Strategies for Embedded Systems Research

EU Project FP7-ICT-215594
http://www.cosine-ist.org

Deliverable

D1.4.1 Report on Workshop on Embedded Systems Education and Training

Version 0.2
12.06.2008

Public

Introduction

Task 1.4 Co-operation in ES education and training
Text z COSINE2 DoW: COSINE2 aims to enhance the impact of European RTD strategies in the area of Embedded Systems. To achieve this, it will be necessary to better align national research strategies with each other, with the EC programmes, and with new initiatives such as the ARTEMIS ETP (European Technology Platform) and the forthcoming JTI (Joint Technology Initiative) on Embedded Systems. COSINE2 pursues the vision of leveraging the co-operation of European research programmes to new levels and to tune research policies optimally to the needs of researchers, the industry, and the public. WP1 Objectives Improve the co-operation between national, regional, and EU-wide research programmes in the field of Embedded Systems Open an increased number of programmes with ES funding opportunities for trans-national collaboration Support to European RTD policy actors and programme managers Support the development of a co-ordinated ES policy for education and training Task 1.4 Educational and training topics in ES RTD have only rarely been addressed at a pan-European view so far. Some academic initiatives such as ARTIST have targeted this topic, but with only little impact at policy level. Based on a first workshop on this topic and expert discussions, COSINE2 will develop a joint position concerning European ES RTD education and training. This position will be disseminated in the relevant ministries, to EC services, and at the COSINE2 web site.

Acknowledgement

Work reported here was funded by the Information and Communication Technologies Programme of the European Commission under the COSINE2 Grant agreement No. FP7-ICT-215594. COSINE2 stands for “Co-ordinating Strategies for Embedded Systems Research”.

The COSINE partners are:

- eutema Technology Management GmbH (Co-ordinator, AT)

- Finnish Funding Agency for Technology and Innovation (FI)
- Deutsches Zentrum für Luft- und Raumfahrt (DE)
- The Israel Directorate for EU FP6 (IL)
- Institute of Information Theory and Automation, Academy of Sciences (CZ)
- Swedish Governmental Agency for Innovation Systems (SE)
- Bundesministerium für Verkehr, Innovation und Technologie (AT)
- Nemzeti Kutatasi es Technologiai Hivatal (HU)
- Flanders Institute for the Promotion of Innovation (BE)
- Ministry of Universities and Research (IT)
- Atomic Energy Commissariat (FR)

General information

Event: COSINE2 Workshop on Embedded Systems Education & Training

Event date and venue: 5th June 2008, Fresh Hotel Athens, Greece

Event organizer: UTIA

Background

Background and objectives of the workshop have been given in the opening page of the conference website and flier:

“Europe boasts itself as a region particularly strong in Embedded Systems and Embedded Systems Research at the university level. With the advent of ARTEMIS Europe is now also well positioned in the area of industrial research.

But how sure can we be that these strengths are sustainable?

Much will depend on how pan-European challenges for Embedded Systems education and training are correctly identified and tackled. The COSINE2 workshop in Athens will focus particularly on policies for an improved education and training on Embedded Systems in Europe. The workshop will address a pan-European perspective, but also emphasize the role of the member states.

Focus: Policies for pan-European Embedded Systems Education and Training

Format: Expert presentations and discussions about

- Industry needs
- Issues for small and medium-sized enterprises
- Market aspekts
- Pan-European education and training requirements

Outcome:
Position paper on Embedded Systems Education in Europe: The role of the EU and its member states.

Workshop preparation

Preparations for the workshop have begun in March 08. The first issue was to determine date and place. The underlying assumption was to organize the *COSINE2* workshop jointly with ARTEMISIA event (before or after the event). All COSINE partners' final decision was Thursday 5th June08, the day after ARTEMISIA General Assembly meeting in Athens.

For the workshop venue Eutema recommended the Fresh Hotel Athens and made the first contact with the hotel management. UTIA continued and finished the other necessary arrangements.

Event programme preparation

Key player in ES were contacted individually by COSINE2 partners. At the end 10 experts agreed to present their experiences.

Event promotion

The event web page was created in April 08. Link:

http://www.oko-ist.cz/index.php?ids=events&id=events08/CosineWS_Athens_08-06-05

Partners asked for the linkage:

ARTEMISISIA Association

IDEALIST project

Technology centre AS CR in Prague (CZ)

NINET Network (CZ)

Information about the event was sent by Idealist mailing list to approx. 600 potential contacts. Information was also disseminated by Artemisia association mailing list.

Target audience: Researches from universities, research institutes and companies in the area of ES

The Workshop Final Programme

9:00 – 9:30 REGISTRATION, COFFEE, NETWORKING

9:30 – 12:00 MORNING SESSIONS

- **Identification of the Key Competences Needed in the Domain of ES in France** (Katia Didaoui, Jean-Luc Dermoy, CEA, France)
- **Introduction to the Austrian ES education** (Erich Prem, Martin Marek, eutema Technology Management GmbH, Austria)
- **The Embedded Systems Industry in Israel and its Training Capabilities** (Aviv Zeevi Balasian, ISERD, Israel)
- **Education of Embedded Systems in CZ** (Martin Danek, Jiri Kadlec, UTIA Prague, Czech rep.)
- **Embedded Systems Education in Belgium** (Filip Van Isacker, IWT Flanders)
- **Overview of ES skills / training in the UK** (Richard Foggie, UK Department for Business, Enterprise and Regulatory Reform)
- **Experience In Searching Qualified Personnel For An Embedded Company in Greece** (Kelly Nasi, Dynesys SA, Greece)

12:00 – 12:30 BUFFET LUNCH

12:30 – 14:30 AFTERNOON SESSIONS AND DISCUSSIONS

- **Embedded Systems Education in Sweden** (Nabiel Elshiewy, VINNOVA, Sweden)
- **Research in SMEs: Required skills and challenges** (Gregory Doumenis, Hellenic Semiconductor Industry Association, Greece)
- Discussion, exchange of views, recommendations

Number of participants: 16 (AT 2, BE 1, CZ 2, DE 2, FR 2, GR 3, HU 1, IL 1, SE 1, UK 1).

Conclusions from the workshop

Participants recognised relation to the new Artemisia working group on education of embedded systems. Mr. Martin Danek representing UTIA, CZ in Artemisia has been elected in the university Chamber B of Artemisia the vice-chair of the Artemisia working group on education. This will help in setting of closer links. The working group is chaired by Prof. Erwin Schoitsch from Austria.

There is good trans-national overlap in the current assessment of the needs of the ES industry and of ES researchers.

Factors such as shortness of skilled ES RTD staff, vocational training etc. (which?) could be found across countries.

New member states are facing a number of specific challenges that suggest some changes in policies.

Participants emphasized that the national authorities have to play important part in the coming discussions because they can directly influence priorities and format of the national education programs.

Follow up

The Cosine2 *Expert workshop on strategies for improving European ES education and training* will be organized within the ICT FET conference and exhibition 22.4.09 – 24.4.09 during the CZ EU presidency in the same location. The conference has the planned audience of 600 participants.

Expert workshop on strategies for improving European ES education and training is proposed to take place in Prague on Wednesday 23.4.2009

The ICT directors meeting, ISTAG meeting with ETP representatives is planned on Monday 21.4.09 afternoon.

The policy oriented part of the ICT FET conference with presence of DG INFSO commissioner is scheduled for 22.4.09

Expert workshop on strategies for improving European ES education and training is proposed to take place in Prague on Wednesday 23.4.2009 from 9 am to 14am.

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COSINE2

Co-ordinating Strategies for Embedded Systems in the European Research Area Follow-up Project

Embedded Systems education in Austria

Erich Prem & Martin Marek
office@eutema.com
www.eutema.com

COSINE
Embedded Systems

Athens, June 5th 2008

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COSINE2 overview

- **Facts**
  - EU-IST project
  - 11 partners from 10 countries
  - Start: 01.12.2007 End: 31.05.2010 (30 months)
  - Website: www.cosine-ist.org
  - Follow-up project of COSINE(1)
- **Objectives**
  - Improve ES Co-operation
  - Open European Embedded Systems Programmes
  - Monitor ES Strategies & Policies
  - Improve Co-operation in Education & Training
  - Establish and Maintain Close Relation with ARTEMIS
  - Improve SME Technology Take-up
  - Install Web Platform and WIKI

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COSINE2 partners

- **COSINE2 partners**
  - eutema, eutema Technology Management GmbH, AT (Coordinator)
  - Tekes *, Finnish Funding Agency for Technology and Innovation, FI
  - DLR *, German Aerospace Centre, DE
  - ISERD, Israel Europe R&D Directorate for FP6, IL
  - UTIA, Institute of Information Theory and Automation, AS CZ, v.v.i., CZ
  - VINNOVA *, Swedish Agency for Innovation Systems, SE
  - BMVIT *, Austrian Ministry for Transport, Innovation and Technology, AT
  - NKTH *, National Office for Research and Technology, HU
  - IWT *, Flanders Institute for the Promotion of Innovation, BE
  - MUR *, Ministry of Universities and Research, IT
  - CEA , Atomic Energy Commissariat, FR

* Agencies funding ES research (e.g. In ARTEMIS)

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ES education in Austria

- ES education characteristics - general
  - Interdisciplinary
  - High complexity needs high qualification
  - Social competences for innovation
  - Practical knowledge
  - Necessary interaction between education & research
- ES education characteristics – Austria
  - Focus on universities of applied sciences
  - 44 courses dealing with ES (1994 – 2004)
  - Focus on certain locations (60% of all ES education institutions)
    - Vienna, Graz, Linz, Hagenberg, etc.
  - Few dedicated curricula at universities
    - Educational programmes are spread over various curricula
    - “Technische Informatik”; Master & Bachelor; TU Vienna
    - Chair in Embedded Systems & Signal Processing
      Alpen Adria University Klagenfurt

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ES education in Austria

- **Institutions with dedicated ES education**

Universities of applied sciences

- Fachhochschule Technikum Wien
  - Embedded Systems, Master
- Fachhochschule Hagenberg
  - Embedded Systems Design, Master
  - Hardware Software Systems Design, Bachelor
- Fachhochschule Villach
  - Systems Engineering, Bachelor
  - Systems Design, Master

Uni-versities

- ES related lectures & branches of curricula are available
- Vienna University of Technology
  - Technische Informatik, Master & Bachelor

