AmiEs-2015

International Symposium on
Ambient Intelligence and Embedded Systems

24 - 26 September, 2015
Oostende, Belgium

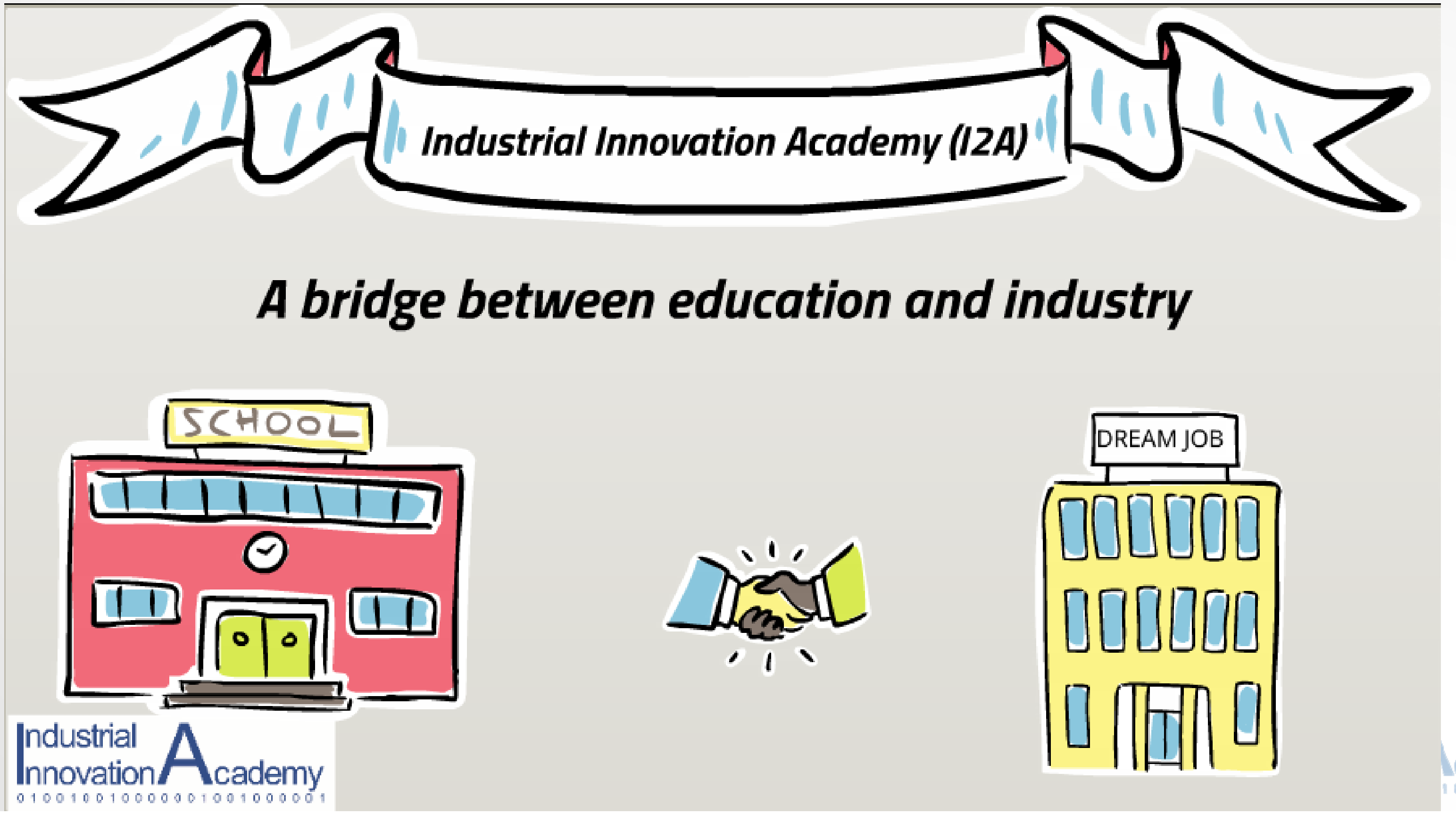
INDUSTRIAL INNOVATION ACADEMY:
A step to Re-engineering ICT education in VUAS

Smail Menani

https://i2a.vamk.fi/index.php/c1w/

BRIEF INTRODUCTION

- ***The Industrial Innovation Academy (I2A) seeks to link the students at the Vaasa University of Applied Sciences (VAMK), with local, regional and international businesses present in Vaasa and the surrounding Ostrobothnia Region.***



START SMALL, GO FAST, GO FAR

THE PRINCIPLE

*Potential for Students to earn **ECTS** as: Project Studies or Work Experience with Real Businesses*

New Members:
Beginner Projects,
Recycled Projects

Experienced Members:
Internal Projects with real-life applications

Expert Members:
Industry Projects, approach and work with clients

All projects, whether internal or external, shall be connected to the curriculum

Industrial Innovation Academy

ORGANIZATIONAL STRUCTURE

Director

Smail Menani

Senior Partners

8 – 10 Senior Partners

Consist of **Management** and **Technical** Side

Junior Partners

Junior Partners

Trainees

1 – 3 Assistants

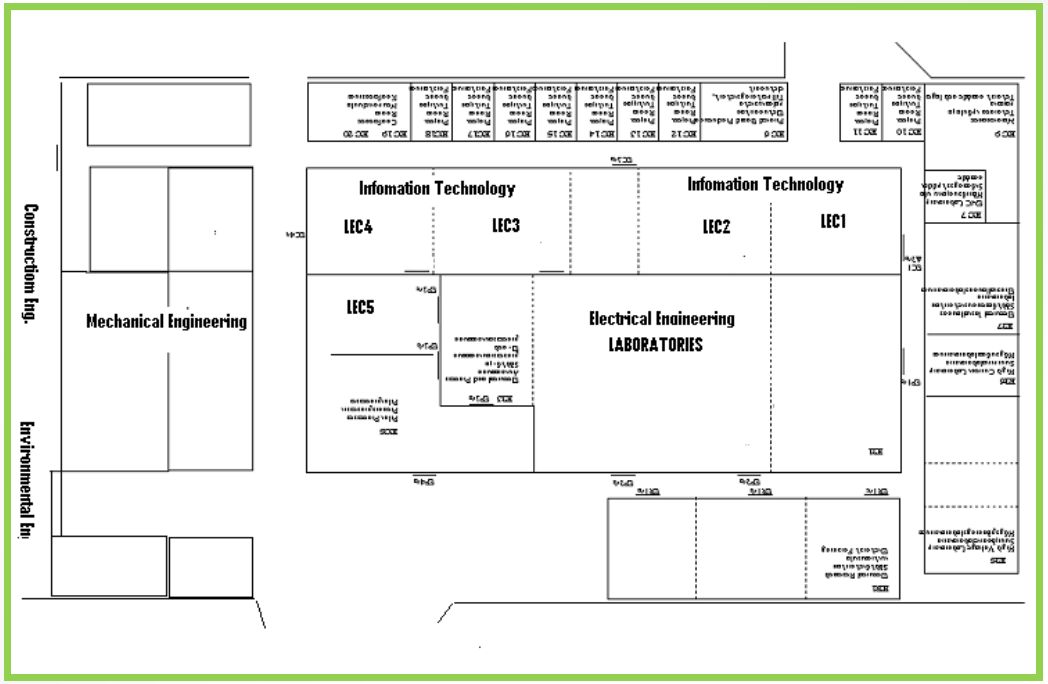
ORGANIZATIONAL STRUCTURE

Role	Recommended	Maximum
Junior Partners	12-15	30
Trainees	12-15	
Assistants	1-2	3

- Total Cap: **45** Members
- **Active**, not passive members
- Provide smooth chain of command and communication
  - Junior Partners and Trainees correspond to Senior Partners
  - Senior Partners correspond to the director
  - Director corresponds to VAMK and the board of VAMK

OUR LOCATION

- Physical:
  - Office at Technobothnia
  - *Puuvillakuja 3, 65200 Vaasa*
- *Virtual:*
  - *www.i2a.vamk.fi*



