Abstract

The master study Systems Engineering is completed by performing a thesis project. This document describes objectives and guidelines for the project and the thesis.
### Objectives of Master Project

**SE courses**
- SE fundamentals
- architecture & design
- integration & test
- logistics
- electives

**industrial context**

**case**

**apply**

**value**

**reflect**

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Apply SE methods, techniques, and concepts in practice and reflect on its application, while providing value to the industrial sponsor.
The goals of the Final Project are:

- the students have to prove again their professional competence and the acquired command of the systems engineering discipline by applying it to a selected problem.

- the selected problem has to be relevant in the context of the company in which the student works, so that knowledge is truly put into practice.

- to facilitate the students to make the step from “just applying” to “critical reflection”.

- to verify that students are capable to operate at academic level.
Stakeholders of the Master Project

- academic supervisor
- coaching
- quality
- grading

- master project

- student
- research paper

- industrial company
  - sponsor
  - industrial context
  - usable results

- company supervisor
  - coaching
  - industrial case

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Systems Engineering Master Project
4  Gerrit Muller

version: 1.7
October 20, 2017
SETP stakeholders
Scoping is Crucial

<table>
<thead>
<tr>
<th>What methods, techniques, tools, concepts</th>
<th>Systems Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>What (sub)systems, releases, functions, qualities, aspects, disciplines, technologies</td>
<td>industrial</td>
</tr>
<tr>
<td>What timing of activities and deliverables</td>
<td>planning</td>
</tr>
<tr>
<td>What resources (student time, means, advisors)</td>
<td>planning</td>
</tr>
<tr>
<td>What approach, criteria</td>
<td>research</td>
</tr>
</tbody>
</table>
Case Positioning

organizational and operational context

System 1
sub-system component component
sub-system component component

System n
sub-system component component
sub-system component component

system requirements
design decisions
parts connections lines of code

number of details

10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
Depth, Breadth and Reflection

SE body of Knowledge

organizational and operation context
user needs and system requirements

design and realization

system requirements
design decisions
parts connections
lines of code

number of details

organizational and operational context

System 1
 subsystem component
 subsystem component
 subsystem component
 subsystem component

System n
 subsystem component
 subsystem component
 subsystem component
 subsystem component

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SETPcaseT
Difference Academic and Industrial Goals

- Academic perspective
  - Organizational and operation context
  - User needs and system requirements
  - Design and realization
  - Case connection

- Industrial perspective
  - SE body of Knowledge
  - Reflection
  - Means (breadth and depth)

- SE body of Knowledge
  - Goal
  - Means
Process of Master Project

1. Pick subject
2. Secure supervisors (NISE, industry)
3. Write proposal, project plan; for paper write abstract
4. Perform project; involve supervisors regularly
5. Write paper and iterate with supervisors
6. Present master project
7. Grading by academic and external assessors
8. Graduation

Publication in journal or conference
SEMP Workshops

- **anticipating in RP how to apply**
  - August

- **approach searching a topic**
  - June

- **research methods prepare academic**
  - August

- **project execution**
  - September

- **academic writing**
  - February

Tentative dates for milestones for IM students

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SEMPworkshops
Master Project Milestones

- **Proposal**
  - System
  - SE need company
  - September

- **Abstract**
  - Academic contribution
  - November

- **Book Plan**
  - Introduction
  - Check structure, style
  - February

- **Final Paper/Report**
  - Presentation
  - May

Tentative dates for milestones for IM students
Plan: Simple PERT Diagram

control system architecture and design
incremental build mathematical models, simulate various inputs
analysis and simulation f1
analysis and simulation f2
"simple" context model, analyze system impact and adapt requirements
verify system performance

analyze stakeholders, requirements, analyze system concepts and context
write phase report
report layout
write draft paper and include findings
finalize paper

legend
- case (depth) 70%
- system and context (breadth) 20%
- "meta" reflection and consolidation 10%

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Percentage</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control system architecture and design</td>
<td>70%</td>
<td>1 wk</td>
</tr>
<tr>
<td>Incremental build mathematical models, simulate inputs</td>
<td>70%</td>
<td>~2 wks</td>
</tr>
<tr>
<td>Analysis and simulation f1</td>
<td>50%</td>
<td>5 wks</td>
</tr>
<tr>
<td>Analysis and simulation f2</td>
<td>20%</td>
<td>~4 wks</td>
</tr>
<tr>
<td>&quot;Simple&quot; context model, analyze system impact and adapt requirements</td>
<td>20%</td>
<td>~4 wks</td>
</tr>
<tr>
<td>Verify system performance</td>
<td>10%</td>
<td>1 wks</td>
</tr>
<tr>
<td>Analyze stakeholders, requirements, analyze concepts</td>
<td>10%</td>
<td>1 wks</td>
</tr>
<tr>
<td>Write phase report</td>
<td>10%</td>
<td>1 wks</td>
</tr>
<tr>
<td>Report layout</td>
<td>10%</td>
<td>1 wks</td>
</tr>
<tr>
<td>Write draft paper and include findings</td>
<td>10%</td>
<td>10 wks</td>
</tr>
<tr>
<td>Finalize paper</td>
<td>60%</td>
<td>2 wks</td>
</tr>
</tbody>
</table>
"A good abstract should answer three questions:

What did I do,
what did I learn,
and why is that important?