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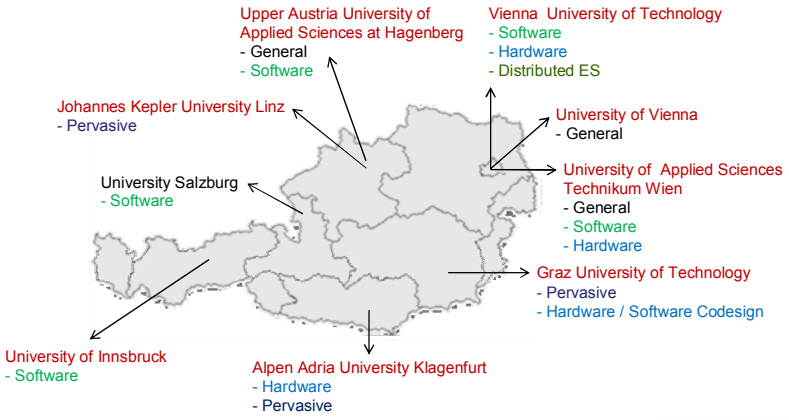
ES in Austria - regional overview



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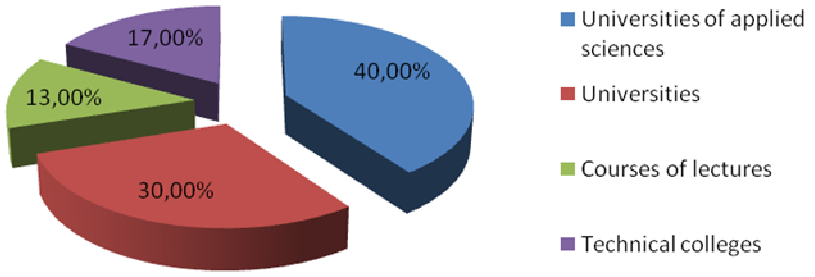
ES education in Austria - overview

Educational offers by educational institutions



Source: IWI, 2004

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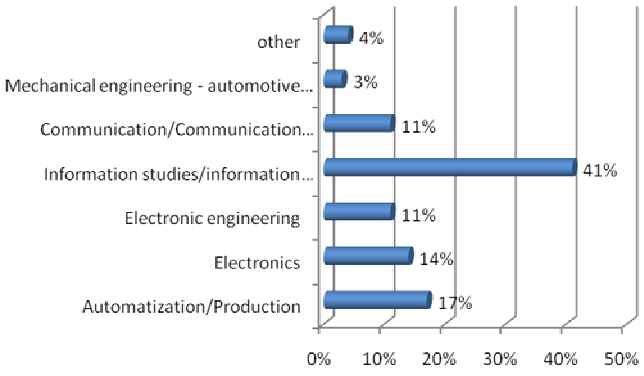
ES education in Austria - overview

ES related education areas



Source: ES Knowledge Base, 2004

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ES education in Austria – Status

"The existing educational offer in the field of Embedded Systems will not be able to meet future demands."

Embedded Systems Knowledge Base, 2004

Since 2004

- Further increase of awareness regarding the importance of ES
- Creation of dedicated ES curricula at some Universities of applied sciences
- All technical faculties offer ES related education

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ES education - challenges I

- Stimulate more ES research
  - A dedicated ES curricula could also stimulate more research activities
- Necessary increase of attractiveness of IT curricula
  - Increasing number of students and graduates in IT curricula
- Increasing the multidisciplinarity in ES education
  - A broad range of technical qualification is needed
  - Synthesis of hard- and software skills

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ES education - challenges I

- Improving the Job perspectives
  - Especially the perspectives for PhDs in Austria are not as good as in other countries – this leads to brain drain
- Low awareness about ES related curricula
  - Improving the promotion of ES curricula could provoce more students and graduates
- Increasing the percentage of women in IT related curricula
  - Only 20% of all IT students are women
- ES remote teaching
  - Distance labs
  - Technical University of Vienna
  - Overcoming the lack of sufficient lab places

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Contact

Questions?

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ISERD - המנהלת הישראלית לתוכנית המסגרת לנמ"פ של האיחוד האירופי
ISERD - Israel-Europe R&D Directorate for the EU Framework Program
Embedded Systems
Training in Israel
1
Aviv Zeevi Balasiano - ISERD


Companies in Israel:
Israel Aerospace Industries, Elbit, Elisra, Tadiran, Orbotech, Rafael, Philips GE-Medical…..
>> Constant Demand for RTES development engineers in the industry
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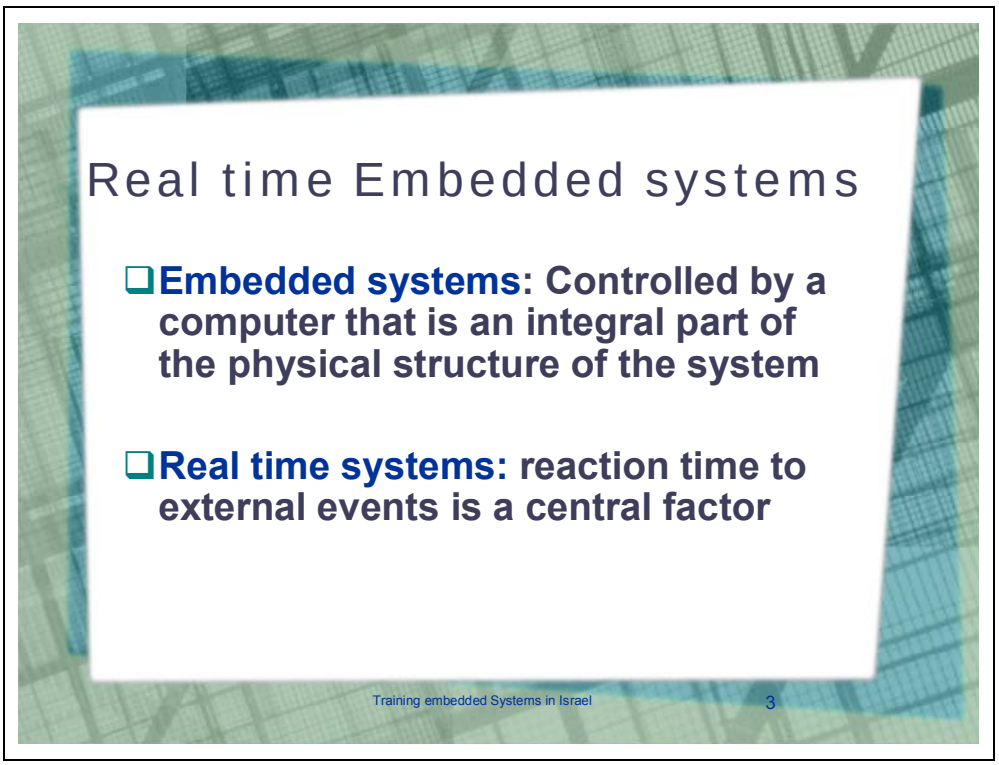
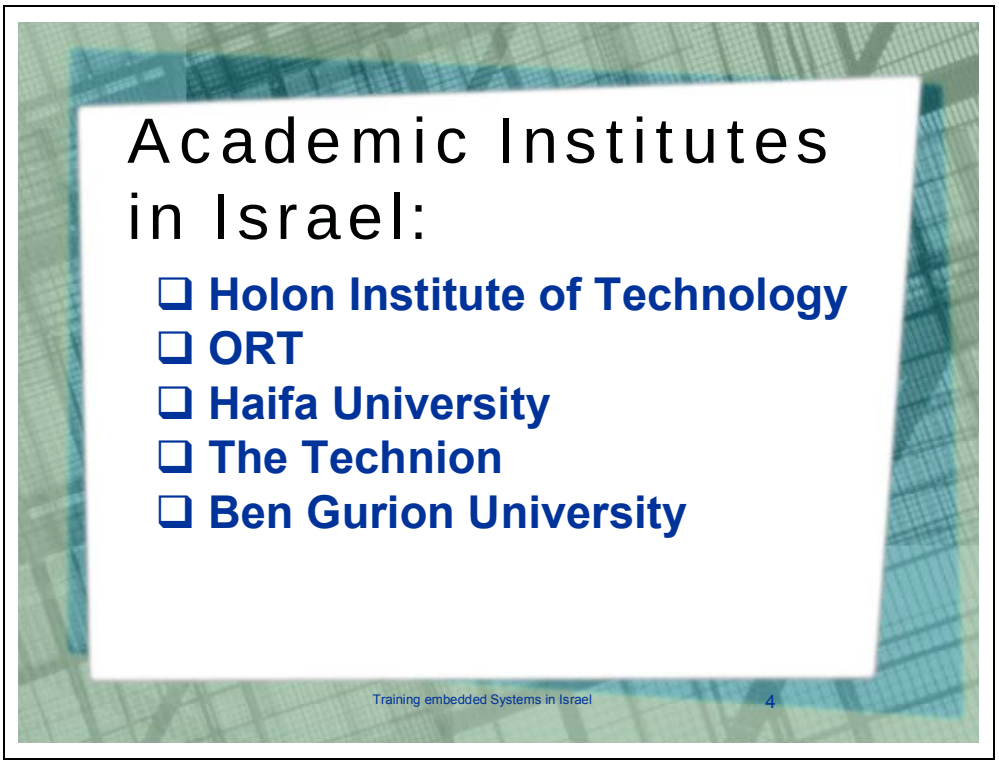
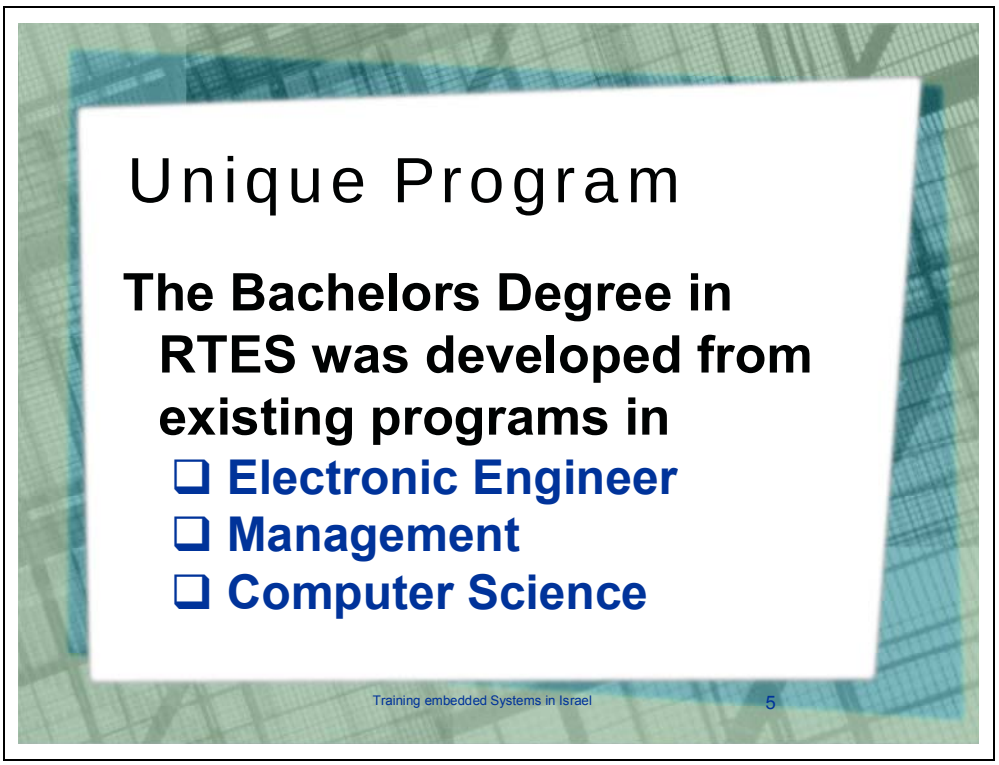
2