Map of Technobothnia

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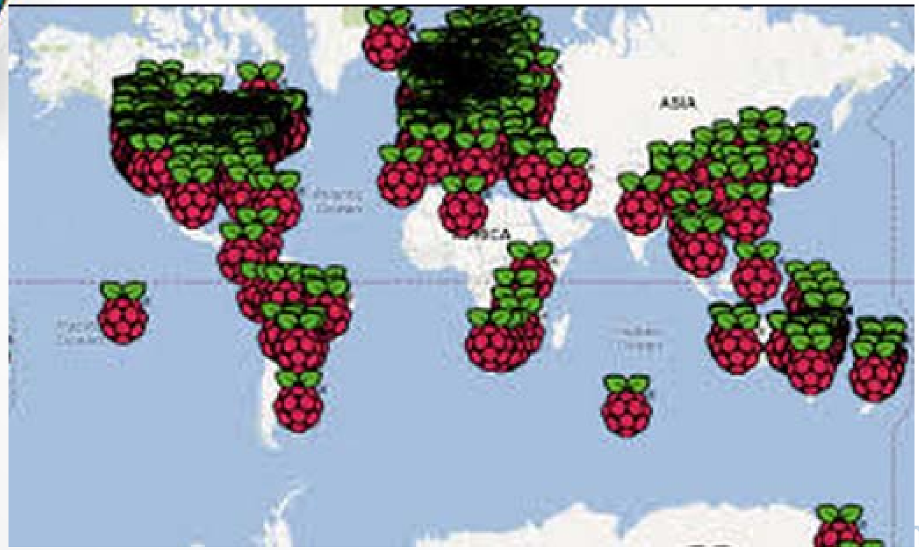
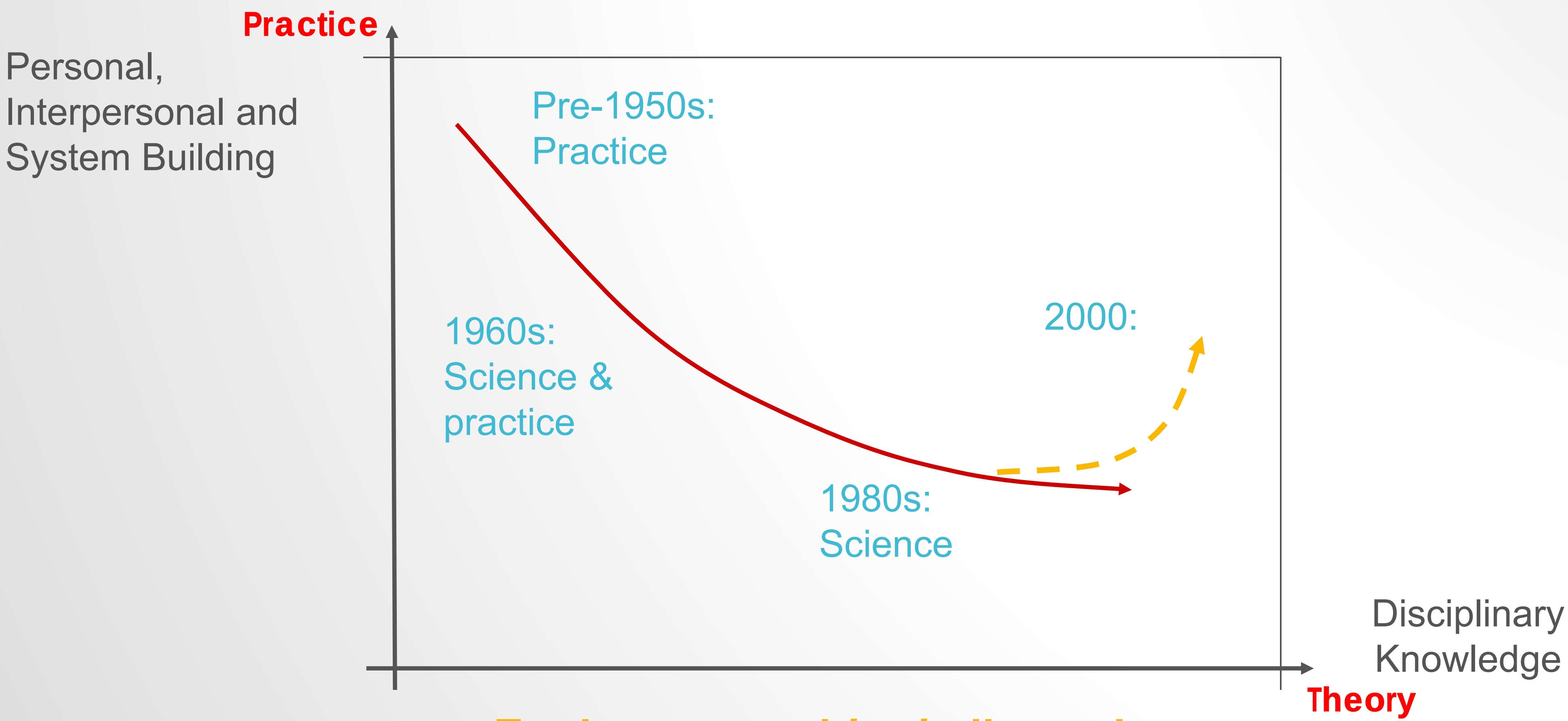
LEARNING TECHNOLOGY



DEVELOPMENT OF ENGINEERING EDUCATION



Engineers need *both* dimensions

Ref: CDIO

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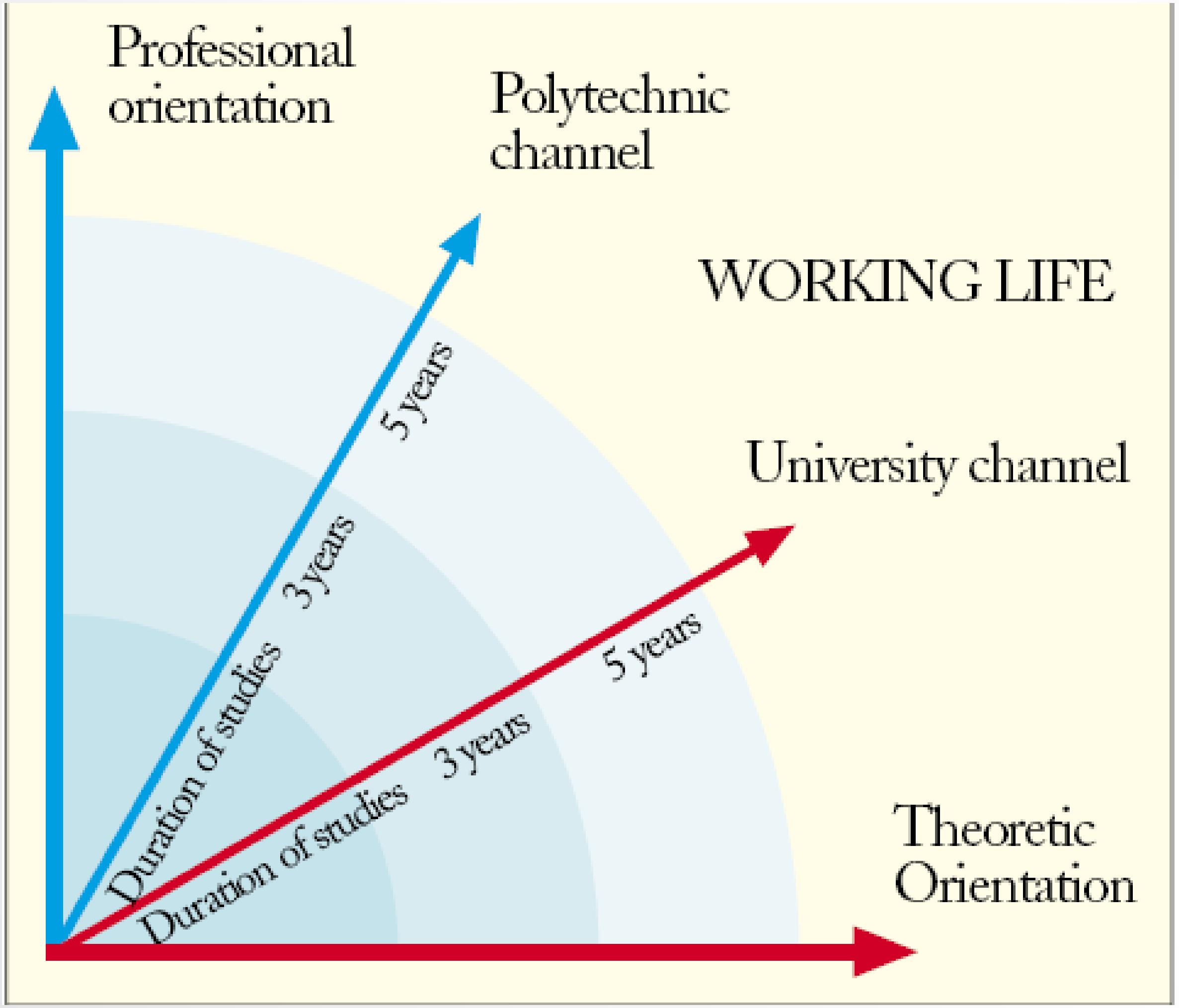
EDUCATION SYSTEM IN FINLAND



