

STUDENT PROJECTS INCLUDED IN DEGREE PROGRAMME IN MECHANICAL ENGINEERING

BACHELOR OF ENGINEERING: 240 CR

EXAMPLES OF SOME PROJECTS

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Keywords: digitalization, new technologies, learning environment, personal study path, learning enabler for internal and international students, project and team work in studies, new roles of a teacher/professor, new roles of a student, project classification and pricing

1. OPENLAB INTRODUCTION

1.1. Background to Openlab concept

Global change happens very rapidly nowadays. However, continuous technological change, creativity and fast innovations influence economic growth. Recent digitalization and new technologies have changed the humans' way to live and co-operate permanently: Global and fast communication, international networks and competition, Real time worldwide knowledge and technology transfer, time and place independent services and education, from company internal innovation to open innovation, robots in work round-the-clock [1].

1.2. Openlab as a learning environment

New roles of a teacher/professor: Teacher/Professor has become a coach for students, a specialist for companies, a project member or manager, a salesperson for university products (education, RDI-projects, services).

New roles of a student: Student has become an individual with PEP and personal study path, a lifetime customer for an education organization, and a team and network player with a huge amount of information on hand, Figure 1.



Figure 1.
New roles of a student

The OpenLab teaching environment makes it possible to combine teaching and RDI activities. Good examples are the Intelligent Machines Degree Programme,

https://www.metropolia.fi/fileadmin/user_upload/M.fi-2015/Palvelut/Julkaisut/MET_inssiforum_04092015.pdf

and participation of Student Formula competition, <http://tamkjournal.tamk.fi/kymmenen-vuotta-formula-student-projektia-tamkissa/>.

1.3. Openlab as an industrial ecosystem/RDI-platform

New roles of TAMK: TAMK as a university has become a learning experience provider and learning enabler for internal and international students (Smart Campus of Tampere3), a RDI-extension for companies, an updating educator for company personnel, and an international partner for other universities, Figure 2.



Figure 2.
New roles of TAMK

Recent changes are done to curriculum in our department

More project and team work in studies: Project management course for all students, Compulsory (20 cr) and free choice project courses (15-30 cr) included in the studies. Connecting TAMK RDI-projects to student work. Students involved more working in TAMK RDI-projects of different kind, Figure 3.



Figure 3.
Students involved more working in TAMK RDI-projects of different kind

Structure of the studies (240 cr)

Target to graduate in 4 years. Structure of the studies (240 cr): Basic professional studies 120 cr, Advanced professional studies 60 cr,

Free-choice studies 15 cr, Practical training 30 cr and Thesis 15 cr.

We can find the structure of the degree Programme in more detail in the curriculum.

Advances Professional Studies (60 cr) before

In addition to Basic Professional Studies, the students master a specific field of Mechanical Engineering. Department of Mechanical Engineering: Machine Automation, Product Development, Production Engineering, Intelligent Machines Together with electricity and Information Technology and Aircraft Engineering.

Advances Professional Studies (60 cr) today

School of Industrial Engineering: In addition to Basic Professional Studies, the students master a specific field of Mechanical Engineering: Machine Automation, Product Development, and Production Engineering, Intelligent Machines Together with electricity and Information Technology and Aircraft Engineering. Mechanical Engineering level multidisciplinary project course (5 cr) for all students from beginning of 2016. School of Industrial Engineering level multidisciplinary project course (5 cr) for all students.

1.4. Student project examples

Openlab concept to integrate all players

TAMK has built Openlab in 2015 to integrate all players and needs. Openlab is a learning environment. Openlab is also an industrial ecosystem/RDI-platform and rolls as a living lab: a user-centered, innovation ecosystem integrating research and innovation processes. TAMK is a member of Enol ([European Network of Living Labs](#)), Figure 4.



Figure 4.
TAMK has built Openlab to integrate all players and needs

OpenLab as a learning environment

Objectives (why & what): Industrial student projects, e.g. Intelligent machine projects, Problem based learning (workshops and student innovation in teams), New investments and learning environment development to support new operational model of collaboration and learning and Enable engineering students' invention & start-ups (e.g. TAMK students co-operative companies), Figure 5.