Real time Embedded systems
Embedded systems: Controlled by a computer that is an integral part of the physical structure of the system
Real time systems: reaction time to external events is a central factor
Training embedded Systems in Israel
3


Academic Institutes in Israel:
Holon Institute of Technology
ORT
Haifa University
The Technion
Ben Gurion University
Training embedded Systems in Israel
4


Unique Program
The Bachelors Degree in RTES was developed from existing programs in
Electronic Engineer
Management
Computer Science
Training embedded Systems in Israel
5


Program Goals
To train Real Time Embedded Systems Engineers
Program graduates will be able to examine, develop, initiate, and strengthen these systems using high standard, practical processes, methods and tools
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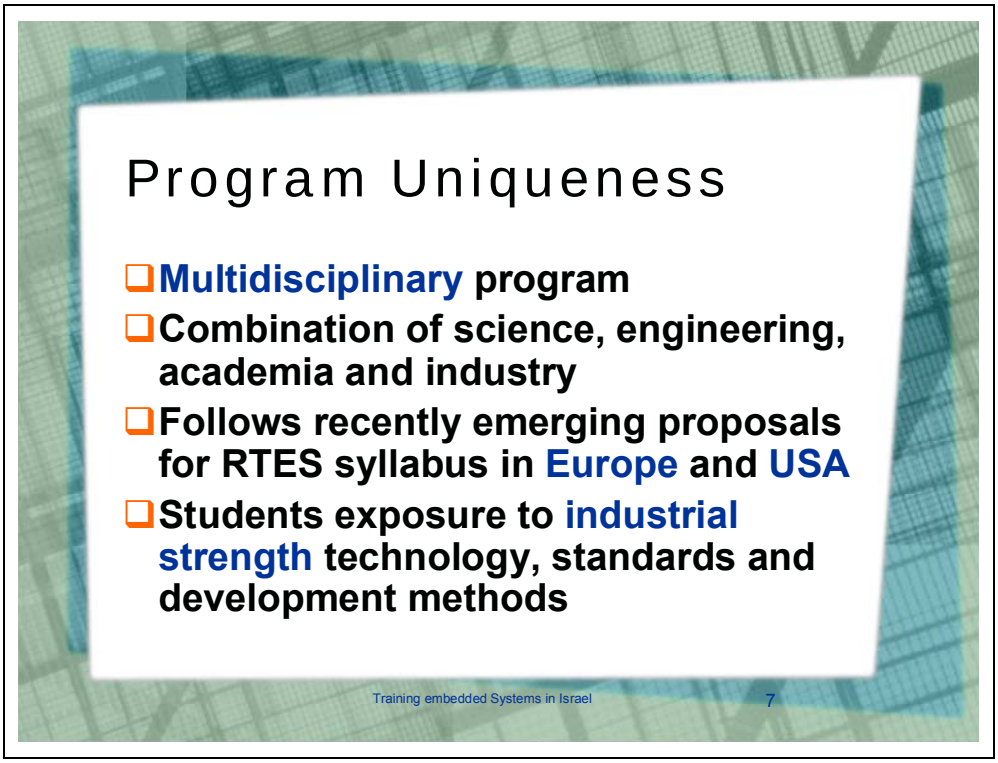
6