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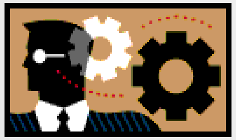
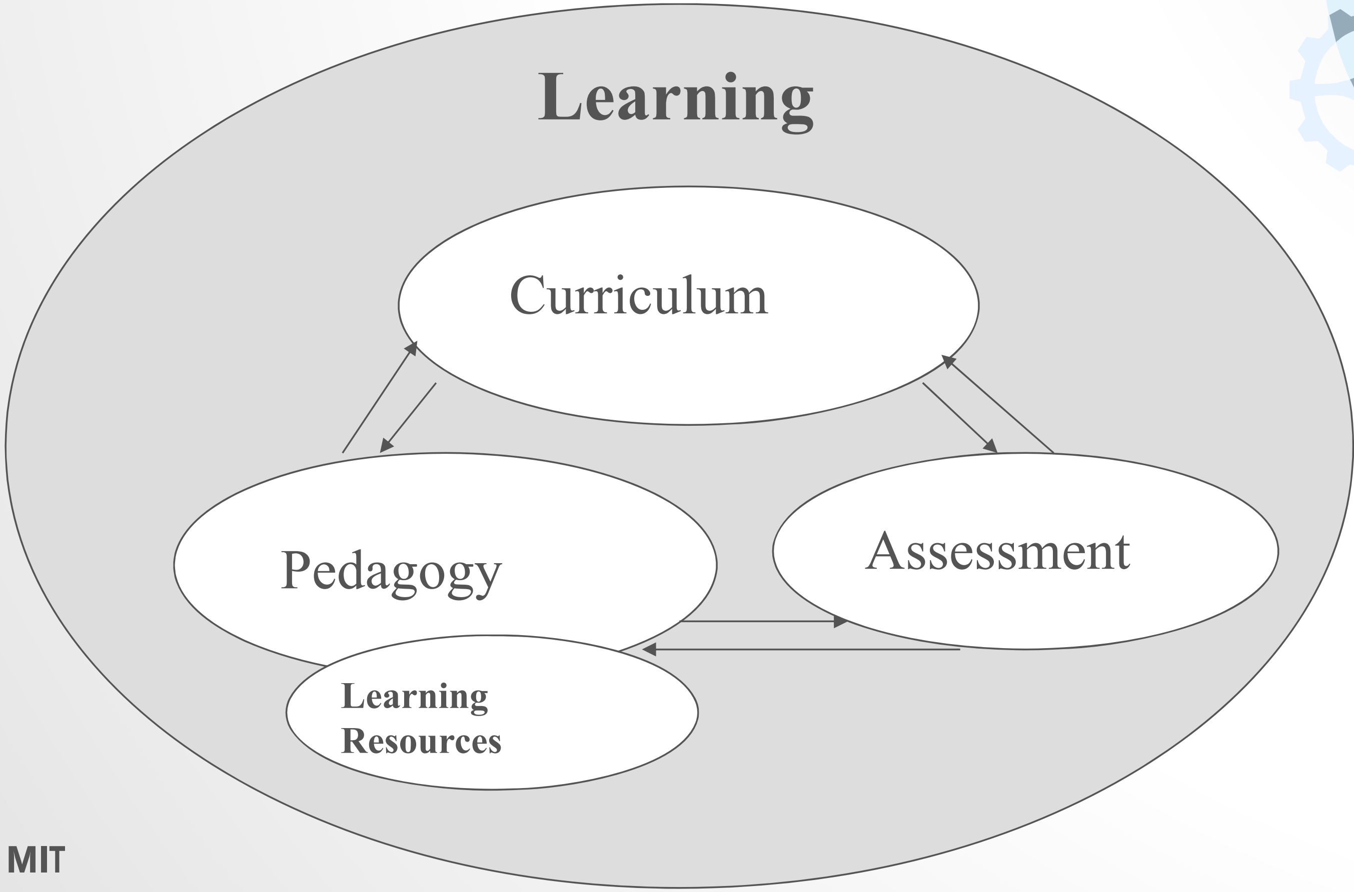
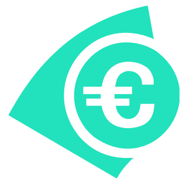
A LEARNING FRAMEWORK







Ref: Doris R. Brodeur, MIT

A LEARNING DESIGN
(WIGGINS & MCTIGHE, 1998)

Stage	Key Design Questions	Design Considerations
Curriculum: Defines desired outcomes	What competences are required	Industry needs Professional standards Program strengths Faculty expertise
Pedagogy: Plan teaching and learning experiences	How to implement the competences	Teaching strategy
Assessment: Determine acceptable evidence	What is evidence of understanding?	assessment methods Match of outcomes and methods

Ref: Doris R. Brodeur, MIT

STRUCTURE OF DEGREE PROGRAM

Structure of degree programme (240 ECTS)

