INNOVATIVE COMMUNICATION TECHNOLOGIES AND ENTREPRENEURSHIP (ICTE)

MASTER OF SCIENCE (MSc) IN ENGINEERING

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Presentation for ICTE industry panel, Nov. 13, 2014
Agenda

- About CMI
- The teaching programmes
- Motivation and background
- "Old" structure (2010 – 2013)
- New structure (2014 - ?)
- Some issues for discussion
About CMI

- CMI (center for Communication, Media and Information technologies) is a cross-disciplinary center at AAU Cph, formed in 2008
- We have “a history” from DTU (from our former center CICT)
- We belong to Department of Electronic Systems at AAU
- We work with mobile, Internet and digital media technologies and study
  - how these technologies can be applied in new and creative ways
  - how they can generate new business opportunities
- We are currently ~50 people:
  - 10 teachers (professors, associate/assistant professors)
  - ~30 PhD students and research associates
  - a number of external teachers
  - 1 secretary and 1 study secretary
Present competences at CMI

• Engineering focusing on service and technology development
  o Application development, smart devices, Internet technologies, security, digital content, privacy, digital identities, network technologies, digital broadcast, …

• Engineering focusing on user involvement
  o Interaction design, user experience, user needs

• Economics – micro, meso and macro
  o Managerial economics, standardization, business models, innovation, entrepreneurship

• Applications of ICT in society
  o Services and solutions for private and professional users
  o Drivers and barriers
Collaboration with industry

• Teaching is developed in collaboration with industry
  o Danish Industry: ITEK / DI, IT-B
  o Motorola
  o TDC
  o DR
  o Teracom Denmark
  o Public authorities in Denmark

• Innovation and entrepreneurship
  o Start-up companies: Mediathand, EyeTribe, BlueTown, etc.
  o Volvo, Svensk Prövning, ...

• Collaboration with industry in national and international research projects and networks
International collaboration

• Ghana Telecom University College (GTUC)
  o ~20 PhD students enrolled at AAU / CMI
• Vishwaniketan's Institute of Management Entrepreneurship & Engineering Technology [IMEET], Pune, India
  o ~5 PhD students enrolled at AAU / CMI
• Center for TeleInFrastructure (CTIF)
  o Based at AAU in Aalborg
  o International units in Rome, Japan, India, USA
• Wireless World Research Forum (WWRF)
• IEEE
• Conferences: ITS, Euro-CPR, ...
• Networks
• Research projects
THE TEACHING PROGRAMMES
- AND SOME STATISTICS
The teaching programmes

- The BSc programme
  - IT, Communication and New Media (ITCOM), including areas such as new generations of mobile networks, wireless networks, digital broadcast networks, etc.
- The MSc programme
  - Innovative Communication Technologies and Entrepreneurship (ICTE) giving a solid application-oriented knowledge within the area of ICT with special emphasis on user- and business aspects
- The PhD programme
  - Multidisciplinary analyses / development of ICT
- The continuing education programme: Master of ICT (MICT)
## Timeline of events