Program Uniqueness
Multidisciplinary program
Combination of science, engineering, academia and industry
Follows recently emerging proposals for RTES syllabus in Europe and USA
Students exposure to industrial strength technology, standards and development methods
Training embedded Systems in Israel
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European dimension
ARTIST – FP6, ARTIST II - 7FP
Coordinated Education and Training Activities to transfer knowledge to students, researchers and engineers
In particular, this will have as an objective to define and promote integrated European curricula on Embedded Software and Systems
* IAI is an active participant
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Industrial Cooperation
❑Participation of industry representatives in Joint Steering Committee for curriculum development
❑Students exposed to industry activities through industry symposia at the institutes
❑ Joint mentors for students' final projects
❑ Incorporation of industry lecturers in curriculum
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Industrial Cooperation (Con.)
❑ Advise and cooperation in the construction of teaching labs
❑ Professional forums for technological information updates
❑ Scholarships for excellence and for training students in areas of need
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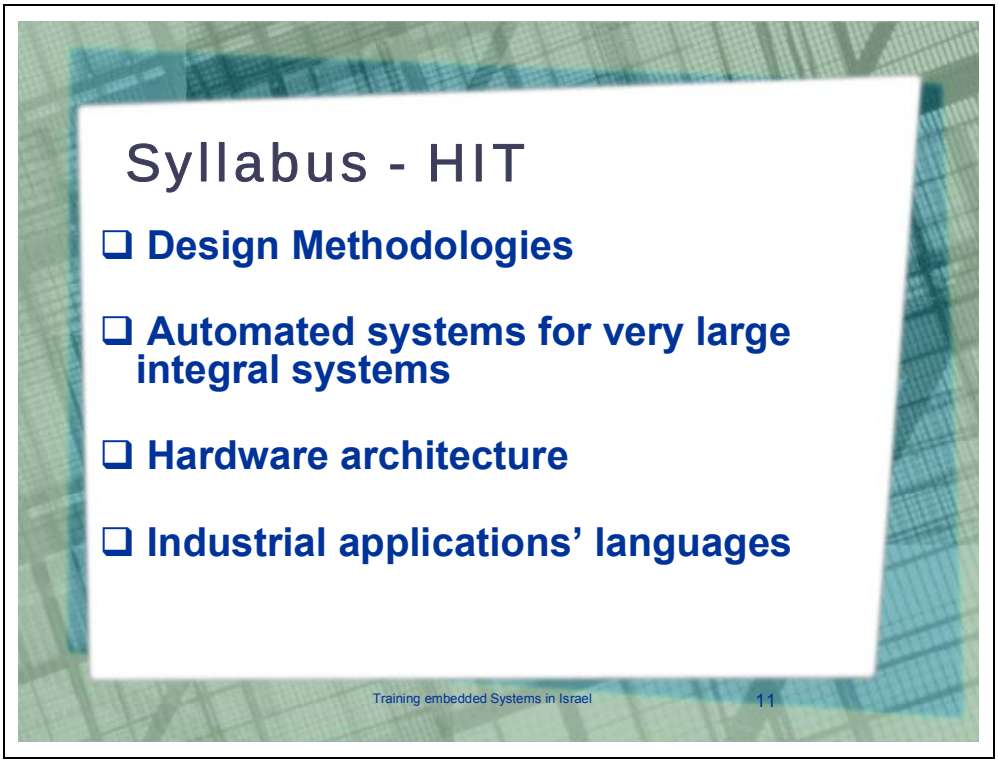
Syllabus - HIT
Design Methodologies
Automated systems for very large integral systems
Hardware architecture
Industrial applications' languages
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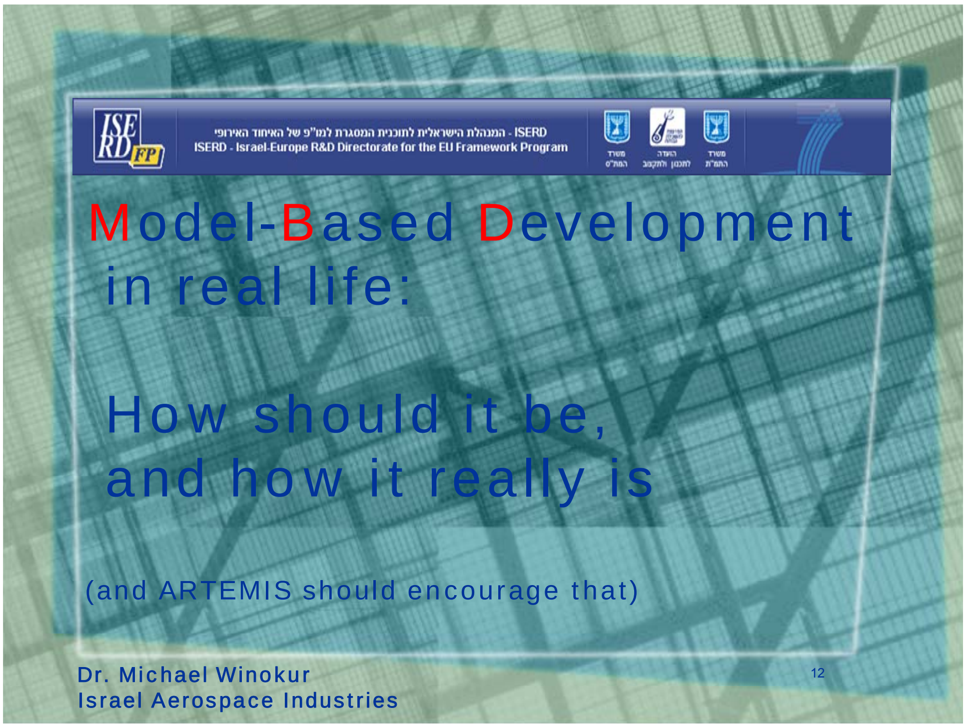
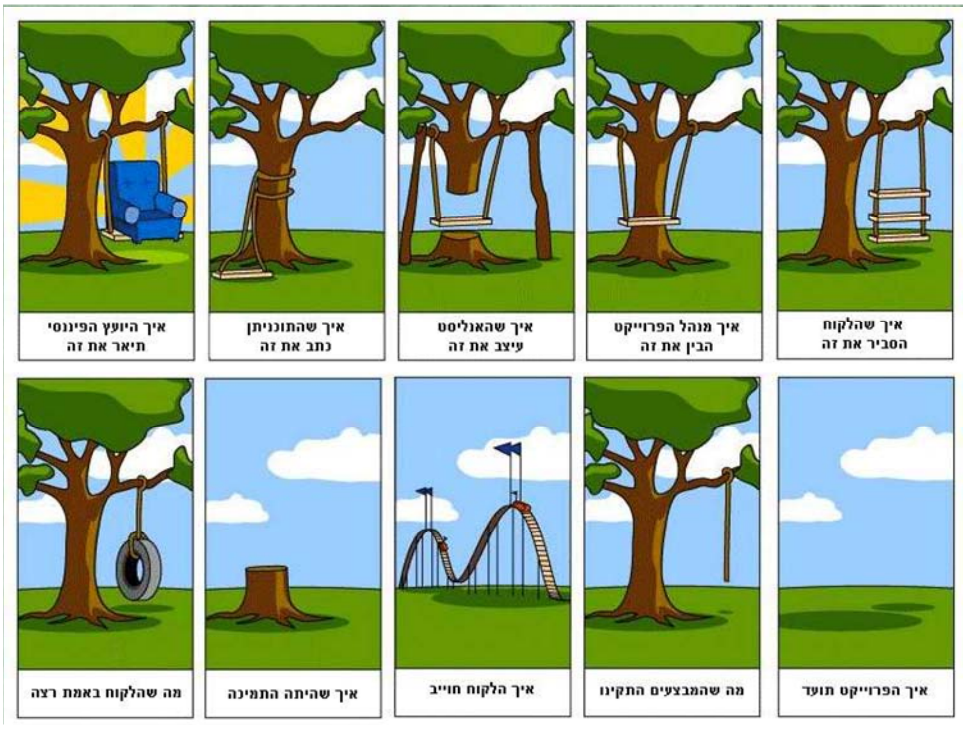
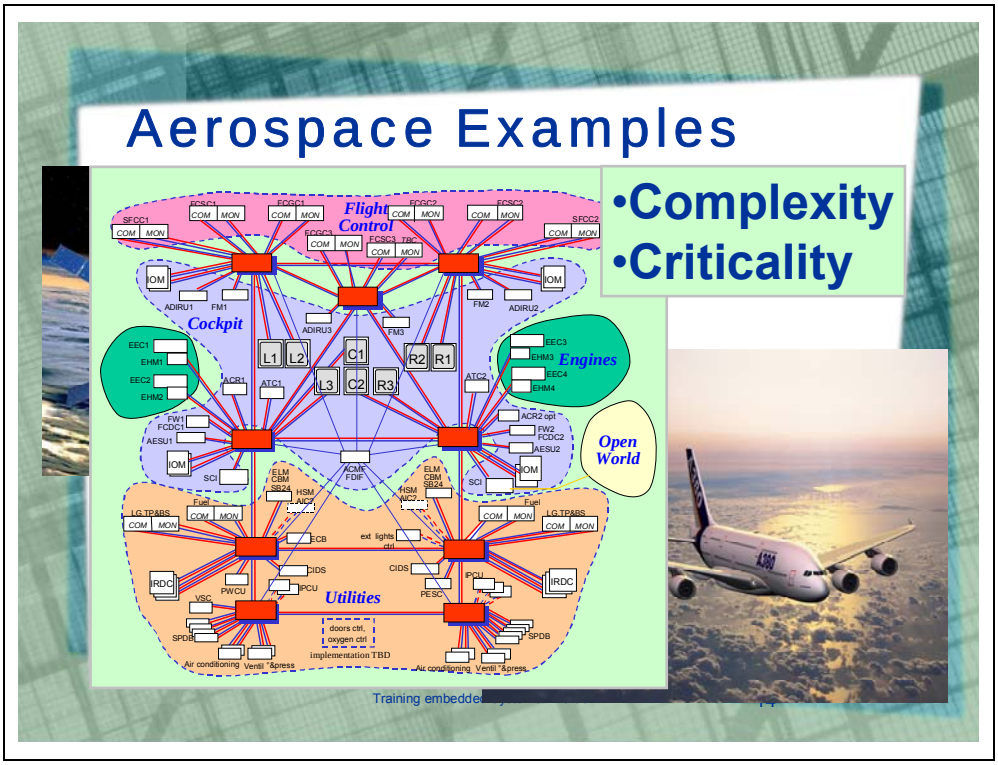
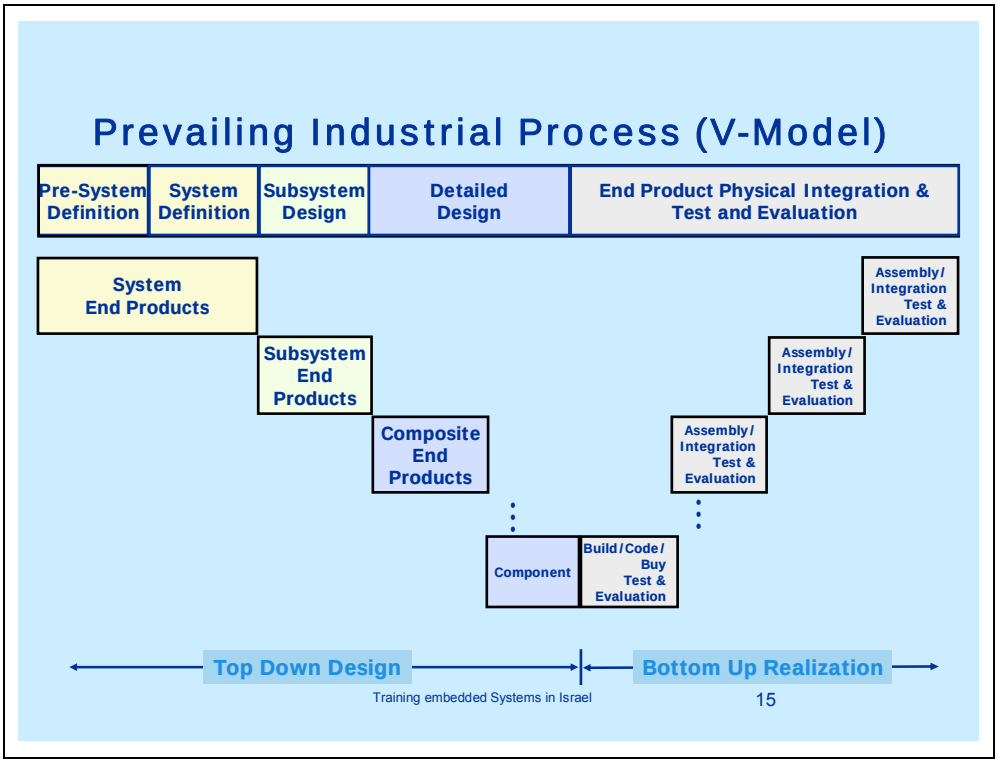

ISERD - המנהלת הישראלית לתוכנית המסגרת למו"פ של האיחוד האירופי
ISERD - Israel-Europe R&D Directorate for the EU Framework Program
Model-Based Development
in real life:
How should it be,
and how it really is
(and ARTEMIS should encourage that)
Dr. Michael Winokur
Israel Aerospace Industries
12


איך שהלקוח הסביר את זה
איך מנהל הפרוייקט הבין את זה
איך שהאנליסט עיצב את זה
איך שהתוכניתן כתב את זה
איך היועץ הפיננסי תיאר את זה
איך הפרוייקט תועד
מה שהמבצעים התקינו
איך הלקוח חוייב
איך שהיתה התמיכה
מה שהלקוח באמת רצה


Aerospace Examples
•Complexity
•Criticality
Flight Control
Cockpit
Engines
Open World
Utilities
Training embedded


Prevailing Industrial Process (V-Model)
Pre-System Definition
System Definition
Subsystem Design
Detailed Design
End Product Physical Integration & Test and Evaluation
System End Products
Subsystem End Products
Composite End Products
Component
Build/Code/Buy Test & Evaluation
Assembly/Integration Test & Evaluation
Assembly/Integration Test & Evaluation
Assembly/Integration Test & Evaluation
Top Down Design
Bottom Up Realization
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Opportunities for improvement in the V-Model

- Manual transfer of data between phases
- Human interpretation of information passed from phase to phase
- Verification between phases:
  - Costly process when certification required
  - Not systematic whenever certification not required
- Usually biased toward “catch and clean” errors at the integration and test phases

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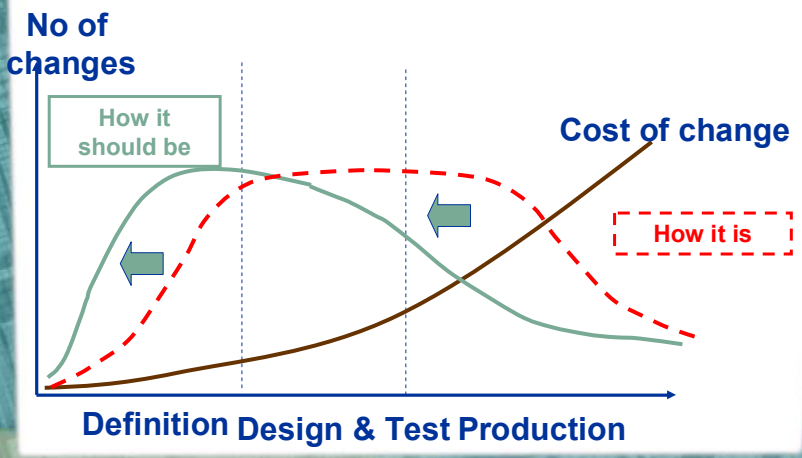
“Catch and clean” errors approach