Final thesis 15

Practical training 30 ECTS

Optional studies 10 ECTS

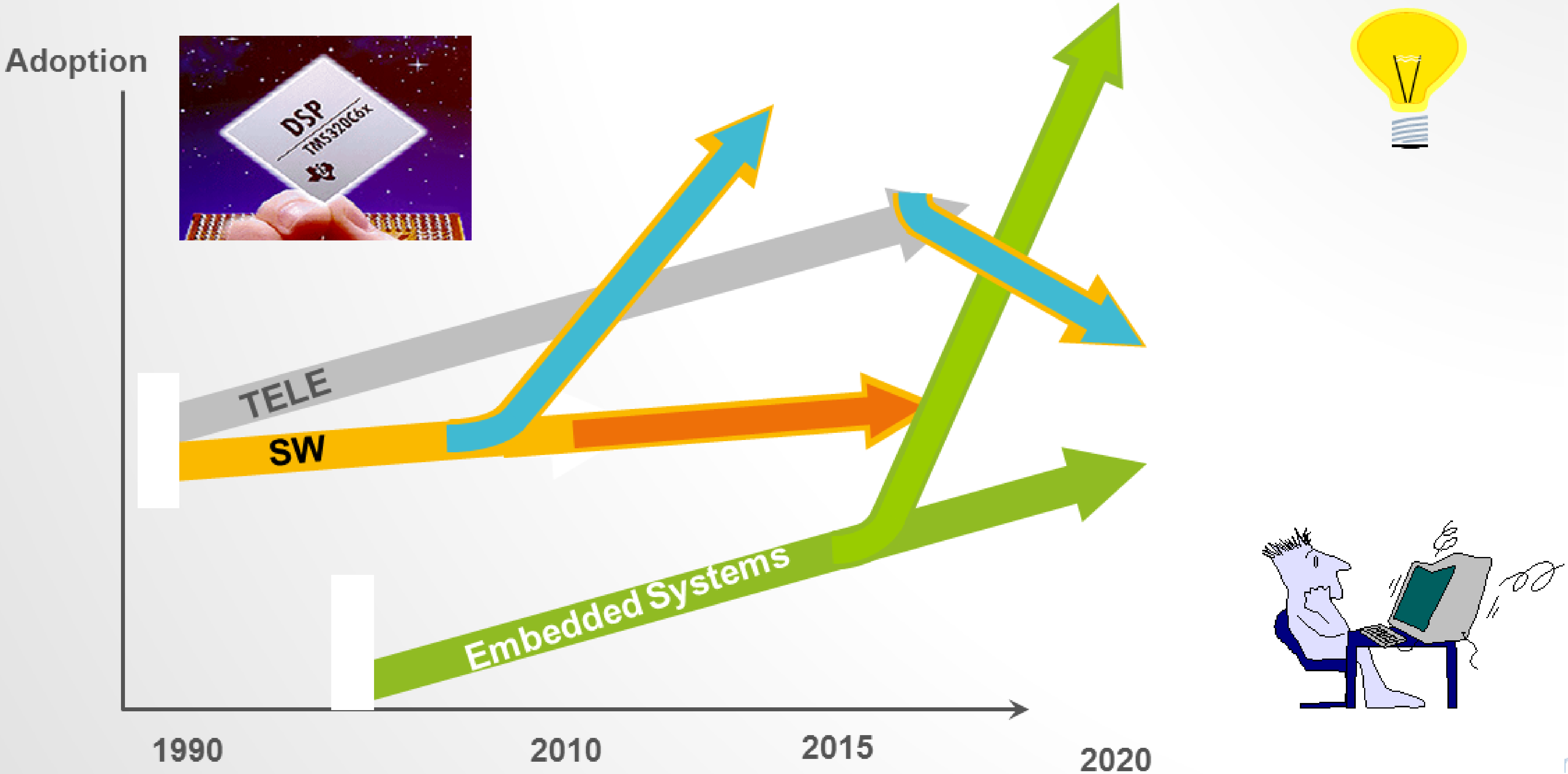
Special professional studies 40 ECTS

Basic studies 145 ECTS

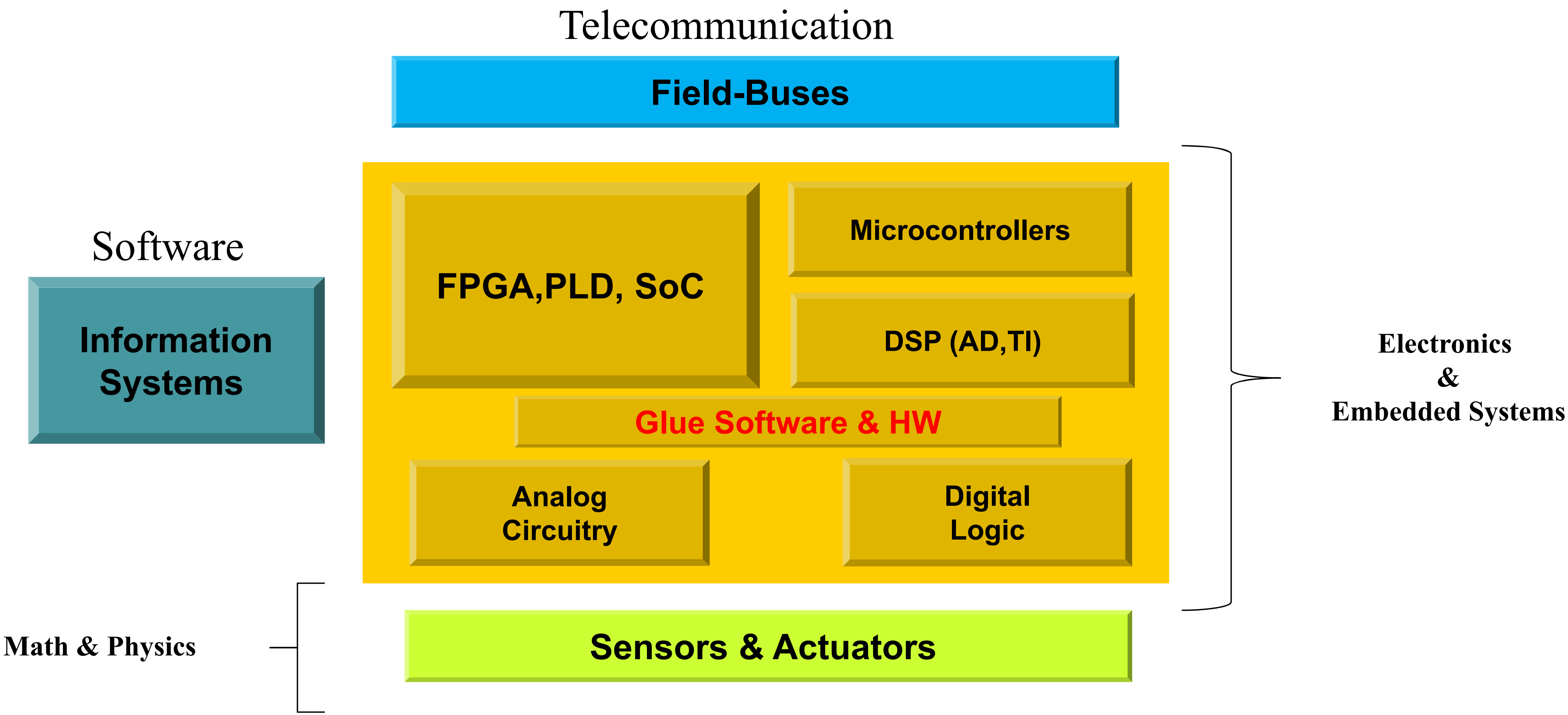
General basic studies	Vocational basic studies

1 study year = 60 ECTS Credits

DIFFERENT OPTIONS MANY CHOICES



Need to redesign
The big picture: From Embedded System

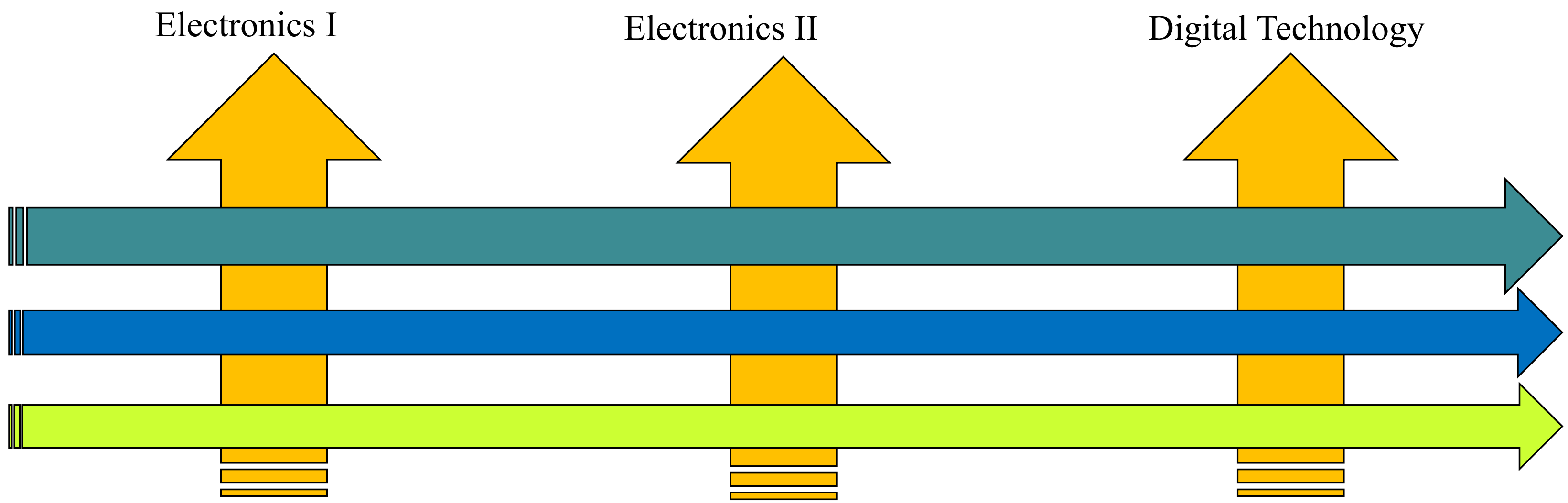


Juonne

Students can generate electrical signals from physical phenomena

Students are able to process electrical signals to be used in digital systems

Students can process a digital signals and use them for system control & communication



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VASA YRKESHÖGSKOLA
UNIVERSITY OF APPLIED SCIENCES

RE-DESIGN THE CURRICULUM

I VUOSI

P1 P2 P3 P4 p5

Ammatti-identiteetti

Opinnot ja tied.
Tietokone opisk
työturvallisuus
Pc-rakennus
Tiedottava viestin
Tietotekn.dokum
Johd. matem
mekaniikka
Tasa- ja vaihtos
käyttöjärj