<table>
<thead>
<tr>
<th>When</th>
<th>What</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early 2008</td>
<td>CMI founded (core group from the former center at DTU called CICT)</td>
</tr>
<tr>
<td>Summer 2008</td>
<td>Development of new BSc and MSc study programmes:</td>
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<tr>
<td></td>
<td>- ITCOM: Only in Copenhagen</td>
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<tr>
<td></td>
<td>- ICTE: Both Copenhagen and Aalborg, CMI proposal merged with initiative in Aalborg</td>
</tr>
<tr>
<td>Sept. 1, 2008</td>
<td>Applications for accreditation submitted to ACE Denmark</td>
</tr>
<tr>
<td>Jan. 2009</td>
<td>ICTE approved</td>
</tr>
<tr>
<td>May 2009</td>
<td>ITCOM approved</td>
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<tr>
<td>Aug. 2009</td>
<td>Decision to close down the old MSc specializations CNS and CVG in Ballerup</td>
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<tr>
<td></td>
<td>CNS merged into ICTE as a 3rd track</td>
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<tr>
<td>Sept. 2009</td>
<td>ICTE launched</td>
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<tr>
<td>Nov. 2009</td>
<td>Decision to have February intake for ICTE in Ballerup</td>
</tr>
<tr>
<td>Sept. 2010</td>
<td>ITCOM launched</td>
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<tr>
<td>2010-2011</td>
<td>Work on revision of ICTE study plan (effective from Sept. 2011)</td>
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<tr>
<td></td>
<td>New template: Knowledge, skills, competencies, ...</td>
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<tr>
<td>2013-2014</td>
<td>Major revision of ICTE Copenhagen part: New courses, only 2 tracks,</td>
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<td></td>
<td>+ agreement with the M-Tech research group to be involved in ICTE</td>
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<tr>
<td></td>
<td>Decision by the Faculty to terminate February intake on ICTE</td>
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<tr>
<td></td>
<td>Decision to close down the Aalborg part of ICTE</td>
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<tr>
<td>2014</td>
<td>New accreditation for ICTE Copenhagen demanded by ACE Denmark</td>
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<td></td>
<td>Application to be submitted Dec. 2014</td>
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<tr>
<td>Feb. 2015</td>
<td>New ICTE curriculum effective</td>
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</tbody>
</table>
Innovative Communication Technologies and Entrepreneurship
(Future title: IT, Communication and Entrepreneurship)

**Directly qualifying bachelor’s degrees:**
- IT, Communication and New Media (ITCOM)
- New: BSc in Medialogy
- A number of other selected BSc degrees from AAU and DTU

**Other bachelor’s degrees within “Technical IT”:**
- Must have a sufficient level of IT skills
- Individual assessment of applications
- Special option: 1-year supplementary programme with 60 ECTS courses and projects from ITCOM. Students enrol on the “Student Place Vacancy Scheme” through EVU at AAU

.Master of Science (MSc) in Engineering: Innovative Communication Technologies and Entrepreneurship (ICTE)

2 years (120 ECTS)
Student population at CMI, Sept. 2014

- **ITCOM (BSc)**
  - 1\textsuperscript{st} semester: ~59 students (in FRK 6)
  - 3\textsuperscript{rd} semester: ~39 students
  - 5\textsuperscript{th} semester: ~19 students

- **ICTE (MSc)**
  - 1\textsuperscript{st} semester: 16 students
  - 2\textsuperscript{nd} semester: 6 students
  - 3\textsuperscript{rd} semester: 16 students
  - 4\textsuperscript{th} semester: 7 students

- **MICT (continuing education)**
  - 16 students

In total at CMI: ~180 students
Evolution of total number of students

ITCOM & ICTE: Total number of degree students

<table>
<thead>
<tr>
<th>Year</th>
<th>ITCOM</th>
<th>ICTE-C</th>
<th>ICTE-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009 Fall</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2010 Spring</td>
<td>9</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>2010 Fall</td>
<td>22</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>2011 Spring</td>
<td>22</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>2011 Fall</td>
<td>43</td>
<td>27</td>
<td>6</td>
</tr>
<tr>
<td>2012 Spring</td>
<td>42</td>
<td>24</td>
<td>5</td>
</tr>
<tr>
<td>2012 Fall</td>
<td>57</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>2013 Spring</td>
<td>56</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>2013 Fall</td>
<td>85</td>
<td>28</td>
<td>1</td>
</tr>
<tr>
<td>2014 Spring</td>
<td>82</td>
<td>32</td>
<td>0</td>
</tr>
<tr>
<td>2014 Fall</td>
<td>105</td>
<td>43</td>
<td>2</td>
</tr>
</tbody>
</table>

Nov. 13, 2014

AALBORG UNIVERSITY DENMARK
Convergence: Technologies, market and users!

Drivers and barriers!

- Market players
- Licenses and regulation
- Business models
- Billing and pricing
- Competition
- Operator strategies
- Fight between standards
- Standardisation bodies

- User needs
- Service delivery
- Types of services
- Cost of services
- Content
- Ease of use
- Personalization
- Privacy
- Security
- Implications of ICT
- ICT strategic problem solving
- Green ICT

- Networks
- Terminals
- Software tools
- Content management
- Security
The future Internet

Service architecture

A lot of networks!
(Fixed, mobile, wireless, broadcasting, ...)

Business models?

What needs to be in here?

How do we bind top and bottom together?