Figure 5.
OpenLab as a learning environment

Openlab as an industrial ecosystem/RDI-platform

RDI-project collaboration with companies Tampere region and educational units expand the network of members and partners (international partners). Technology sharing: Advanced robotics (case ABB, Social robotics' TBD), 3D printing (scanning and measurement) and AR&VR environment/platform. Innovation platform, hackathons, seminars & workshops: Industrial internet (IoT), Digitalisation, Forums related to Global network operation, Sourcing, Supply chain, Product development, etc. Laboratory services in mechanical engineering. Visit website for more: <http://www.tamk.fi/fi/web/tamk/openlab>. Industrial ecosystem in Tampere region – Intelligent Machines, it is connected to top research & education. We connect it also to new innovation and applications enablers, Figure 6, [2].

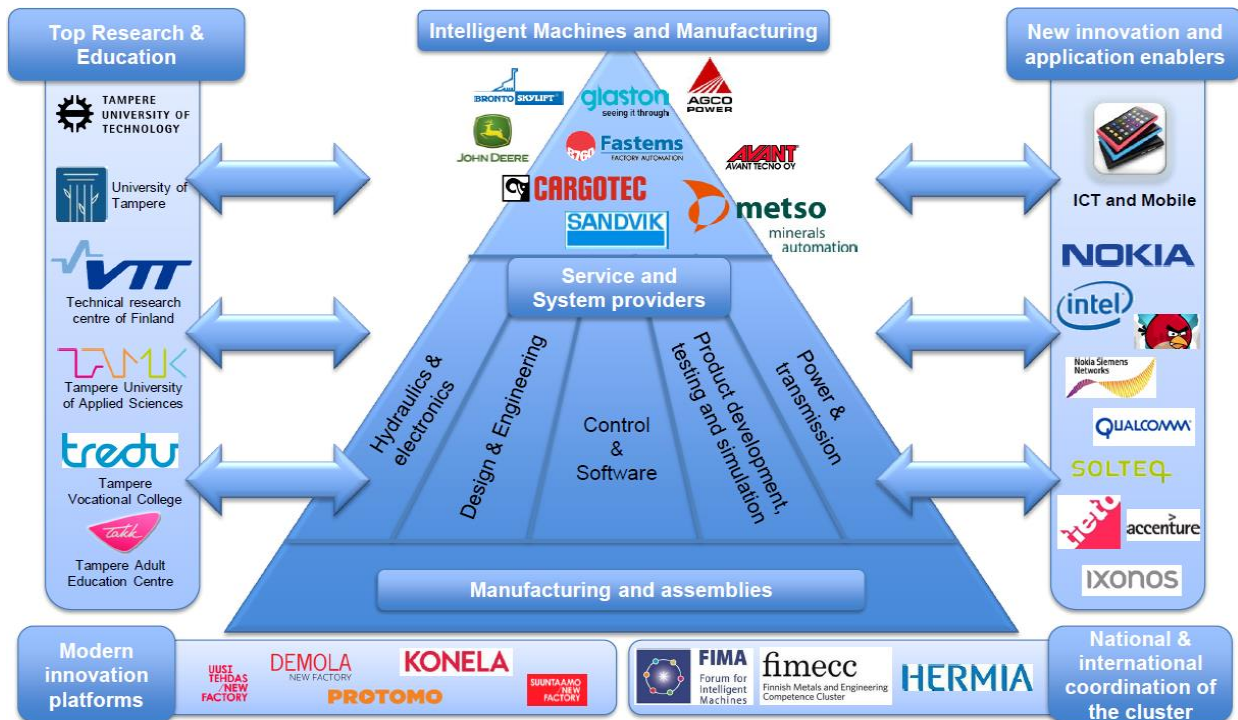


Figure 6.
Industrial ecosystem in Tampere region – Intelligent Machines, it is connected to top research & education

Openlab focus areas: Combining experiencing safely, enable doing & learning and challenge yourself. Students' projects, laboratory services, innovation projects, seminars & forums and courses & training are all possible in Openlab environment. Companies, TAMK staff, TAMK students and collaborators are working together in different projects. Facilities & services, equipment & machines, skills & expertise, students & projects have all-important role when we are discussing to solve different problems.

In Openlab environment is possible to use new technologies, AM & 3D printing, modern manufacturing technologies, quality measurements and verification, re-engineering, product design and simulation, prototyping in collaboration with Pirkanmaan Protopaja Network, digitalization and IoT, robotics and automation. Experiencing safely, enable doing, learning, and Challenge

yourself. Operational model for collaborative RDI-projects: The characteristics of the operational model for collaborative RDI-projects are easy access, trust & confidentiality, quick response, flexible curriculum, project organisation is in charge, simple rules (true network model) and visible pricing & productized offering. Ongoing: Integration to SMACC, working together with VTT and TUT also toward T3, Figure 7, [3].