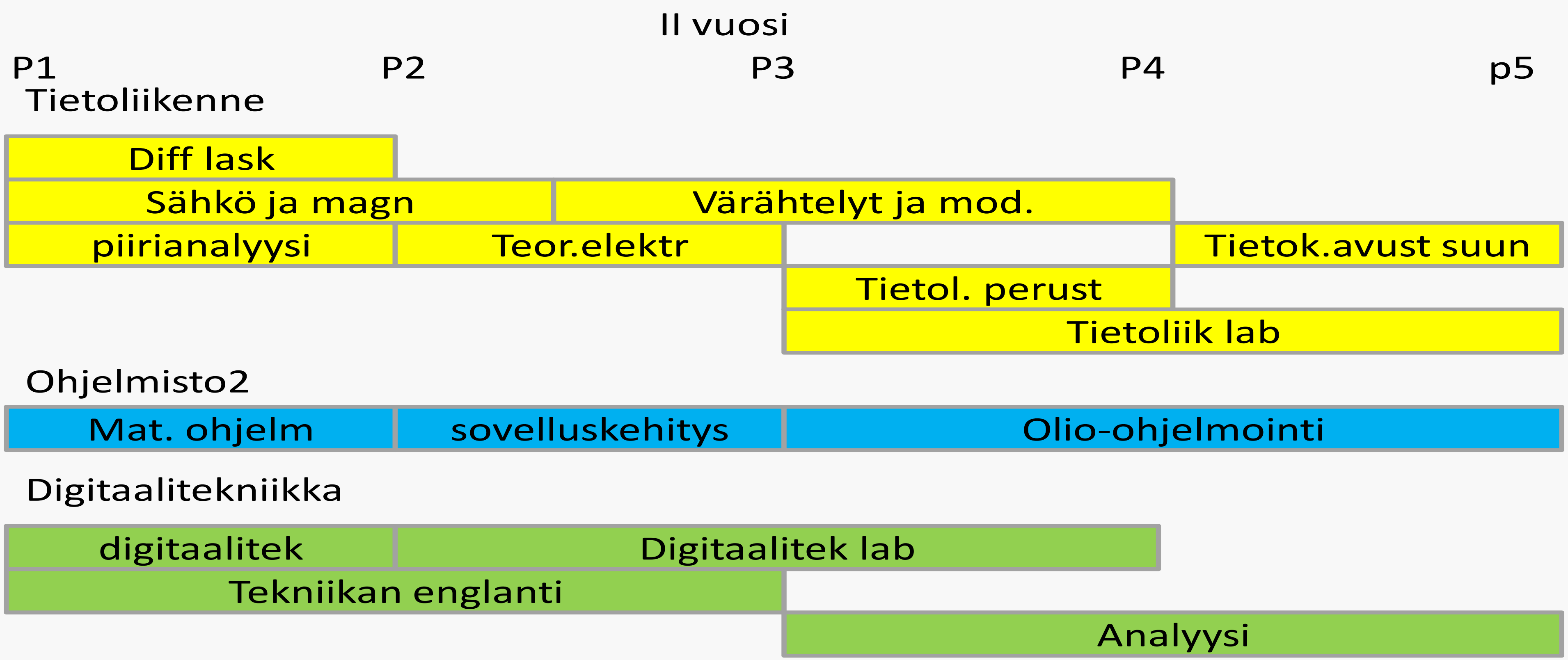
Elektroniikka

Perus.el+labrat

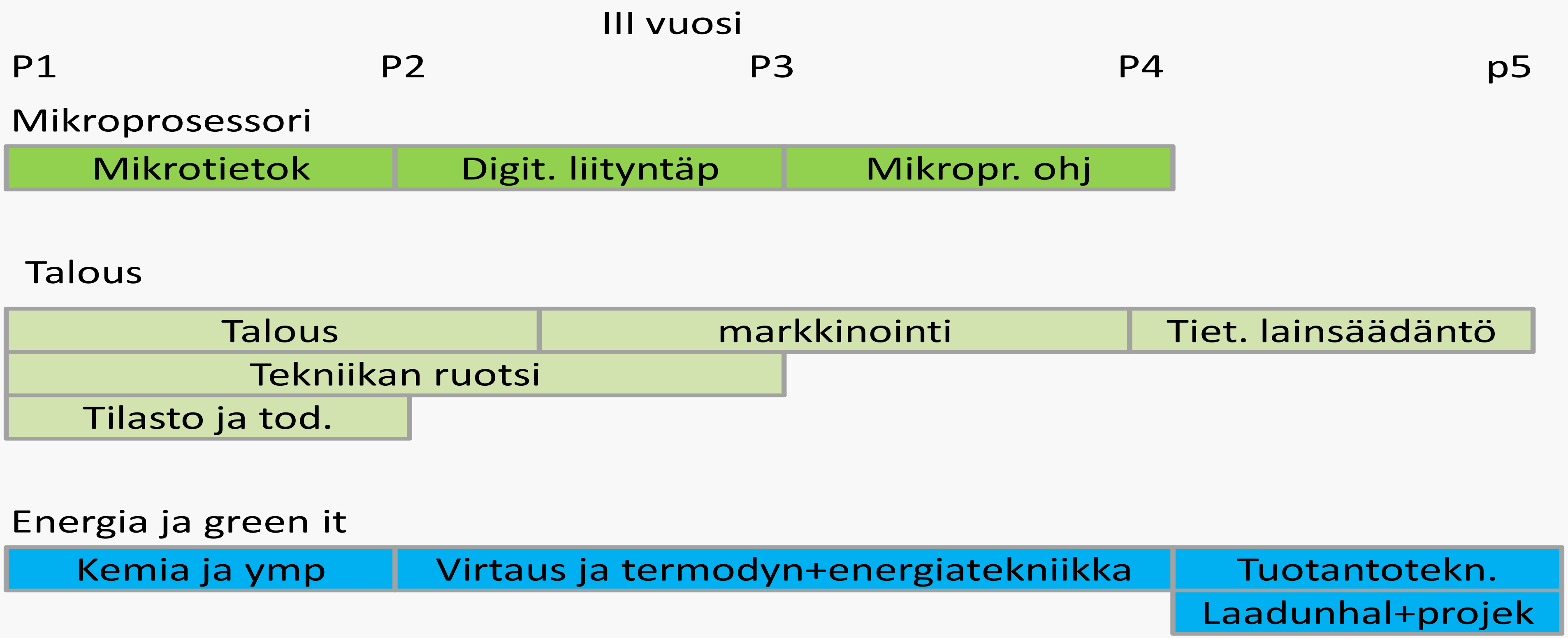
Ohjelmisto 1

Ohj.per
Ict-työkalut
Tietokoneverk.p
Lin.alg+analyt geom

Tiedottava viestintä: labraselostukset (elektoriniikan labrat) esitelmä (PC-rakennus)
Projekteja: peruselektronnikan labrat, tietoverkot, tietotekn. Dkoukent (tietokoneverkot)

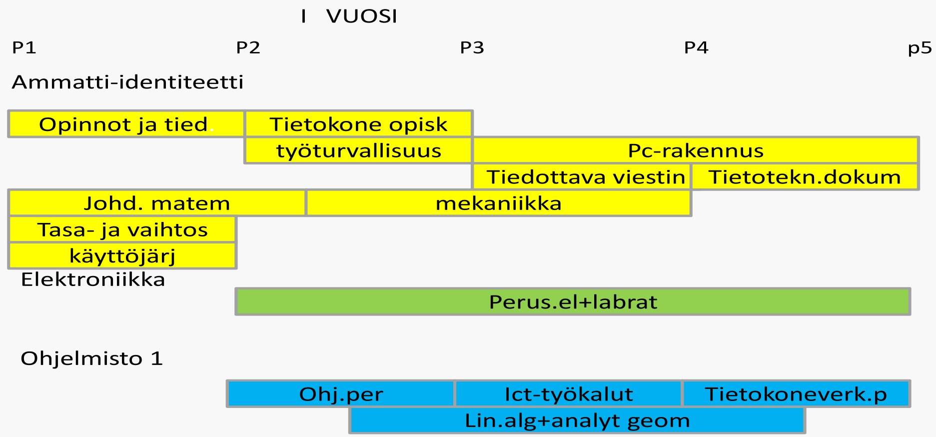


Projektit: tietok.avust suunnittelu, olio-ohjelmointi, digitaalitekn. lab


III vuosi
P1
P2
P3
P4
p5
Mikroprosessori
Mikrotietok
Digit. liityntäp
Mikropr. ohj
Talous
Talous
markkinointi
Tiet. lainsäädäntö
Tekniikan ruotsi
Tilasto ja tod.
Energia ja green it
Kemia ja ymp
Virtaus ja termodyn+energiatekniikka
Tuotantotekn.
Laadunhal+projek

1st Year

			P1	P2	P3	P4
		43	18	11	8	6
Professional Identite I	Studies and Information Acquisition	2	2			
	Computer as a Tool	3	3			
	Safety at Work	2		2		
	PC Assembly and Upgrading	3			3	
	Engineering Drawing	3				3
	Introduction to Technical Mathematics	4	4			
Electronics I	Electricity and Magnetism	3	3			
	DC and AC Circuits	3	3			
	Basics of Electronics	3		3		
	Electronics Labs	3			3	
Software I	Basics of Programming	3		3		
	Basics of Operating Systems	3	3			
	Use of Data Network ?	3				3
	Linux	3		3		
	Analytic Geometry and Linear Algebra	2			2	



Tiedottava viestintä: labraselostukset (elektoriniikan labrat) esitelmä (PC-rakennus)
Projekteja: peruselektronnikan labrat, tietoverkot, tietotekn. Dkoukent (tietokoneverkot)