User experience?

Business models?

Content provider

Payment provider

Equipment producer

Regulator

Content aggregator

Service provider

Network operator

Market & Regulation

Networks & software technologies

End users

Mobile devices

Computers

Digital TV

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What do we want from our candidates?

• “... explore and exploit the potential of new ICT and media technologies with an engineering approach ...”
  o They should be able to develop innovative solutions and services, which can advance the field and make a difference
  o They should be able to make really solid requirement specifications for their prototypes taking into account all the relevant aspects
  o They should have a solid background in network technologies, Internet technologies, business aspects and standards in order to make good engineering decisions
  o They should be capable of analysing a “full-scale” solution and then realize a more limited prototype as a part of that

• “... contribute creatively and innovatively to identify and propose new business opportunities ...”
  o They should be innovative and creative, be entrepreneurs
"Pushing the boundaries"

ICT services
("Toolbox")

- Content
- Information
- Innovation
- Entrepreneurship

- Business model?
- Market conditions

- Technical limitations

- Privacy
- Ethics
- Security
- Usability

- Legislation
- Standards
- Patents
- DRM
- Copyright

Nov. 13, 2014
Need for T-Shaped Professionals:
ICT-enabled deep expert-thinking and broad complex communications

Broad across many, deep in at least one …
Converging media technologies

Need for engineers with solid technical competences with a focus on user needs and market potential => Innovation, entrepreneurship!
“OLD” STRUCTURE
(2010 – 2013)
Initial structure of ICTE (2008 application)

1st & 2nd semester:
- Platforms & applications (Common)

3rd & 4th semester:
- Converging Media
- Telecommunications Infrastructure

Copenhagen

Aalborg
ICTE specializations and sub-specializations

(separate admission in Copenhagen and Aalborg)

Copenhagen:

- Converging Media Technologies
  - Service development
  - Business development
  - Secure services and technologies

Aalborg:

- Telecom Infrastructures
  - Cognitive Radio
  - eHealth

Nov. 13, 2014
Three tracks leading to different job profiles

- **Service development – engineers who**
  - Can design and develop creative and innovative ICT services, applications and solutions
    - using state-of-the-art technologies
  - Can set up a valid requirement specification
  - Understand the user requirements and the context of use for new ICT services and solutions
  - Understand how users interact with and experience ICT in their daily life

- **Business development – engineers who**
  - Are capable of analyzing the implications of new technologies
  - Can contribute to ICT innovation
  - Can contribute to development of new business models and revenue sharing models
  - Can solve IT-strategic problems
  - Understand regulatory issues

- **Secure services and technologies – engineers who**
  - Can develop applications with a focus on security aspects
  - Can perform analysis of security risks, trouble-shooting
  - Can develop secure solutions and services for authentication, identity management and payment
  - Can take part in the development of new secure network technologies (e.g. sensor networks or body networks)
Courses and projects

• Technology
  o Internet technologies and service architectures
  o Communication and broadcast networks
  o Development of ICT and media services
  o Application security and identity management
  o Content and media management
  o Advanced security topics

• Users and society
  o Interaction design
  o Cognitive systems and semantic modelling
  o Creativity and ICT design

• Market
  o Entrepreneurship, innovation and business models
  o Managerial economics
  o Standardization
  o Governance of ICT infrastructures
  o Governance of ICT content, services and applications

• General
  o Project-Organized Problem Based Learning and Scientific methods
  o Green ICT – Business of sustainability

• Semester projects

--- : Mandatory
--- : Mandatory / elective
--- : Elective
# The MSc program: ICTE tracks and semester themes

(September intake)