Collaborative business model: Membership fee bases on the size of company. Fee covers the fixed costs from network management and general services such as meeting arrangements, single point of contact services and Seminar and project proposal & planning support. Network fee and project fee is described on Figure 8.

SMACC services: The description of SMACC services is on Figure 9.

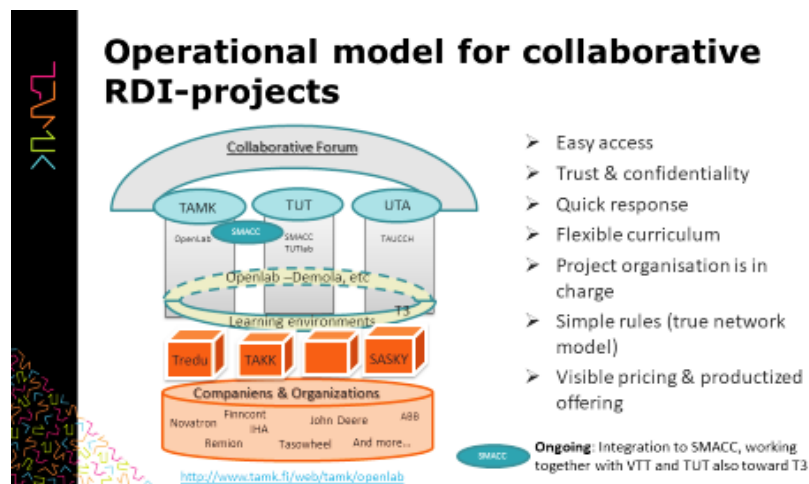


Figure 7.
Integration to SMACC, working together with VTT and TUT also toward T3

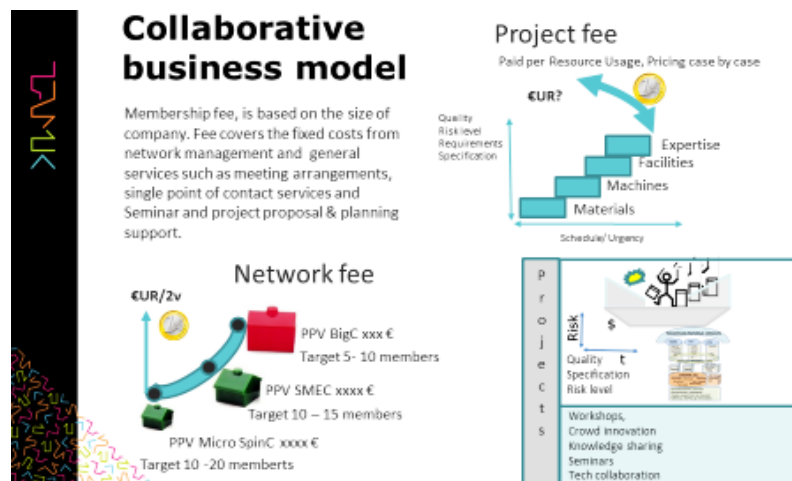


Figure 8.
Description of network fee and project fee



Figure 9.
The description of SMACC services

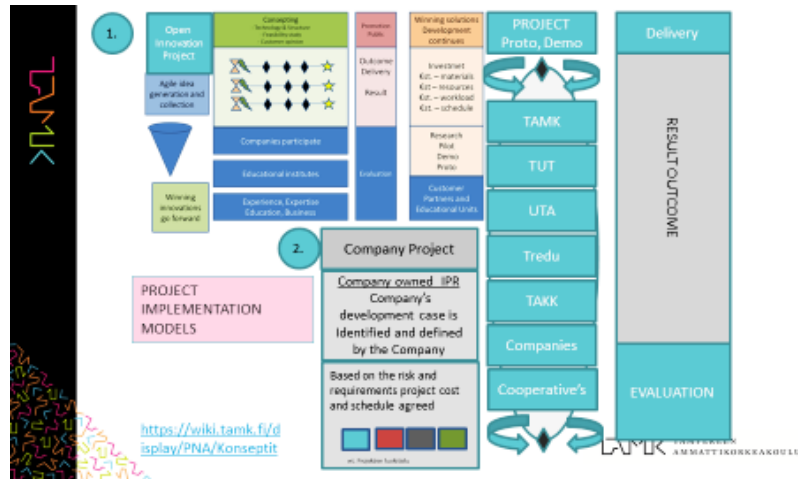


Figure 10.
The description of project implementation models

Project classification and pricing

BLUE PROJECT	ORANGE PROJECT	RED PROJECT	GREEN PROJECT	
Students Staff	Student Staff	Students Staff	Cooperative Staff	WHO'S DOING & RESPONSIBLE
LOW	MEDIUM	HIGH	LOW - MEDIUM	RISK LEVEL CHALLENGE REQUIREMENT LEVEL SCHEDULE & PRIORITY
Lower <ul style="list-style-type: none"> • Direct expenses • Rent • Travel costs 	Medium <ul style="list-style-type: none"> • Direct costs • Travel costs • Rent • Staff members salary costs (partial) 	High <ul style="list-style-type: none"> • All expenses • Staff member salary costs • Market based margin 	Low <ul style="list-style-type: none"> • Direct costs + • Moderate margin 	PRICE
Final thesis Student projects	Case based expertise + team guidance	Commercial R&D services "Engineering /consulting" Solutions to companies	Students co-operative	OTHER

Figure 11.
The description of project classification and pricing



Figure 12.
Electric walker for senior citizen

The description of project implementation models is on Figure 10.

Project classification and pricing: The description of project classification and pricing is on Figure 11.

Student Project example – VR: Examples of some students projects: Electric walker for senior citizen (Figure 12), Very large 3D-printer (1.2 m³) (Figure 13) and VR-project.



Figure 13.
Very large 3D-printer (1.2 m³)

2. MECHANICAL ENGINEERING, INTELLIGENT MACHINES

Project-Based Learning (from Mechanical Engineering Curriculum)

Together with practical work assignments and group work, a student may do projects. The projects, which instructors will supervise, can replace courses if so agreed or they can be included as free-choice studies. The subjects for the projects can come from business life or be, for example, development assignments of the laboratory. There will be a report because of the project. We will evaluate the work on the grounds of the report. Project and practical assignments have an especially important focus on the study path of production systems.