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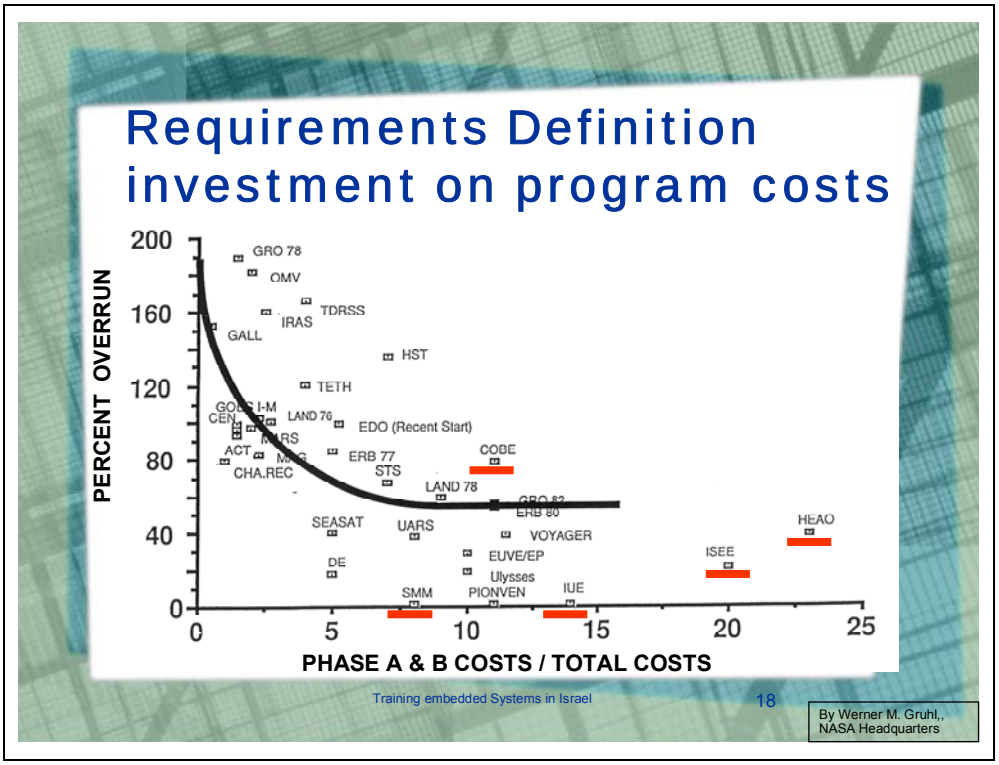
Requirements Definition
investment on program costs
PERCENT OVERRUN
200
160
120
80
40
0
0
5
10
15
20
25
PHASE A & B COSTS / TOTAL COSTS
GRO 78
OMV
TDRSS
IRAS
GALL
HST
TETH
LAND 76
EDO (Recent Start)
ERB 77
STS
CODE
LAND 78
SEASAT
UARS
VOYAGER
HEAO
ISEE
EUVE/EP
Ulysses
PIONVEN
IUE
SMM
DE
ACT
CHA.REC
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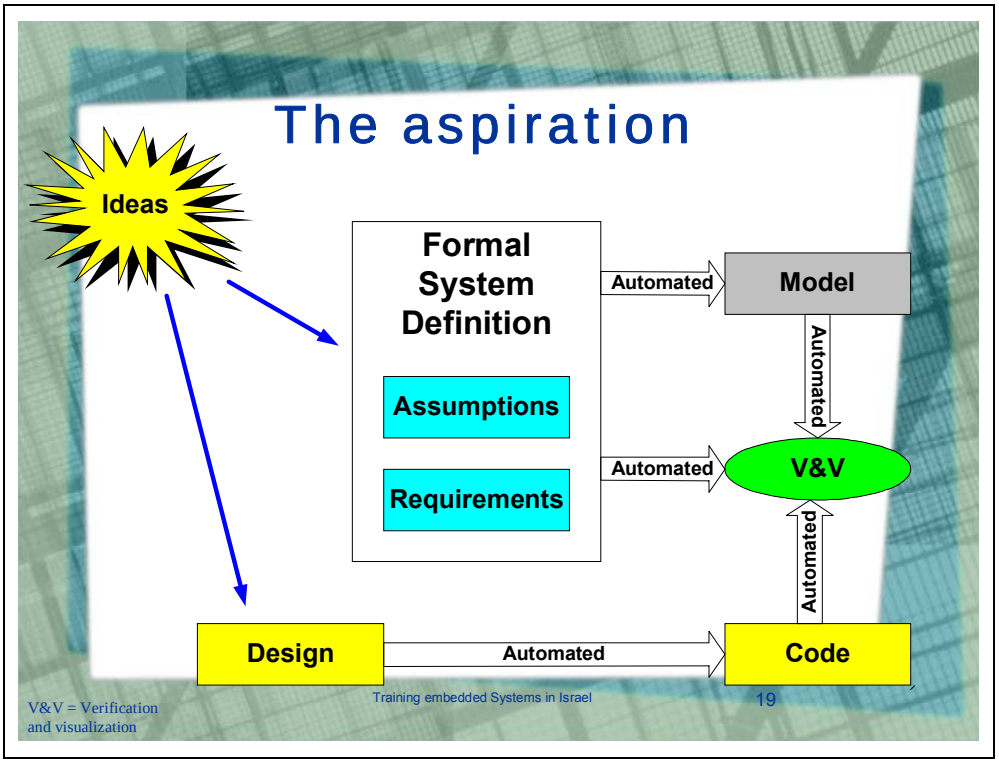
18
By Werner M. Gruhl,,
NASA Headquarters


The aspiration
Ideas
Formal
System
Definition
Assumptions
Requirements
Automated
Model
Automated
Automated
V&V
Automated
Design
Automated
Code
V&V = Verification
and visualization
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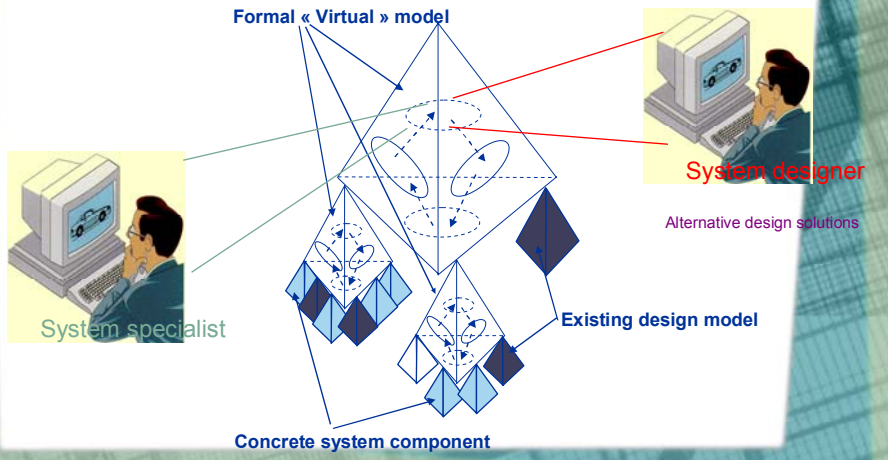
System definiton – How it should be



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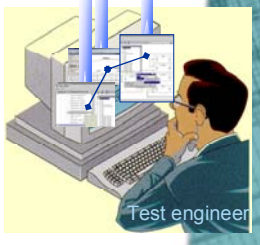
Ideal Application Scenario
Distributed Model building

- **Co-operation between several specialists within a project**
- **Task-oriented development environment based on single data sources:**
  - **Distributed data must be interconnected**
  - **Data presentation must be consistent and up to date**



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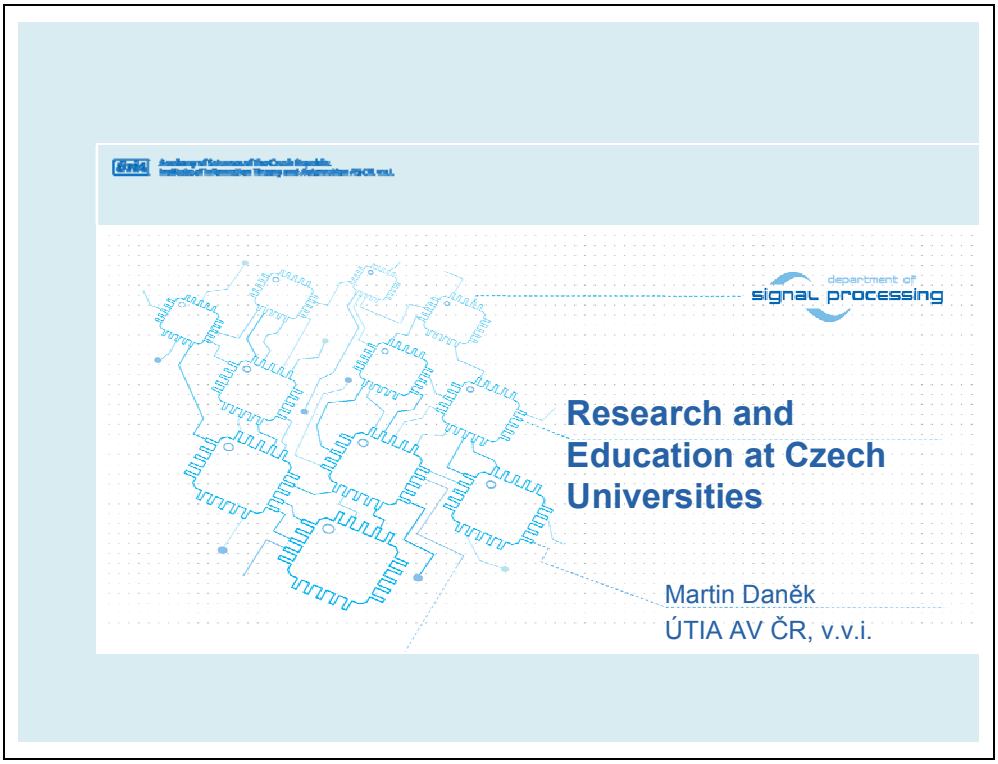
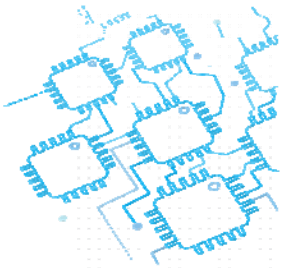
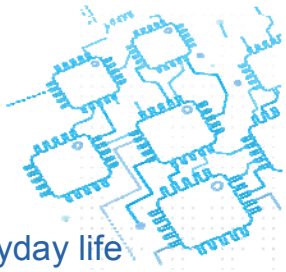

department of
signal processing
Research and Education at Czech Universities
Martin Daněk
ÚTIA AV ČR, v.v.i.

