Mono-disciplinary root knowledge to be maintained
Overload of Impressions for Fresh Bachelors

- processes
- procedures
- tools
- organization
- requirements
- engineering
- testing
- documentation
- changes
- components
- technology
- functions
- products
- systems
- "hard" technology

- humans
  - project leader
  - managers
  - colleagues
  - project engineer
  - other disciplines
  - CEO
  - CFO

- process/organization
  - systems engineering

- finance
  - EBITA
  - RONA
  - NRE
  - sales price
  - ROI
  - cost
  - margin

- business functions
  - logistics
  - production
  - sales
  - service
  - quality assurance

- customer/life cycle
  - legacy
  - installed base
  - problems

Industry Master; Engineering Work Experience part-time Job
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IMWEcontextExperience
## Employer Guidelines

### What is the employer expected to do?

- Treat industry master as "normal" engineer.
- Taking part-time into account.
- Provide limited scope engineering tasks.
- Allocate capacity and responsibility for work and study related coaching.
- Provide regular feedback to the student.
- Appraise according HR system.
- Involve students in meetings and business processes.

### What does the employer get in return?

- Normal engineering tasks are being done.
- Inquisitive employee.
- Broader and productive engineers tailored to own needs and domain.
- Long term more systems engineers.
## What is the employee expected to do?

+ to perform normal engineering tasks
+ to be inquisitive, curious, wondering
+ to be cooperative
+ to work hard (it is more difficult to deliver part-time)
+ to reflect on theory and practice of Systems Engineering
+ to apply as much exercises and home work on local situation

## What does the employee get in return?

+ building up engineering experience
+ appreciation for Systems Engineering methods and techniques
+ a rich frame of reference
+ personal development
be modest in view of domain knowledge
but don't underrate SE knowledge
Roles

- **company supervisor**
  - keep in contact with BUC
  - work related
  - what tasks, duties
  - when, how much time
  - how
  - feedback on results
  - embedding in organization
    - study related
  - support to find right:
    - means, people, documentation
  - stimulates reflection
  - monitors growth

- **student**
  - work
  - study
  - try-out SE techniques and methods in job (low-key)
  - apply exercises and home work
    on local situation
  - reflect
  - attend education and workshops
  - keep in contact with supervisors and BUC

- **Buskerud University College**
  - provide education
  - provide workshops:
  - monitor growth
  - monitor SE relevance
  - keep in contact with HR, supervisor, and students
What is Competence?

<table>
<thead>
<tr>
<th>Attitude</th>
<th>(perseverance, faith, critical, constructive, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train</td>
<td></td>
</tr>
<tr>
<td>Ability</td>
<td>(know when to use what skill and knowledge)</td>
</tr>
<tr>
<td>Apply/use often, experience</td>
<td></td>
</tr>
<tr>
<td>Skills</td>
<td>(calculate missing angle, calculate hypothenusa)</td>
</tr>
<tr>
<td>Exercise</td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td>(triangle has 3 corners, sum of angles is 180 degrees, Pythagoras $c^2 = a^2 + b^2$)</td>
</tr>
<tr>
<td>Learn</td>
<td></td>
</tr>
</tbody>
</table>

Competence = knowledge + skills + ability + attitude
Competence Program Partitioning

what

attitude
ability
skills
knowledge

how

lecturing
exercises
assignments
practice
coaching
reflection

who

teacher/coach
participant
Examples of Respective Tasks for Students

**typical engineering tasks**

1. make minor change(s) to component or function
2. make sizable change(s) to component or function
3. add feature(s) or function(s) to component
4. execute tests at subsystem level
5. participate in requirement review at component level
tasks evolve, similar to other new engineers

- single tasks evolve, similar to other new engineers
  - engineer
  - technology
  - discipline
  - aspect
  - stakeholder
  - well defined
- few tasks evolve, similar to other new engineers
  - engineers
  - technologies
  - disciplines
  - aspects
  - stakeholders
  - less defined
RP: Stimulate Students to Relate Theory and Practice

Reflective Practice

School
(Theory)
SE courses

Work
(Practice)
work in company

Master Project
last half year of study

workshops during first years of study
Non-disclosure of Confidential Information

All information exchanged between HiBu staff and students is to be treated as confidential

Academic supervisors are not allowed to make any confidential information public without permission of the company

Exception is information that was already known to the supervisor or is already public

See publication procedure http://www.gaudisite.nl/BuskerudSEpublicationProcedureSlides.pdf
Reflection by WWHWWW Questions

Why
What
How
Who
When
Where
Example questions for Mentors

What change/feature/... is asked for?
What are the requirements for this change/feature/...?
Who is asking for it?
Why is that stakeholder asking for it?
What are the needs and concerns of this stakeholder?
When is the deadline for this task?
How will the task be realized?
What tools, methods, techniques have to be applied?
What company processes apply?