Each student will make at least one project (minimum project is five cr). Third grade students choose the study path: Industrial Engineering, Machine Automation, Product Development, Aircraft Technology, and Intelligent Machines. Depending on the study path, the size of project may be much higher.

3. INTELLIGENT MACHINES STUDY PATH

Size of the project is 30cr; length of the project is usually over year. Students from many Degree Programme in the same group (Mechanical engineering, Automotive, Electrical Power, Computer Systems). The situation is the same as at work. Topics of the project come from industry, from R&D&I work of TAMK or from students.

4. GRADES AND CREDITS

Based on hourly bookkeeping, student's portfolios and discussion. We divide the project into five parts. Preplanning a Project. Implementation skills of the project. Initiating a Project. This section provides a project schedule and project plan:

- Project Planning,
- Project Implementation,
- Project Testing.

5. PROJECT LESSONS WITH STUDENTS

Lesson 1: Introduction to principles and tools of teamwork. A project charter – says what the project will be and gives authority for the project. An SOW – deliver a Statement of Work states the products or services. A project scope statement – shows the objectives and limits of the project. A project management plan – shows how the project will be executed and controlled. A project manager is someone who is responsible for planning and running a project. A stakeholder is someone who is involved in or who is affected by a project. A team leader is someone who guides, monitors and leads a team. A key contact point is someone who is the main contact in a company or team. A consultant is someone who provides expert help and advice in a particular area. A contractor is someone who provides independent services or goods to another company.

Lesson 2: Introduction to principles and tools of teamwork.

Lesson 3: Create the groups for teamwork.

Lesson 3: Students are located in different groups.

Lesson 4: First step in teamwork is that students will present themselves to other students in English.

Lesson 5: The Assignment (assignments) will be presented to students.

Lessons 6-7: Each group will solve different task.
Task 1: Drone project.
Task 2: 3D printing and 3D In Designer project.
Task 3: Student projects with enterprises.

Lesson 7: Teacher will participate in teamwork and guide the teams.

Lesson 8: Groups will present the tasks and results.