Basic Structure of Czech Government-Funded Research



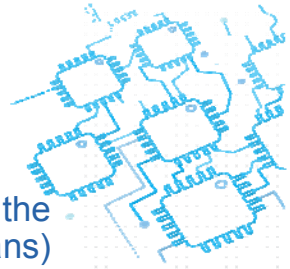
- Universities
  - Faculties
- Academy of Sciences of the Czech Republic
  - Institutes
- Other institutes
  - Meteorology
  - Agriculture
  - Defense-related

Research in the Socialist Era



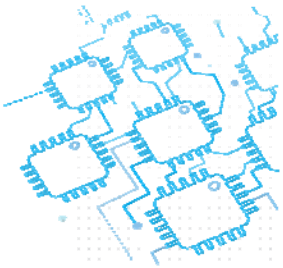
- Five-year planning periods
- No real link between research and everyday life
- No link between the East block and the West
  - Parallel development of similar solutions (industrial control, Intel discrete parts up to cca. x86, …)
- State funded applied research programmes – main industries:
  - Heavy (steel)
  - Military
  - Aircraft
  - Space

1990-1997



- Many new entrepreneurs
  - Former company employees bought the company (privatization, bad bank loans)
  - People with new business ideas
  - People sacked from former jobs
- Restructuring of education and research
  - Elimination of experimental (manufacturing) departments – “Machinery can be better sold if electronic is imported from the West”.
  - New East-West research links => new pressures

1990-1997 (2)

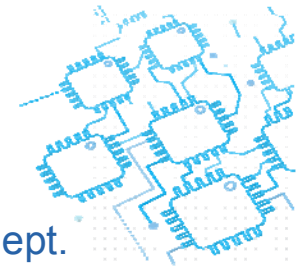


- New national research funding schemes
  - GACR, GAAV, “Research Centres”
  - Research assessed by the number of publications and citations
  - No real pressure to use the research results in practice
- EU research “training programmes”
  - BENEFIT, Copernicus (for universities)

1997-2007

- Increasingly bigger difference between commercial salaries and salaries in academia
  - Many capable people left for industry
  - Young people cannot afford low salaries
- A few people in academia with industry experience
  - Personal sacrifice, decreased income
- Elitist system of research teams, not caring much for the less lucky ones
  - Not using the full potential
  - Danger of stagnation
- No research planning
  - But since 2008 the Czech government starts to favour research used in practice

Academia and Companies



- Big companies have their own corporate research, int. strategy dept.
  - IBM, Philips
- SMEs do not consider themselves rich enough to be able to afford research
  - Research for industry not common
- EU research projects are the only chance for people from the academia to work with big EU companies
  - Philips, Thales, EADS, Siemens

Effects on Education

- Universities do not have enough money
  - To attract and motivate highly skilled people to teach students.
  - To equip labs with enough development kits and other (measuring) equipment.
  - To hire lab administrators.
  - To hire research personnel to perform independent, quality research without a primary obligation to teach.
- This all presents additional difficulties for lecturers and students, causing many students to incline to SW-only courses (OS/DB design, etc.)

Side-Effects of Structural Funds

- The majority of R&D projects funded from the structural funds in 2008-13 will build new research facilities (buildings).
- Drawing money from the structural funds requires the state to cover salaries for the newly hired staff.
- This will consume all realistic increases of the Czech national R&D funding in the years 2010-2020.

Opportunities

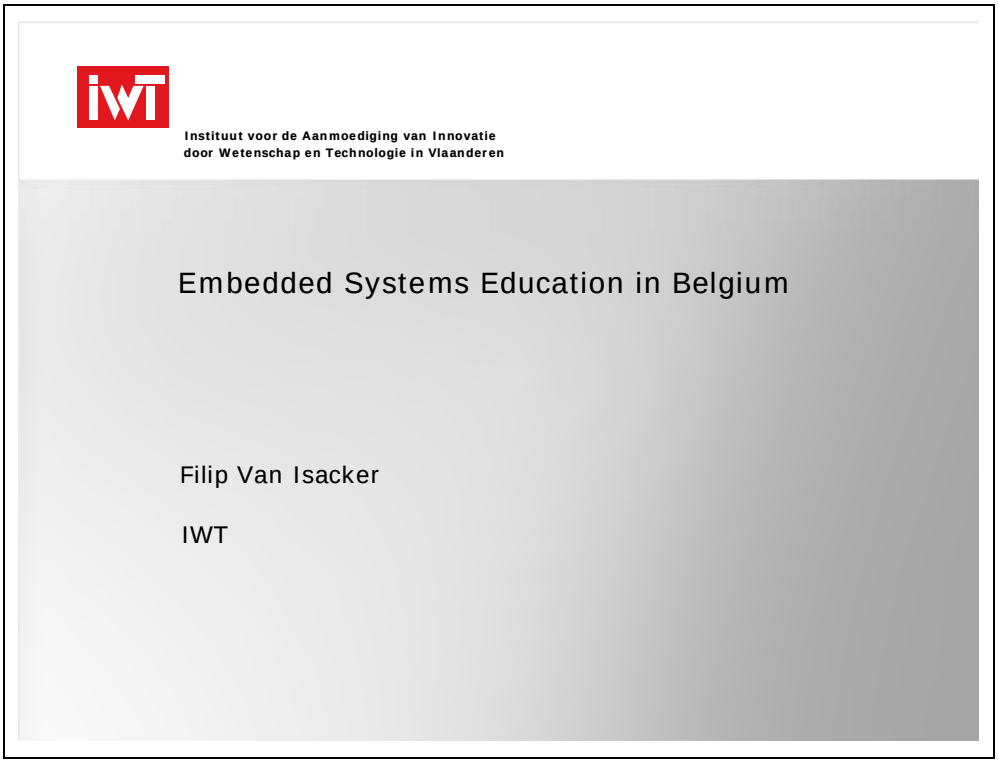
- Access to technology strongly motivates undergraduate students.
- Collaborative FP projects with real development work provide strong incentive to young postdocs.
- The existing infrastructure of the Academy of Sciences can be used to teach topics like embedded systems and for specialized courses required by the industry.

- Cultural differences between Czech Republic and other EU countries is smaller than between the EU and India/China/…
- Czech Republic is closer, with minimal time difference.
- Czech citizens do not tend to leave Czech Republic.

Concrete Ways Forward

- Focused actions to bring funding and support the best
  - University lab teams with multiple FP participations (can be round 5 teams each with 5-20 postdocs)
- Effects
  - Education of increased numbers of Czech Embedded Systems experts, forming SMEs (sub)contracted by large European companies.


Institute for the Promotion of Innovation
in Flanders


Instituut voor de Aanmoediging van Innovatie
door Wetenschap en Technologie in Vlaanderen
Embedded Systems Education in Belgium
Filip Van Isacker
IWT

Overview

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- Industry needs and continuous training :

  case DSP Valley
  case Sirris Software Engineering

- Embedded systems in university and associated university programs :

  cases University of Leuven (KULeuven)
  case Free University of Brussels (VUB)
  case Karel De Grote Hogeschool

iwt

3

Industry needs and continuous training

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Program for **Flemish Cooperative Innovation Networks**

- Projects by consortia of companies (> 10), professional federations or collective research centra
- Activities:
  1) Pro-active **information** on innovation for companies and particularly SMEs with mutual technological problems: seminars, workshops,...
  2) Supporting companies in mutual **cooperation** and cooperation with knowledge centres: identify training gaps,...
- Funding on project basis : 4 year, 2 FTE, subsidies up to 80 %, 24,6 MEUR for 55 projects in 2007

Organisations in the **embedded systems** domain:

- DSP Valley
- Sirris Software Engineering group

iwt

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DSP Valley
Introduction

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Technology network organisation
Established in 1998, related to IMEC
Focus on the design of hardware and software technology for **digital signal processing** systems (methods & tools, digital audio, digital imaging, telecommunication & navigation technologies)
Regional focus : 2 hours driving (Leuven – Eindhoven)
50 members (SMEs – large companies – knowledge centres)
Activities:
- Inform : website and webtools, seminars,…
- Stimulate cooperation : companies, knowledge centres, government
- Promote the region as centre of excellence : exhibitions,…

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DSP Valley
Seminars

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Since 2003
+- 3 seminars/year
Afternoon sessions
+- 6 speakers :
industry cases
academic state-of-the-art
local/international
english language
+- 100 participants (between 43 and 146)
Local participation (Belgium – Netherlands)
Seminar – small exhibition – networking drink
Focus on:
- platforms, tools and methods
- use cases

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DSP Valley
Seminars 2008

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Tool chains for embedded sw: proprietary vs open source
- Eclipse for embedded systems
- Buildroot: The open source way for streamlined custom embedded systems
- Using Adobe Flash Lite on embedded products
- Combining open source and proprietary software for embedded software development

Sensor driven mechatronics
- Wireless control systems
- WiLab: a large-scale real-life wireless test environment
- Integrated intelligent sensors in mechatronics
- Sensor simulation on FPGA hardware

iMT

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DSP Valley
Seminars 2007

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Embedded sw engineering: how is it done
- How to gain confidence in software? Implementation in avionics software development
- Gradual implementation of structured software development within growing high-tech startups

Embedded operation systems: facts and trends
- RTOS – 25 Years On
- Linux in the NXP TV520 Nexperia Digital TV System
- Selecting an RTOS: what's important and what's not

Mobile applications for tourism

iMT

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DSP Valley

Seminars 2006

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Embedding quality in your software

- Lessons from using formal modeling for embedded software development
- Quality software - the balance between technology, organisation and process
- What can you expect of the CMM model and what not? Lessons learned after 10 years CMM deployment in Philips Bruges

How to choose your embedded platform

- Choosing the optimal hardware platform for your application software
- The ideal RTOS

From UML to embedded software

- UML/SysML for embedded systems: state of the art
- From System to Software, how UML supports a requirement driven approach
- Embedded software design and implementation using the Rhapsody UML tool suite

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DSP Valley

Seminars 2003-2006

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- Embedded **image processing**
- Embedded systems in **robotics and automation**
- **Home automation** – now and tomorrow
- **Testing** of software & embedded systems
- **Java** & (RT) embedded systems
- Secure software development & embedded **security**
- Efficient SoC Design based on **Reusable Multiprocessor Architectures**
- ESAMA - Embedded systems & **Mobile applications**
- **ZigBee** - wireless communication for industrial applications
- **Tool chains** for eSW development
- The use of **FPGA** in Embedded Systems
- **C-based system-level design**: Future or reality...?

