Software – the new math

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Tampere University of Technology

Number of students: ~10000 Teaching & Research staff: ~2000 Annual Budget: ~65ME + ~65ME Faculties:

- Automation, Mechanical and Materials Engineering,
- Business & Built Environment
- Computing and Electrical Engineering,
- Science and Environmental Engineering

Changes in society

Nokia failure has led to massive layoffs of skilled workforce

- Hands-on developers still going strong
- Middle management in particular struggling for a new job

Computing increasingly driving all fields of industry

- Partly overlooked due to the Nokia effect
- Heavy machinery still going strong
- Service businesses increasingly building on software

In general economical problems overshadow much of the social activity

Changes in university sector

Economical problems also reflect on universities

 Cuts in university bidgets; More and more difficult to establish research projects with companies that are already struggling

University system was radically altered 2010

- Really strong emphasis placed on research visibility at the cost of industry effect via graduates
- Now possible to lay off university staff
- 2-way management system
 - Run like a company, with the rector as a managing director
 - Academic tasks still managed through academic institutions

New (much more result-oriented than old way) funding rules

- Emphasis on high-visibiliity journals
- Funding only from students who gain more than 55cp per year

Changes inside the university

Shift from small departments with 2-3 professors to entities with preferably more than 10 professors to create bigger research groups

Research assessment and evaluation (summer 2011) done by experts who did not value any constructive artefacts

More recently, realization that software is everywhere

- Having every department deal with their own software related things is much more expensive than having one (strong) unit
- Involves both education and research

Faculty of Computing and Electrical Engineering

Communications Engineering (~4 professors) Computer Engineering (~5 professors) Electronics (~10 professors) High-voltage Electronics (~4 professors) Signal Processing (~10 professors) Software Systems (~10 professors)

Rector's and university board's actions

Outside expert hired to create new organization for the faculty

Based on research cooperation, coherent activities inside departments

Schedule

- Interviews of key personnel early 2012
 - -> Proposal for a new dept focusing on programming
- New dept heads named mid 2012
- New depts would start at the beginning of 2013

Game of thrones

Before Communications Engineering

Computer Engineering

Electronics

High-voltage Electronics

Signal Processing

Software Systems

Electrical Engineering

Now

Electronics and Communications Engineering

Pervasive Computing

Signal Processing

Dept. Pervasive Computing: "If it involves programming, we will do it"

Goal: Create a unit that is academically strong but at the same time socially open enough to cooperate with other departments

- Deep cooperation across the university
 - Both research and education

- Focus on programming, not hard-core computer science Personnel:

- 11 professors
- Total of about 140 professors/teachers/researchers/research assistants,

Output/year (estimated)

- ~15000 credit points
- ~70 BScs
- ~60 MScs
- 8-10 PhDs

"Programming everyware"

Dept. Pervasive Computing: Motivation

Previously, computing related research was scattered to different departments

- Little synergy between different research groups, even if software is a necessary component in almost all fields
- Similar projects executed by different research groups without knowing of each other (e.g. sensor networks, UML, etc)
- With a bigger unit, it is more feasible to create bigger projects (e.g. EU)

Dept. Pervasive Computing: Launch

Create a *ware centric department

- Strategy and mission creation August/September 2012
- Comparison to other similar departments in Finland in October/November 2012
- Operational Jan 2013

New curricula created during winter 2012-13

- Based on existing courses, but now special focus to
 1) software as a fuel for innovation
 - 1) solitivate as a fuel for innovation
 - 2) offering SW minor to all other departments
- New research approach created spring 2013
 - · Geared towards bigger projects with numerous professors involved
 - Weekly "sprints" where research software is created and demonstrated

Minors and majors

Bachelor

Computer engineering Software systems

Master

Pervasive systems Embedded systems Information security Software engineering User experience

Other stuff

Common basic studies More computing than math at faculty level

Software minor for all

University-wide freedom to pick a side minor from whatever field to foster cross-fertilization ->

Special "Software systems" with assumptions about background

Laboratories

Elementary courses (prof. Mikko Tiusanen)

• Computer Literacy, Elementary Programming Courses.

Embedded Systems and Computer Engineering (prof. Hannu-Matti Järvinen, prof. Jarmo Takala, prof. Timo D. Hämäläinen)

• Design and implementation of embedded systems, operating systems...

Distributed software (prof. Tommi Mikkonen, prof. Tarja Systä)

• Implementation of distributed systems, Internet application technology, mobile applications...

Software Engineering (prof. Kai Koskimies, prof. Kari Systä)

 Process, project management, product/configuration management, testing, specification and design methods, OO Methods, SW architectures...

Usability (prof. Kaisa Väänänen-Vainio-Mattila, prof. Timo Saari)

• Usability, user experience, UI design, ...

Information security (prof. *Jarmo Harju*)

• Secure programming, secure networking, ...

How we run daily business – the big cycle

Everyone (yes, everyone) has to specify results for the next semester at the beginning of it

Exact items vary in accordance to the position; examples:

- Professor: paper submissions, planned projects, planned dissertations, planned courses
- Graduate student: paper submissions, research artefacts, courses, dissertation date

• Pre-graduate student: research artefacts, courses, graduation date Checked at the end of the semester, with corrective actions

Planning also makes it easier to allocate larger tasks to people (major articles, EU projects etc)

How we run daily business – the small cycle

Research groups have weekly meetings where status of each activity is collected

- Possibility to react early to deviations in the plans made for the semester
- New demo-oriented way of working, with weekly results reported

Course personnel of each (large) class have weekly meetings where status of the class is checked

- Similar treatment of all employees
- No free riders nor goldilocks

How we run daily business – money

Ever since the beginning of the new department, we have had claims that we are not cost-efficient

Lots of teaching

Monitoring and planning with 4 cost areas

- Teaching
- Administration
- Externally funded research
- Internally funded 'free' research
- Everybody reports working hours montly
 - Requisite of some funders of external research
 - Pushed to everyone so that those who bring in zero contribution would wake up