6. GOING INTERNATIONAL

Going international 2: Goals & contents: Student gets familiar with international working environment and learn to acquire market information to support the internationalisation goals. Students familiarize themselves to strategic decision-making process, procedures and methodology concerning internationalisation. Based on the information students consider the internationalisation possibilities of their entrepreneur client, get knowledge of the target country and acquire relevant market knowledge. Methodology: independent research, group project work. Schedule:

1. Session: Goals, contents and requirements of the study module. Instructions for project work: taking the theories into possession. PESTEL-analysis and division of the target countries to project groups. Assignment instructions and requirements for the written report.
2. Session: Snapshot of the project 1 with coaching method.
3. Session: Snapshot of the project 2 with coaching method.
4. Session: Project work presentations.

Requirements to complete the course:

1. Active participation to the Project.
2. Reports: PESTEL-report: Based on PESTEL-analysis. Assignment report: Required market analysis.
3. Project presentations.

7. VR (VIRTUAL REALITY) AND AR (AUGMENTED REALITY)

On Figures 14-15 is the OpenLab environment.

On Figures 16-19 are some virtual reality and augment reality projects.



Figure 14.
The OpenLab environment



Figure 15.
The OpenLab environment

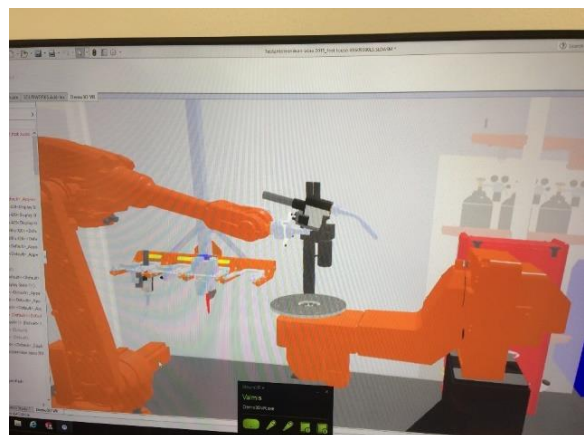


Figure 16.
VR (Virtual Reality). Real "walk" inside the CAD-model
by using Solid Works 3D-CAD software
and HTC Virtual glasses

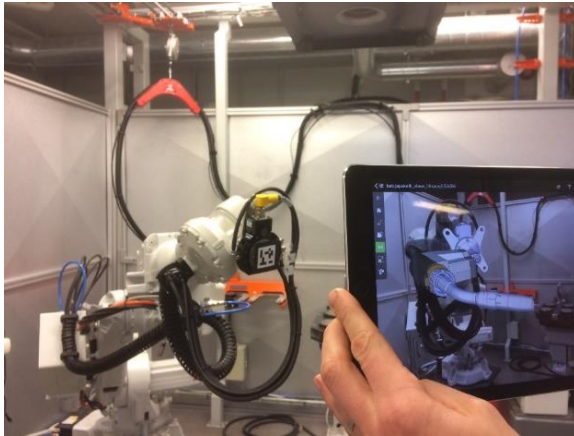


Figure 17.
Augmented reality, CAD-model has been added
in the real view



Figure 18.
Scanned room space by using Matter port

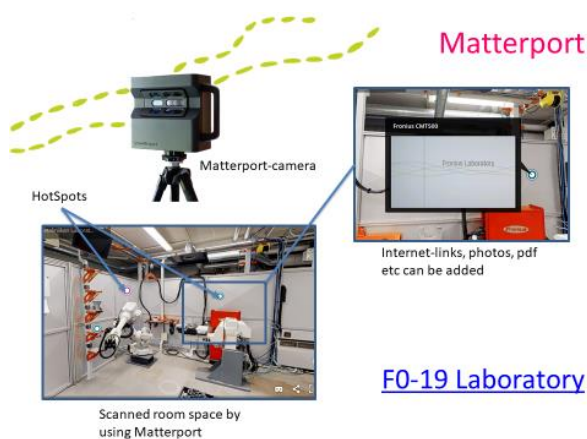


Figure 19.
Scanned room space by using Matter port.
Hotspots and Internet-links

8. ACKNOWLEDGEMENTS

The author would like to thank the following professors:

Aho Markus, markus.aho@tamk.fi,

OpenLab Introduction (Chapter 1),

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Going International.

9. CONCLUSIONS

Work is done more often in a project-oriented way and students should be well acquainted with project work already during the studies. Opening the laboratories allows the cooperation of the University, students and companies and it will benefit all parties.

10. REFERENCES

- [1] TAMK. <http://www.tamk.fi/web/tamken/home>
- [2] OpenLab. <http://smacc.fi/en/labs/openlab-prototyping-factory/>
- [3] ENOLL. <https://enoll.org/>