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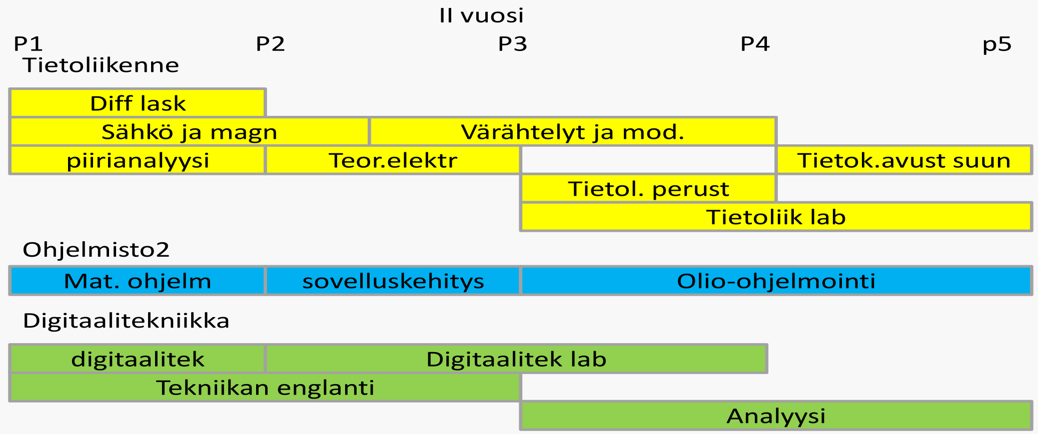
2nd Year

			P1	P2	P3	P4
		51	14	12	17	11
Professional Identite II	Differential Calculus	2	2			
	Basics of Mathematical Software	2				2
	Analysis	3			3	
	Computer Aided Design of Electronics	4	4			
	Circuit Analysis	3				3
	Electronic Systems Theory	3				3
	ICT English	3	3			
	Basics of Computer Networks	3			3	
	Basics of Computer Networks Lab ex	4			4	
Electronics II	Digital Electronics	2	2			
	Digital Electronics Lab	2		2		
	Computer Architecture	4		4		
	Interfacing in Digital Systems	2			2	
Software II	Basics of Computer Networks	3		3		3
	Application Development	3	3			
	C-Programming	3		3		
	Object Oriented Programming	5			5	



Projektit: tietok.avust suunnittelu, olio-ohjelmointi, digitaalitekn. lab

46+53=99

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3rd Year

			P1	P2	P3	P4
		24	9	12	4	4
Professional Identite III	**Legislation of Information Technology**	**3**				
	Speaking Skills in Finnish	**4**				
	Statistics and Probability Theory	**2**				
	Communication Skills II	**3**				
Electronics II						
	Digital Systems	**4**	**4**			
	Microprossessors and Controllers	**5**		**5**		
	Project				**4**	
	Production Engineering					4
Energy & GIT	**Chemistry and Environment**	**3**	**5**			
	Energy Technology			**7**		

46+53+24=123

Left 117= 95 + 22

III vuosi

P1 P2 P3 P4 p5

Mikroprosessori

Mikrotietok	Digit. liityntäp	Mikropr. ohj

Talous

Talous	markkinointi	Tiet. lainsäädäntö
Tekniikan ruotsi		
Tilasto ja tod.		

Energia ja green it

Kemia ja ymp	Virtaus ja termodyn+energiatekniikka	Tuotantotekn.
		Laadunhal+projek

Thesis: 15
Practical Training 30
Major: 30
Minor: 10
Optional:
10

Total: 95

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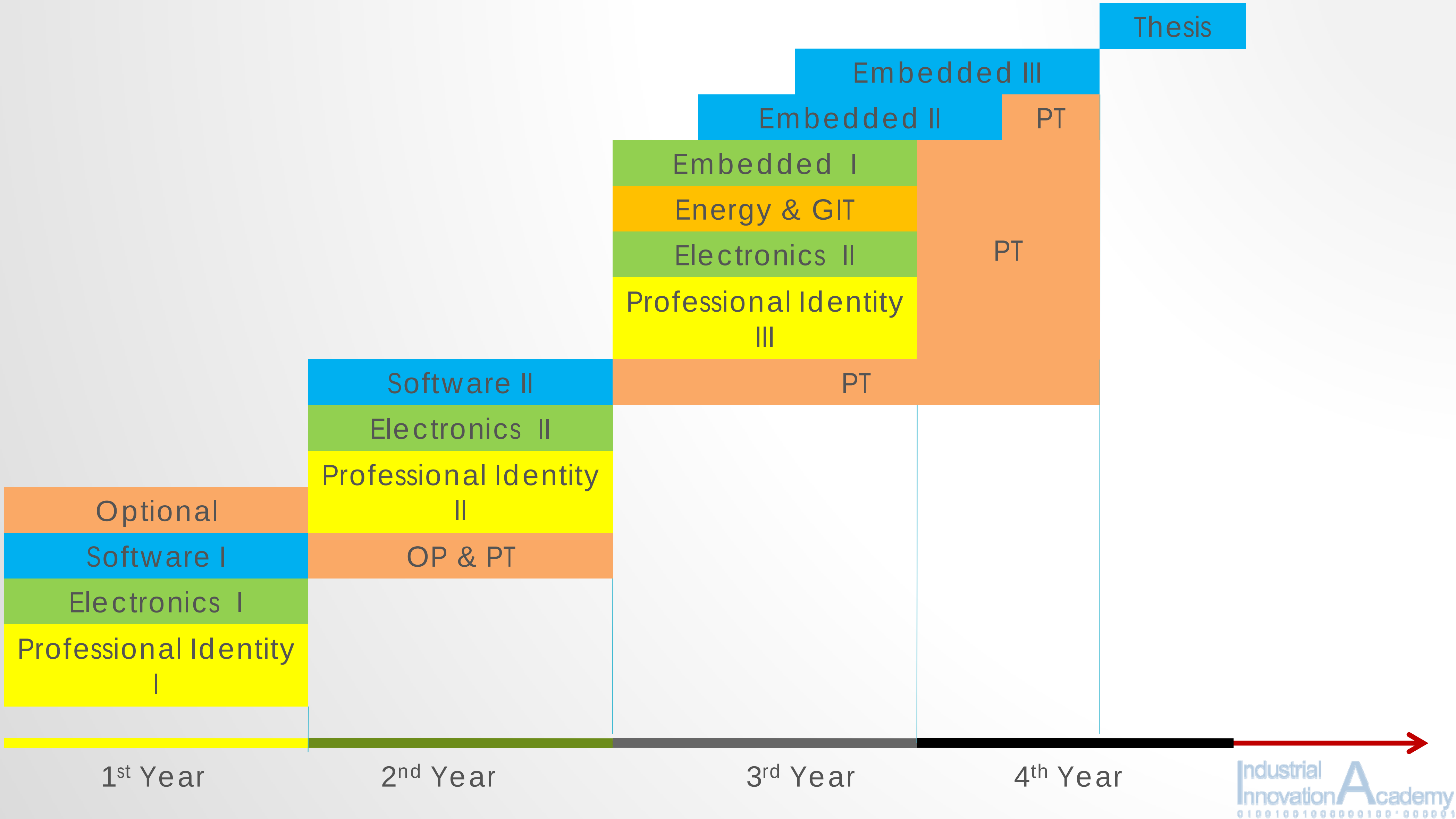
Thesis
Embedded III
Embedded II
PT
Embedded I
Energy & GIT
Electronics II
Professional Identity III
PT
Software II
PT
Electronics II
Professional Identity II
Optional
OP & PT
Software I
Electronics I
Professional Identity I
1st Year
2nd Year
3rd Year
4th Year
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Microcontrollers Laboratory, 4 ECTS
IIS1103

Must	Should	Nice	Content
			I/O Manipulations
x			Port direction settings
x			Port settings
x			I/O logic levels
x			Read from Inputs and Write to Outputs
x			Use of LEDs
x			Use of 7-segement display
	x		Use of LCD display
			Interrupts
x			External user interrupt
x			Timer interrupt
		x	ADC interrupt
		x	UART interrupt
			Timer
x			Timer Mode
	x		Event Counter Mode
	x		One-shot Timer Mode
x			Pulse Width Modulation Mode
	x		Pulse Period/Pulse Width Measurement Mode
			A/D Converter
x			One-shot Mode
x			Repeat Mode

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SO WHAT NEXT?