The key is to identify something or things that can be reused in the future."

Prof. Michael Pennotti, Stevens Institute of Technology
"fast forward" yourself into the future. What do you expect to be the project outcome?

Students write an initial abstract at the start to think through what can happen. At the end of writing the paper, you write the real abstract. The academic supervisor has to accept the initial abstract before starting the project.
<table>
<thead>
<tr>
<th>Project Execution</th>
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</thead>
<tbody>
<tr>
<td>maintain a project log</td>
</tr>
<tr>
<td>keep supervisors involved</td>
</tr>
<tr>
<td>time box and iterate</td>
</tr>
<tr>
<td>early feedback on paper</td>
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</tbody>
</table>
1. Explanation of the subject; what is the goal of the project?

2. Positioning of the subject in the academic context and literature; what does this paper add to the Body of Knowledge?

3. How is the project performed, what has been done.

4. Evaluation of the project, reflection on the results and the project itself.

5. Paper should be submittable to a refereed conference or to a journal; the academic supervisor may accept a report as well.
1. Clearly introduce the problem that the manuscript is discussing/addressing,

2. Discuss the problem background. That is, discuss the research that has been previously conducted by you or others in the field (or related fields) to solve/address the same or similar problem,

3. Develop a succinct argument for the methods or ideas proposed in your manuscript,

4. Present a clear and understandable justification of why the proposed methods or ideas contribute to a superior or different solution to the problem. A clear statement of your contributions is often crucial to reviewers. Clear specify this when possible. And finally,

5. Discuss the likely future directions of the research being conducted by you (your group).

student presentation of master project
~30 minutes presentation
~20 minutes questioning by examinators
~10 minutes examinators conclude
committee:
- academic supervisor
- at least one other academic staff member of SE
- external assessor
- (optional) company supervisor or representative
- at least 3 people
<table>
<thead>
<tr>
<th>Step</th>
</tr>
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<tbody>
<tr>
<td>Company screens paper for sensitive or confidential issues, see <a href="http://www.gaudisite.nl/BuskerudSEpublicationProcedureSlides.pdf">http://www.gaudisite.nl/BuskerudSEpublicationProcedureSlides.pdf</a></td>
</tr>
<tr>
<td>Select target journal or conference, typical choices are:</td>
</tr>
<tr>
<td>INCOSE symposium, CSER, Journal of SE</td>
</tr>
<tr>
<td>Transform the paper into the prescribed format or template</td>
</tr>
<tr>
<td>Review of the paper by NISE and Company, adapt paper</td>
</tr>
<tr>
<td>Submit paper to journal or conference</td>
</tr>
<tr>
<td>Process journal or conference feedback</td>
</tr>
<tr>
<td>Final review by company</td>
</tr>
<tr>
<td>Submit final version</td>
</tr>
<tr>
<td>Visit conference and present paper</td>
</tr>
</tbody>
</table>
If a third party is involved, e.g. a customer or supplier, then ask the third party to agree with publication procedure:


and ask who will be reviewer for the third party.
Submission instructions

use for all preparation deliverables the following conventions:
filename: SEMP <your name> <subject>..<version>..<extension>
  e.g. SEMP John Student abstract.2.doc
where subject = {proposal | abstract | plan | presentation | paper | ...}

email to:      <gerrit . muller @ gmail . com>
subject:       SEMP <subject>

"standard" file types preferred, e.g. pdf, jpg, doc, xls, ppt
workshop 1 in June
workshop 2 in August
workshop 3 in September
   Master Project; Writing an Abstract: http://www.gaudisite.nl/MasterProjectWritingAnAbstract.pdf
   Master Project; Execution Phase: http://www.gaudisite.nl/MasterProjectProjectExecution.pdf
Validation of Systems Engineering Methods and Techniques in Industry
Systems Engineering Research Methods (paper)
Published Master Project papers: http://www.gaudisite.nl/MasterProjectPapers.html
Workshop Academic Writing http://www.gaudisite.nl/RPacademicWritingSlides.pdf