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DSP Valley
New initiatives

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Continuous training eSW : robot competition

- Participate in international robot soccer competition
- Cooperation in teams (companies/knowledge centres) on development of robots
- Is considered more effective than courses : fun/competition
- International competition : Robocup, Eurobot, Roboludens

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Sirris
Software Engineering Group

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Collective research centre of the technological industry in Belgium
13 sectors (metals and materials, automotive,..., ICT)
Expertise in materials, production techniques, proces organization
Software engineering group established in 2004
Focus on "companies with software in final products"
Market survey (70 organisations) to identify industry needs and to define strategic programs
4 strategic programs:

- Software **Product Development Models**
- **Open Source** Software Development
- **Quality**: Failure Method Effects Analysis
- **Task based architectures**: increase reuse and decrease complexity

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Sirris

Program Software Product Development Models

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What ?

from tailor made software, to product lines, to a configurable product base

with impact on software development methods

Subdomains

release definition, software product quality, software product development technologies

Projects

Hardware/software co-design

www.twins-itea.org

Agile development in embedded product development

www.agile-itea.org

Sirris

Program Software Product Development Models

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Requirements engineering course

- 4 session course
- Management of changing software requirements
- Specification and validation of non-functional requirements
- Partitioning of requirements between hard- and software
- Prioritization of requirements

Embedded systems in university and associated university programs

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Cases :
- University of Leuven (KULeuven)
- Free University of Brussels (VUB)
- Karel De Grote Hogeschool

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KULeuven
Department of Computer Science

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Master of engineering in Computer Science options:
- Distributed systems*
- Secure software*
- Artificial intelligence
- Human machine interface
- Mathematical engineering techniques

Master in Informatics options:
- Databases
- Software engineering*
- Networks and distributed systems*
- Artificial intelligence
- Multimedia
- Secure software*

KULeuven

Distrinet Research Group

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Distrinet: distributed software / secure software
Projects on embedded systems:

- Software Engineering for Embedded Systems using a Component-Oriented Approach (SEESCOA - SBO)
- Context-Driven Adaptation of Mobile Services (CoDaMoS - SBO)
- Software Development process for real-time Embedded Software Systems (DESS - ITEA)
- Agile Software Development of Embedded Systems (AGILE - ITEA)
- Evolution Management and Process for Real-time Embedded Software Systems (EMPRESS - ITEA)
- Model-based Approach to Real-Time Embedded Systems development (MARTES - ITEA)
- Support for Predictable Integration of mission Critical Embedded Systems (SPICES - ITEA)
- Creation of Smart Local Services (CROSLOCiS - IBBT)
- High-tech Embedded Systems Challenges (CONDOR - Senternovem)

KULeuven

Distrinet Research Group

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Task force Embedded and ubiquitous systems:

- Runtime adaptability of ubiquitous systems software (adaptability to the changing context)
- Run-time evolution of software in component based systems
- Context-aware computing
- Model Driven Development of software for embedded systems
- Agile Software Engineering methods, adapted to embedded system

KULeuven

Embedded systems courses

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Software for Real-time and Embedded Systems

Master of engineering in Computer Science/Master in informatics

Aim :

Study of the typical problems of real-time and embedded systems, methods and techniques for modelling, designing and realizing real-time and embedded programmes. Study of device drives, scheduling algorithms for real-time systems and of real-time operating systems (RTOS).

Course Material :

Alan Burns, Andy Welling, "Real-time Systems and Programming Languages", 2001 Third edition, Addison Wesley, ISBN 0-201-72988-1

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KULeuven

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Software for Real-time and Embedded Systems

Content:

- Introduction, examples, characteristics of RT&ES
- Background of Ada, Java and RT&ES, introduction to real-time specification for Java (RTSJ)
- Concurrency
- Communication and synchronization with shared memory, communication and synchronization with messages
- Asynchronous events
- Atomic actions
- Time
- Programming of devic drivers
- RTLinux, possibly completed wih other RT OS
- Possible: modelling RT applications

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KULeuven

Embedded systems courses

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Software for real-time control

Master of engineering in Electronics/ICT

Aim :

Study of typical problems of real time and embedded systems, methods and techniques to design and realize real time and embedded programmes

Course Material :

Alan Burns, Andy Welling, "Real-time Systems and Programming Languages", 2001 Third edition, Addison Wesley, ISBN 0-201-72988-1

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KULeuven

Embedded systems courses

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Software for real-time control

Content :

- Specific characteristics of real time and embedded systems
- Software engineering aspects
- Reliability and error tolerance
- Concurrent programming
- Real time aspects
- Low-level programming
- RTOS (real time operating systems)

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VUB (Free University of Brussels)
Department of Computer Science

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Master of engineering in Computer Science options:
- Artificial intelligence
- Multimedia
- Software engineering*
- Web & Information systems

Master in Applied Informatics

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VUB (Free University of Brussels)
Ubilab project 2007

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Answer to the **curriculum-crosscutting need** to expose students to the diversity of hardware to realize the future vision of ubiquitous computing

Vision of ubiquitous computing:
- Evolution of computer science has often been driven by changes in the hardware landscape
- Miniaturisation, wireless network infrastructure, cheap microcontrollers with sensors and actuators embedded in everyday life objects, “computational dust” in the form of RFID-tags and sensor networks
- These phenomena are drastically changing the field of Computer Science
- UbiLab is the VUB’s attempt to bring these developments to the student, by providing students with the necessary equipment

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VUB (Free University of Brussels)
Ubilab project

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Ubilab **hardware lab**:
- Smartphones (HTC, Nokia)
- Barebones Microcontrollers (Atmel)
- Microcontroller Development Boards (AVR, ARM)
- Add-on Modules (Arduino, Virtual Cogs VC21)
- RFID

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VUB (Free University of Brussels)
Ubilab project

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The following courses use the equipment provided by UbiLab:
- **Software Distribution and Mobility:** abstraction techniques supporting the design of mobile devices and sensor networks
- **Web Information Systems:** techniques to realize Web-based systems for which it is indispensable to take the variety of platforms into account. Adaptation of software systems to their environment.
- **Multiagent Learning:** techniques for coordination and negotiation amongst computational agents and for machine learning.
- **Interpretation of Computer Programs 1:** basic virtual machine abstractions.
- **Programming Project 1:** e.g. 2008 assignment: a small digital pet that can complain and show happiness based on its internal state

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Karel De Grote Hogeschool

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Master of Electronics – ICT options:
- ICT with focus on data communication
- Electronics with focus on **embedded systems**
- **Automotive engineering**: ICT and embedded systems

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Institute for the Promotion of Innovation in Flanders

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Fax.: +32 (0)2 223 11 81
E-mail: info@iwt.be
www.iwt.be


BERR
Department for Business
Enterprise & Regulatory Reform


ES education in the UK – an overview

BERR | Department for Business Enterprise & Regulatory Reform

COSINE Athens 5 June 2008
ES education in UK

The challenges

- Code in everything
- SW development a major barrier to embedded developments in EU
- multiparallelism

BERR | Department for Business Enterprise & Regulatory Reform

COSINE Athens 5 June 2008
ES education in UK

UK position

- Aging population of coders
- HEIs strong in IT, less so in ES
- Perceptions of engineers

BERR | Department for Business Enterprise & Regulatory Reform

COSINE Athens 5 June 2008
ES education in UK

Ways forward?

- Overseas sourcing
- Raising profile – ELC, SEMTA
- Third party training
- ???

BERR | Department for Business Enterprise & Regulatory Reform

COSINE Athens 5 June 2008
ES education in UK

Ways forward?

- Overseas sourcing
- Raising profile – ELC, SEMTA
- Third party training
- ???

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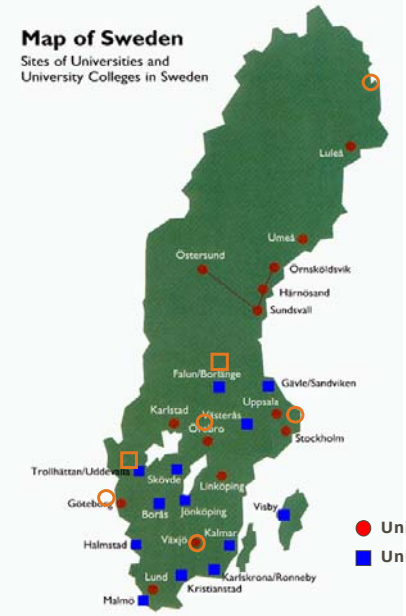
Embedded Systems Education in Sweden

Nabiel Elshiewy

VINNOVA



Sweden: Short facts

- Population: **9** million
- Higher education institutions: **39**
  - State Universities: **14**
  - State University Colleges: **22**
  - Independent HEI's: **3**

  (Chalmers University of Technology, the Stockholm School of Economics and Jönköping University Foundation)
- Teaching and research staff: **24,100**
- Students: **340,000**
- Foreign students: **14,000**,

  or 15% of new arrivals

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Main Actors in Swedish Educational System

VINNOVA

Major actors in R&D funding in Sweden

- Swedish Research Council (VR)
- Swedish Agency for Innovation Systems (VINNOVA)
- Swedish Foundation for Strategic Research (SSF)
- Knowledge Foundation (KKS)

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Why Embedded Systems

- Embedded systems are now the basis for many current and more future products and services on a global level
- To cope with competition, cost reduction and demand, knowledge and development within embedded systems play a key role in a strong Swedish export industry generating sustainable growth and prosperity

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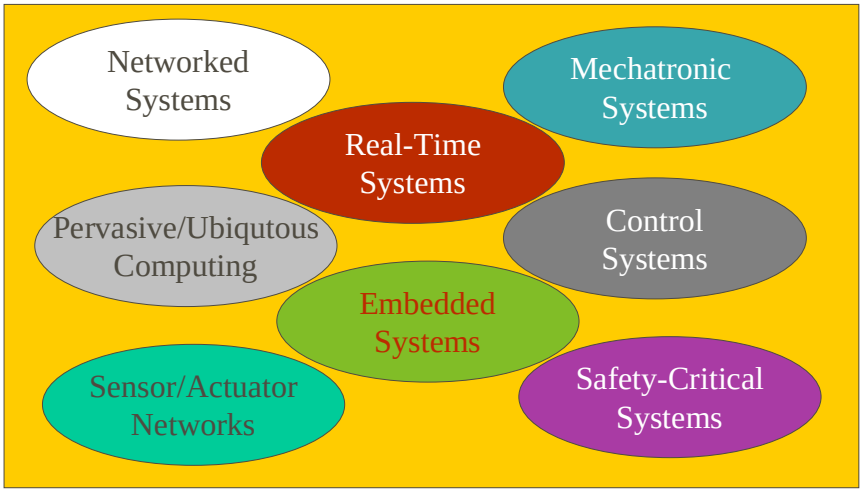
It is not a solo player!