http://www.puv.fi/opsweb/?code=IT-2015

IT	2015-2016										General Competencies							Subject Specific Competencies						
Starting time	2015 autumn										G1	G2	G3	G4	G5	G6	IG1	IT1	IT2	IT3	IT4	IT5	IT6	IT7
	Information Technology, 240 cr																							
		I-IT-1		I-IT-2		I-IT-3		I-IT-4		CR														
		1.		2.		3.		4.																
		A	S	A	S	A	S	A	S	Tot.														
	Yearly load	60		60		80		60																
Code	String/Study module	30	30	30	30	40	40	30	30	240														
IITP0000	BASIC AND PROFESSIONAL STUDIES									145														
IITP0100	**Introduction to Engineering Studies**	17	5	2						24														
IITP0110	Introduction to Information Technology Studies	2										x												
IITP0102	Computer as a Study Tool	3											x		x									
IITP0105	Introduction to Technical Mathematics	4									x						x							
IITP0107	Engineering Drawing	3												x										
IITP0108	Finnish for Foreigners	3											x	x		x								
IITP0106	Mechanics	2	2														x							
IITP0103	PC Assembly and Upgrading		3																		x			x
IITP0104	Communication Skills			2									x		x									
IITP0200	**Electronics I**	10	5							15														
IITP0201	DC and AC Circuits	3									x						x				x			x
IITP0202	Safety at Work	2										x							x					
IITP0204	Basics of Electronics and Labs	5	2								x										x			x
IITP0203	Digital Electronics I		3								x									x	x			x
IITP0300	**Basics of ICT Skills**	3	10	2						15														
IITP0301	Basics of Programming	3																	x			x		
IITP0302	Basics of Computer Networks		5																		x	x		x
IITP0303	Basics of Web Development		3																x			x		
IITP0304	Analytic Geometry and Linear Algebra		2														x							
IITP0305	Basics of Mathematical Software			2													x							
IITA0100	**Telecommunications and Electronics**		3	11	7					21														

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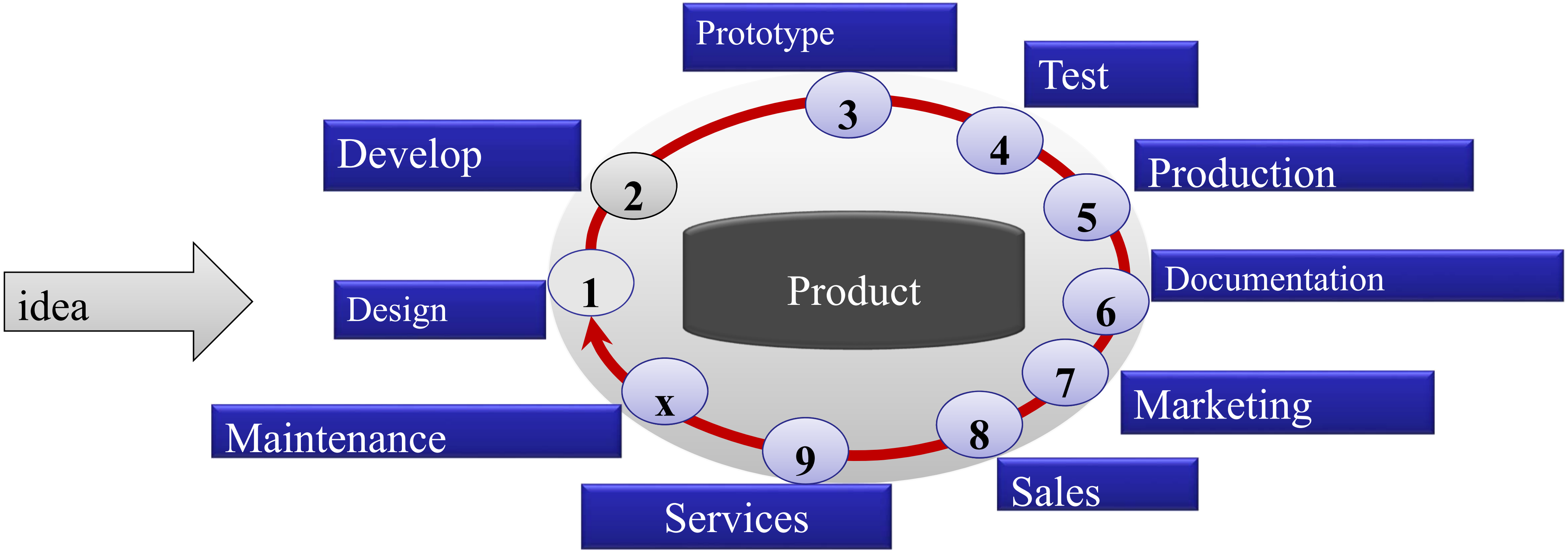
Thesis Factory



Thesis Factory: To support the curriculum

Product Development

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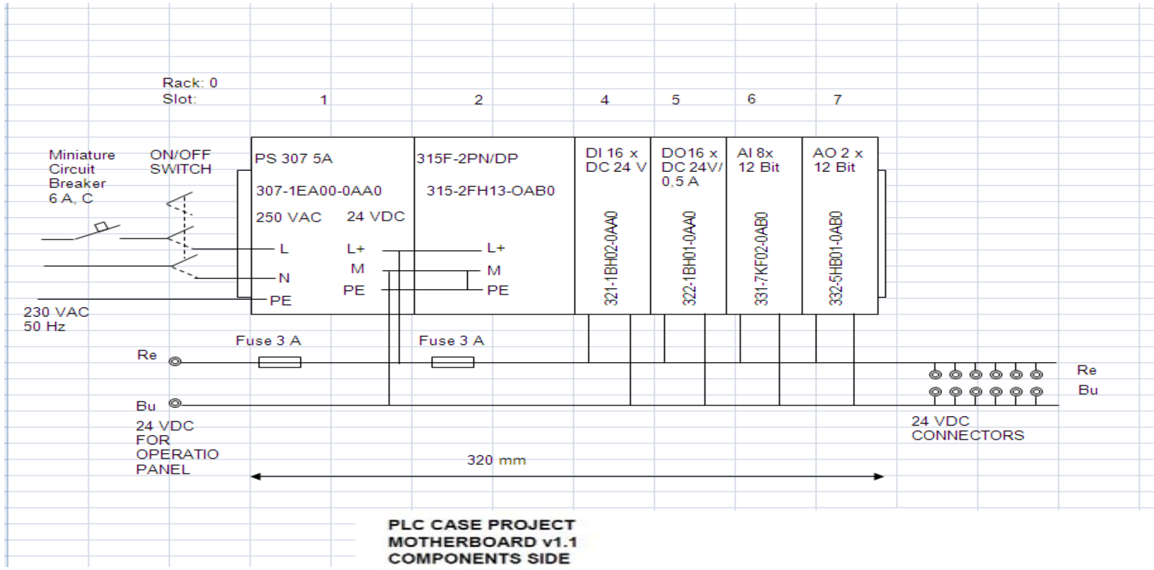
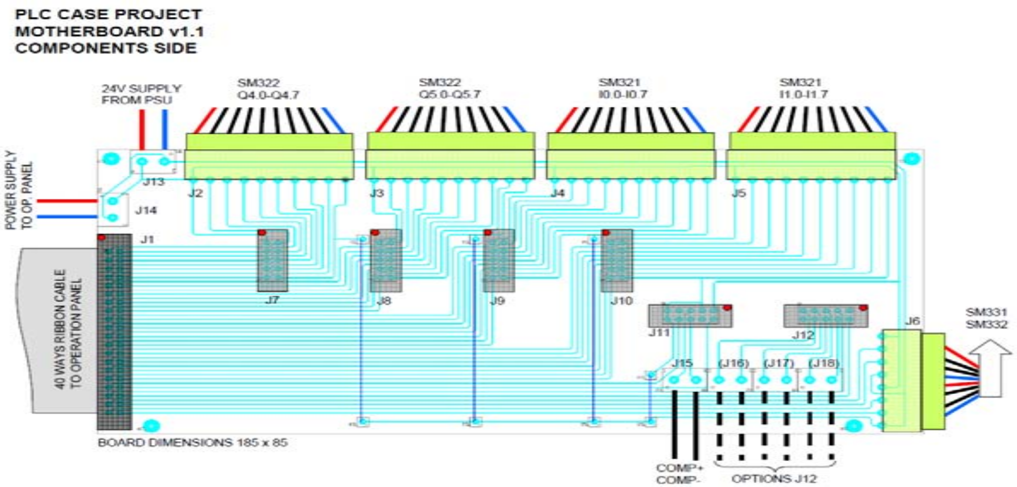
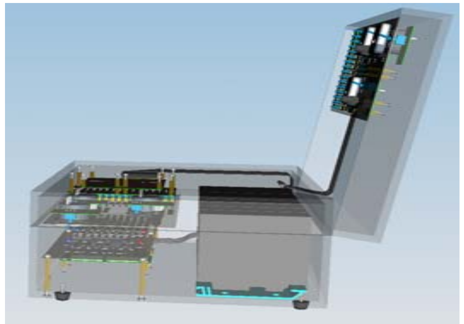
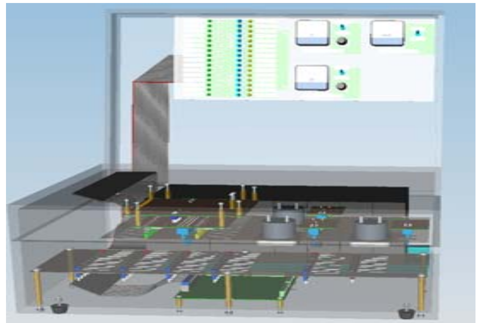
From ideas to product