<table>
<thead>
<tr>
<th>Semester</th>
<th>Service development</th>
<th>Business development</th>
<th>Secure services and technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st semester</strong></td>
<td></td>
<td><strong>Services and platforms</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Communication and broadcast networks</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td><strong>Entrepreneurship, Innovation and Business Models</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td><strong>Internet technologies and service architectures</strong></td>
<td></td>
</tr>
<tr>
<td><strong>2nd semester</strong></td>
<td><strong>Application development</strong></td>
<td><strong>Design and markets</strong></td>
<td><strong>Secure services</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Development of ICT &amp; media services</strong></td>
<td><strong>Managerial economics</strong></td>
<td><strong>Application security &amp; identity management</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Interaction design</strong></td>
<td><strong>Standardization</strong></td>
<td><strong>Development of ICT &amp; media services</strong></td>
</tr>
<tr>
<td></td>
<td>+ 1 elective</td>
<td>+ 1 elective</td>
<td>+ 1 elective</td>
</tr>
<tr>
<td><strong>3rd semester</strong></td>
<td><strong>Advanced ICT solutions</strong></td>
<td><strong>Governance and strategies</strong></td>
<td><strong>Secure technologies</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Content &amp; media management</strong></td>
<td><strong>Governance of ICT infrastructures</strong></td>
<td><strong>Advanced security topics</strong></td>
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<tr>
<td></td>
<td>+ 2 electives</td>
<td>+ 2 electives</td>
<td>+ 2 electives</td>
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<tr>
<td><strong>4th semester</strong></td>
<td></td>
<td></td>
<td><strong>MSc Thesis project</strong></td>
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</table>
## ICTE tracks and semester themes

(February intake)

<table>
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<th>Semester</th>
<th>Service development</th>
<th>Business development</th>
<th>Secure services and technologies</th>
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</thead>
<tbody>
<tr>
<td>1st semester</td>
<td>Application development</td>
<td>Design and markets</td>
<td>Secure services</td>
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<td></td>
<td>Development of ICT &amp; media services</td>
<td>Managerial economics</td>
<td>Application security &amp; identity management</td>
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<tr>
<td></td>
<td>Interaction design</td>
<td>Standardization</td>
<td>Development of ICT &amp; media services</td>
</tr>
<tr>
<td></td>
<td>+ 1 elective</td>
<td>+1 elective</td>
<td>+ 1 elective</td>
</tr>
<tr>
<td>2nd semester</td>
<td>Services and platforms</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Communication and broadcast networks</td>
<td></td>
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<tr>
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<td>Entrepreneurship, Innovation and Business Models</td>
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<td>Governance of ICT infrastructures</td>
<td>Advanced security topics</td>
</tr>
<tr>
<td>3rd semester</td>
<td>Advanced ICT solutions</td>
<td>Governance and strategies</td>
<td>Secure technologies</td>
</tr>
<tr>
<td></td>
<td>2 electives</td>
<td>2 electives</td>
<td>2 electives</td>
</tr>
<tr>
<td>4th semester</td>
<td>MSc Thesis project</td>
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NEW STRUCTURE
(2014 – ?)
We are currently in a transition phase. The future title is likely to be:

**MSc in IT, Communication and Entrepreneurship**

(running only in Copenhagen)
Service development

Engineering profile:

- Understand how users interact with and experience ICT in their daily life
- Understand the user requirements and the context of use for new ICT services and solutions
- Can set up a valid requirement specification
- Can design and develop creative and innovative ICT services, applications and solutions
- Can develop applications with focus on security aspects
- Can develop secure solutions and services for authentication, identity management and payment
- Can perform analysis of security risks, trouble-shooting

Job opportunities

- Companies in the IT, telecom and media industry
- Infrastructure, service and content providers
- Contribute to new services and solutions, which target the needs of users in their daily life
- Develop secure services, e.g. for mobile payment
- Focus on user requirements, user interfaces and user experience
- Act as a link between development units and sales & marketing division – because you understand both sides!

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Business development

Engineering profile:

• Are capable of analyzing the implications of new technologies
• Understand regulatory issues
• Can solve IT-strategic problems
• Can contribute to development of new business models and revenue sharing models
• Can contribute to ICT innovation

Job opportunities

• Consultant firms
• Public authorities
• Analyse new ICT technologies and their implications
• Segmentation of users, identifying target users
• Contribute to strategy, decision making and business development based on new ICT opportunities

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Courses and projects

• Technology
  o Internet technologies and service architectures
  o Communication and broadcast networks
  o Development of ICT and media services
  o Identity and access management
  o Content and media management
  o Smart sensor data processing (*)

• Users and society
  o Interaction design
  o Cyber security and trust

• Market
  • Entrepreneurship, innovation and business models
  • Managerial economics
  • Green ICT – Sustainable business development
  • Standardization
  • Internet economics and governance