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Higher Education & Research in Embedded Systems and Related Topics

- Blekinge Institute of Technology
- Chalmers University of Technology
- Halmstad University
- Linköping University
- Luleå University of Technology
- Lund University
- Mid Sweden University
- Mälardalen University
- Royal Institute of Technology
- Swedish Institute of Computer Science
- University of Skövde
- Uppsala University

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Example: Research & Education Initiatives

- ARTES
  - Network for Real-Time Research and Graduate Education in Sweden
  - National research programme 1997-2006
- MRTC
  - Real-Time and Embedded Systems Research Centre at Mälardalen University in Västerås
- SAVE (Component-based Design of Safety-Critical Vehicular Systems)
  - National research programme 2003 –2007
- SAVE-IT
  - National industrial graduate school 2004 –2010
- PROGRESS
  - Centre for Predictable Embedded Software and Systems at Mälardalen 2006 –2010
- EASE
  - Industrial Excellence Centre for Embedded Applications SW Engineering
  - Secure competitive edge for industrial partners: ABB, Ericsson, SonyEricsson, UIQ Technology
- TeknikCollege
  - National initiative to support technical education and training on all levels

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ARTES

- A national network for research and education in real-time and embedded systems
- 28 Companies, including ABB, Alfa Laval, Ericsson, SAAB, etc.
- 18 Academic groups from 9 universities
- Budget: about 10 Million Euros
- Summer schools, research projects, national courses support
- Funding more than 40 PhD students through the network
- More info: www.artes.uu.se

VINNOVA

TeknikCollege

- A generic concept for regional competence centres
- Provide young and adults technical- and process-oriented education at all levels (vocational, secondary and post-gymnasium)
- Co-ordination between municipal authorities, schools, educational organisations and companies
- Focus on technology-intensive branches
- Education is linked to the profiles of regional technology companies

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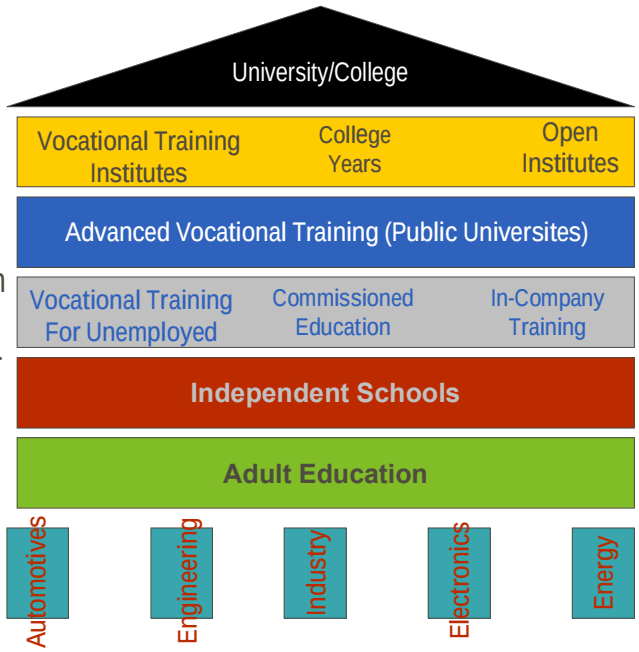

Teknik-College:

Co-ordination of technical Education for young and adults

VINNOVA

Experimental Studies in Embedded Systems Education in Sweden

- Results from several years of experimental studies performed at the Royal Institute of Technology (KTH) Stockholm
- Reported in:
  - Martin Törngren, Martin Grimheden and Niklas Adamsson: Experiences from large embedded systems development projects in education, involving industry and research, Special Interest Group on Embedded Systems SIGBED Review – Special Issue on Second Workshop on Embedded Systems Education (WESE), 2007

VINNOVA

Experiment: Final year M.Sc. Course

- Adopting product development approach
- Aim is to provide knowledge and skills to develop products in small or large development teams
- Implemented in terms of large projects in cooperation with external industrial partners
- Carried out in close connection to research groups
- Based on a product specification, students apply and integrate their accumulated knowledge in the development of a prototype

VINNOVA

Experiment Results

- Highly beneficial to carry out large projects in an educational setting, with external partners as project providers, and in close cooperation with research groups
- external partners feed the course, students and faculty with many industrially relevant problems, useful for
  - motivational purposes in course work
  - exemplification in other related courses
  - case studies in research
- Carrying out the projects in close connection to research groups provides synergy between research and education, and can improve the academic level of the projects

VINNOVA

A Further interesting Dimension

- Running the projects in iterations, requiring new groups of students to take over an already partly developed complex system and work incrementally on this system
- Students are then faced with very typical industrial situations, gaining more realistic experience
- Authors advocate that students should be exposed to a mixture of “build from scratch” and “incremental” projects during their education

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Concluding Remarks

- Further educational programs and projects at several Swedish universities are reported at workshops and conferences
- A lot of interesting work is already done, in particular within the European ARTIST programme
- Need to study in more detail and make use in COSINE-2 work

High-tech
Innovation
Entrepreneurship

HellenicSIA
EN.E.B.H.

Research in SMEs:
Required skills and challenges

www.hellenic-sia.org

Dr. Gregory Doumenis
President, GDT S.A. – Vice Chairman of Hellenic SIA

HellenicSIA

Mission

- The Hellenic Semiconductor Industry Association is a nonprofit association of the Semiconductor and embedded systems sector in Greece.
  - Unique combination of multi-disciplinary expertise.
- Hellenic-SIA works to improve the hi-tech business sector in Greece and to foster international collaboration.

Vision

To build in Greece a world-class μElectronics and Embedded Systems industry, famous for its technology superiority and innovation

H-SIA profile

Hellenic Semiconductor Industry Association

- **Founded** in 2004 as non-for-profit organization by renowned individuals that had excelled abroad as executives, professors, researchers, engineers
- **Full members**: fast-growing companies, SMEs or multinational design-centers in the semiconductor and embedded systems food-chain
- **Associate members:** universities, research institutions, microelectronics labs, individuals
- **Funding**: venture capital, bootstrapping, design centers
- **Customer-base:** US, EU, Japan, RoA
- **~€30M foreign direct investments, ~€70M sales** (est. 2007)
- **700+ employees** (Q1 2008)

H-SIA members

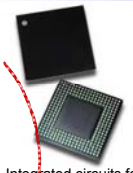
- Already counts **33 industrial members**, 2 µElectronics research institutions & 13 Academic labs
- All members develop original cutting-edge technology targeting the global market

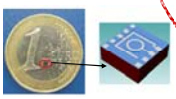
Successful products and technologies


video coders IP cores & boards MPEG 4-10/AVC (H.264)


Transceivers for DECT wireless telephony


NG Residential gateways: Ethernet Switch, ADSL2/2+, SoftPBX, USB2.0, WiFi a/b/g/e, SD Flash Card UWB, GPON, VDSL, HDTV


Integrated circuits for Gbit Ethernet and wireless (GSM, 3G, WiFi, WiMax) comms

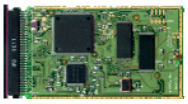

Integrated flow and acceleration sensors


Analog, Mixed-signal and RF integrated circuits


Single-chip transceivers for wireless data: WiFi, WiMax


On-Board cameras


Electronic Design Automation (EDA) software tools


Integrated PCMCIA systems for wireless laptop access

Mid-term goals

- **Increase membership of** H-SIA from 48 to 150 in 5-7 yrs.
- Create **4000+ new jobs** for scientists and engineers
- Rapidly grow **patent filing** for global coverage
- Improve collaboration between **companies-universities**
- **Repatriate** Greek-origin engineers from abroad

R&D in S(M)Es (ad-hoc definition)

Research:

- Related to long term product planning!
- Usually aided by state or EU RTD funds
- 2-4 years from concept to market introduction

Development:

- Related to current or next generation products
- Usually self-financed (or aided by non-RTD funding instruments)
- 0,5-2 years from decision to product introduction.

R&D in S(M)Es (II)

Research & development are **combined** in S(M)Es:

- Usually one (critical) department
- Also involved in product development/support
- Anything between 2-15 persons

Training and skill development:

- Mostly “on the job”; in some cases “outsourced” (seminar, courses)
- No training plans, limited budget
- Young recruiters should be ready to aid “production” after 2-3 months max.

Required skills – I (graduate)

Good and practical foundations in S/W technologies:

- ES S/W becomes large and unmanageable
  - S/W development cycle, S/W projects management tools…
  - Linux development experience is a MUST
- Good (working) command of high level programming languages
  - C/C++/JAVA, ….
  - Network programming
- Practical coding experience
  - At least 2 large projects, one in embedded programming

Required skills – II (BSc, MSc)

Solid knowledge of ES principles:

- ES H/W
  - Microprocessors, memory systems, interfaces, networking principles
- ES development tools (hands-on!)
  - Linkers, mappers, debuggers
  - Working experience in ES firmware development (i.e. device driver)
- Hands-on experience on performance aspects
  - RT and near RT requirements (i.e. UI reaction time, network timeouts,…)
  - **Impact of S/W architecture and coding style to system performance**

Required skills – III (MSc, PhD)

SOTA knowledge in one domain:

- ES H/W, or ES S/W and performance
- Application specific systems engineering – No “plain vanilla”
  - multimedia, wireless, data networking…

Management skills:

- Imperative quality!
  - In the US, a CTO in a startup is ~24-30y.o.
  - In Europe, a PhD graduate is ~26-28y.o.
- Needs knowledge about
  - project management,
  - HR (productivity, team management)

Challenges for academia

Interface between academia and industry:

- Fast reaction time to cater with technology evolution
- "Bidirectional" links:
  - follow the (research) trend
  - listen to the market

"New blood" must bring-in new technologies!

- i.e. Current research trends should be known to MSc graduates

Challenges for the industry

- We need good collaboration with academia
  - to survive!
  - to address new challeng
  - To introduce disruptive technologies

Thank You!

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