• General
  • Project-organized Problem Based Learning (POPBL) and scientific methods

• Semester projects

(*) The M-Tech group at AAU-Cph contributes with this course and supervision of semester and thesis projects
# ICTE tracks and semester themes

<table>
<thead>
<tr>
<th>Semester</th>
<th>Service development</th>
<th>Business development</th>
</tr>
</thead>
</table>
| 1<sup>st</sup> semester | Services and platforms  
Communication and broadcast networks  
Enterprise, Innovation and Business Models  
Internet technologies and service architectures | | |
| 2<sup>nd</sup> semester | Application development  
Development of ICT & media services  
Identity and access management + 1 elective | Design and markets  
Managerial economics  
Green ICT – Sustainable business development + 1 elective |
| 3<sup>rd</sup> semester | Advanced ICT solutions  
Content & media management + 2 electives | Governance and strategies  
Standardization  
or Internet economics & Governance + 2 electives |
| 4<sup>th</sup> semester | | MSc Thesis project |
ICTE courses and tracks (Regular)

Spring
- Smart sensor data processing
- Content and media management
- Identity and access management
- Development of ICT & media services
- Internet technologies & service architectures
- Project-organized Problem Based Learning and scientific methods (sub-module of semester project)

Fall
- Cyber security and trust
- Internet economics and governance
- Green ICT – Sustainable business development
- Managerial economics

Spring
- Thesis project

Business development
- Standardization
- Entrepreneurship, innovation & business models
# Alternatives for 3rd – 4th semester

<table>
<thead>
<tr>
<th>3rd semester</th>
<th>4th semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1</td>
<td>A regular semester with 3 courses and a 15 ECTS semester project</td>
</tr>
<tr>
<td>Option 2</td>
<td>Academic internship in Denmark or abroad (25 ECTS) + 1 mandatory course (5 ECTS)</td>
</tr>
<tr>
<td>Option 3</td>
<td>Study abroad (30 ECTS). In this case the 5 ECTS mandatory course may be waived.</td>
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<tr>
<td>Option 4</td>
<td>A long thesis project extending over 2 semesters, combined with the 5 ECTS mandatory course on the 3rd semester.</td>
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<tr>
<td></td>
<td>The following combinations are possible:</td>
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<tr>
<td></td>
<td>• 55 ECTS + 1 mandatory course on the 3rd semester</td>
</tr>
<tr>
<td></td>
<td>• 50 ECTS + 1 mandatory course + 1 elective course on the 3rd semester</td>
</tr>
<tr>
<td></td>
<td>• 45 ECTS + 1 mandatory course + 2 elective courses on the 3rd semester</td>
</tr>
</tbody>
</table>

Any other individual study plans must be separately approved
ICTE: Distribution of students on tracks

![Bar chart showing the distribution of students across different tracks and semesters from 2009 Fall to 2015 Spring. The chart includes data for Not decided, SST, BD, and SD categories.](chart.png)
Where do we get the students from?

• Three entry paths:
  o International Office (EU/non-EU)
  o Studiekontoret: Other Danish universities and institutions
  o Internal: AAU bachelor programmes (ITCOM and Medialogy)

• How to differentiate between bachelor and master level?
  o Conflicting requirements between our “own” students and newcomers
    ▪ More of the same (from toolbox to advanced solutions, architectures, …)?
    ▪ Supplementing the bachelor with new areas/competences, e.g. strong IT competence supplemented with more business?

• What are the main feeding lines?
  o More ITCOM students should be attracted
    ▪ 2013: 5 students out of 13 continued, 4 remain
    ▪ 2014: 1 student out of 13 continued together + 1 taking the ITCOM supplementary programme
    ▪ Bigger ITCOM batches in the future
  o Intake from Medialogy?
Some issues for discussion

• Focus of ICTE
  o (Even) more focus on entrepreneurship?
  o Structure with 2 specialisations

• Future competence profile
  o Industry needs and job opportunities
  o Narrow specialists vs. broader inter-disciplinarity
  o The PBL model, balance between courses and project work?

• New title:
  o IT, Communication and Entrepreneurship

• More collaboration with industry
  o Matching expectations
  o Internship, semester projects, thesis projects