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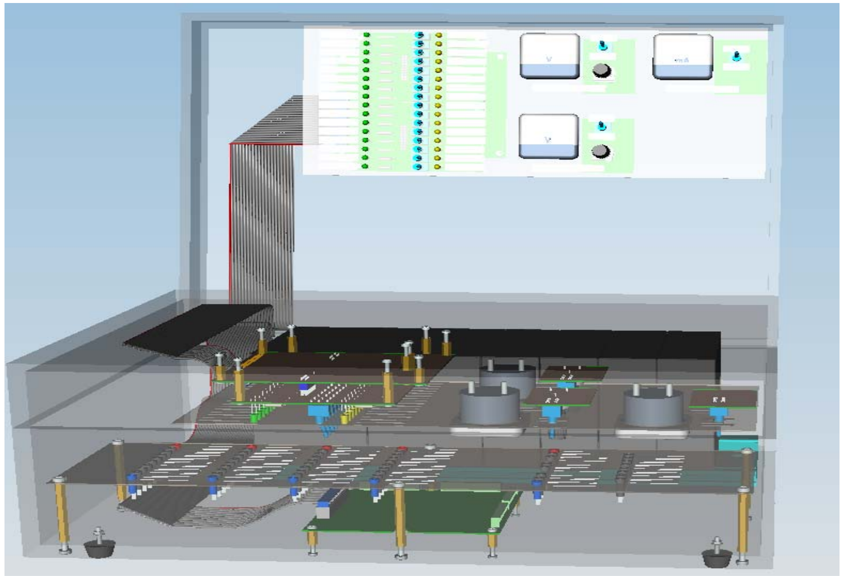
Product Characteristics

- Designed using CAD tools
- Design optimization
- Integrate all in a single aluminum case
- Great mobility and accessibility
- Modular and easy to replace blocks
- Electrical Safety requirement



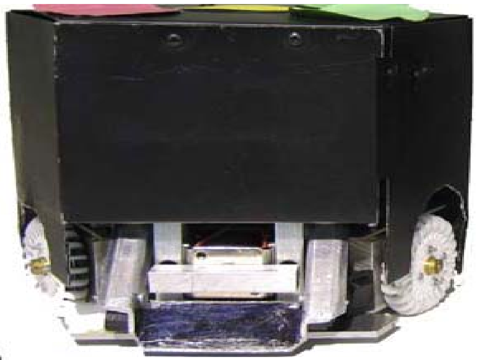
- Upper panel is used for both analog and digital simulation
- Lower panel is used for real life applications

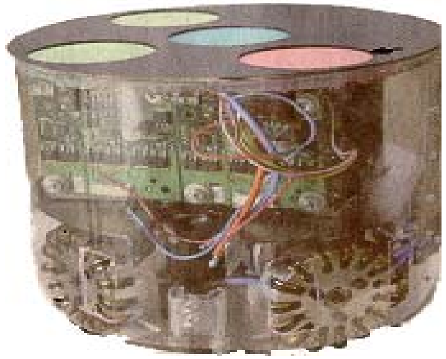
Other product: GSM/GPRS Remote Monitoring and Control Terminal

Key Specifications:

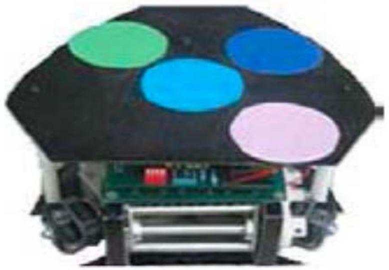
- Analogue Input 4-20ma: 2
- Digital input 12V: 8
- Digital output 12V: 8
- Communication: GSM/GPRS
- Link to PLC: Ethernet
- Power supply: 6~18VDC
- Debug port: serial RS232

The Botnia Robot Team





1st generation



SR1

- 3-omni-directional-wheel design
- Faulhaber DC motors, 16 CPR encoder, 9.7:1 gearhead,
- Spinner bar kicker
- Atmel ATmega microcontroller
- Discrete motor controllers and drivers
- Radiometrix RF 433 MHz wireless module
- NiMH batteries, 8 cells

SR1E

- More reliable PCB and motor driver circuit
- Major improvements of motor controller firmware

Major weakness

- Very weak kicker
- Very unreliable wireless link
- Low efficiency circuit
- Low performance

4th generation

SR4

- Modeled with CAD and completely manufactured with CNC
- 4-omni-directional-wheel design
- Maxon flat brushless DC motors, 360 CPR encoder, 4.2:1 gear reduction
- Forward/chip kicker and dribbler bar all-in-one design
- Servo motor to adjust the attitude of dribbler bar
- IR array for autonomous ball positioning
- ARM7 microcontroller and FPGA
- Discrete MOSFET motor drivers for maximum performance
- DECT 1.9 GHz and Linx wireless modules with error detection
- DC inverter to 200V for the solenoid kicker with IR trigger
- LiPo batteries, 4 cells
- Very high efficiency (over 80%)
- Reliable electronics with full protection and high performance
- Diagnostic mode for easy debug
- Debug and firmware download through wireless link
- LCD for easy debug

SR4 design is among the top in the world based on own and some best teams experience

Revolutions from SR1 to SR4

	SR1, 2005	SR2, 2006	SR3, 2007	SR4, 2008
Microcontroller	ATMEGA8535	ATMEGA128	ARM7	ARM7
FPGA	NO	NO	NO	Cyclone II
Communication Module	Radiometrix 433	Radiometrix 433+869 (DECT in SR2E)	DECT	DECT+Linx
Kicker Circuit	No	Basic	Basic	High efficiency
Motors	3 Brushed Motors	3 Brushed Motors	4 Brushless Motors	4 Brushless Motors
Motor Encoders	16 CPR	128 CPR	None	360 CPR
Motor Drivers	Discrete chips	Discrete chips	Discrete modules	MOSFET
Motor Driver Capability	0.6 A	1 A	1 A	20+ A
Motor Controllers	Discrete PID chips	Discrete PID chips	Discrete modules	FPGA soft PID
Dribbler	No	No (Bad)	Designed, but not built	Yes, but not in use
Infra Red Detectors	No	Yes	Yes	IR arrays
Power circuit	Basic	Basic	Basic	High efficiency
Mechanical design	Very little CAD	Partially CAD	Partially CAD	All CAD
Mechanical process	Majority handmade	Majority handmade	CNC + handmade	CNC

The introduction of NAO

And many more other Projects

BUT STILL MORE IS NEEDED

WHY?

Regional Dimenssion

Enterprise	Scope of Business in Vaasa	Projects Finland	Projects Abroad	Personnel by Function
ABB: a leader in energy control.	• Power plant control and protection systems, • utility communications and substation automation • Power Transmission and Distribution • Substation Automation • R&D	5% (1	95% (1	
Wärtsilä: a leading provider of power plants	• Gas and Dual/tri fuel Power Plants • Biopower • R&D	1.5%(2	98.5%(2	
Vaasa Engineering: Supplier of efficient total solutions in the energy field	• Hydropower • Testing and Commissioning • Energy Consulting • Project Management • Automation	20%(3	80%(3	
VACON : Saves Energy Reduce the greenhouse effect	• AC drives • R&D	10%(4	90%(4	**44% Sales and Marketing(4 39% Production 13% R&D 4% Administration**
VAMP: Power Systems protection	• **Arc protection** • **Generator and Motor protection** • **Power Distribution protection**			

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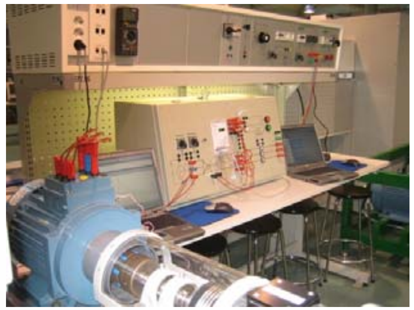
SOME EXAMPLE



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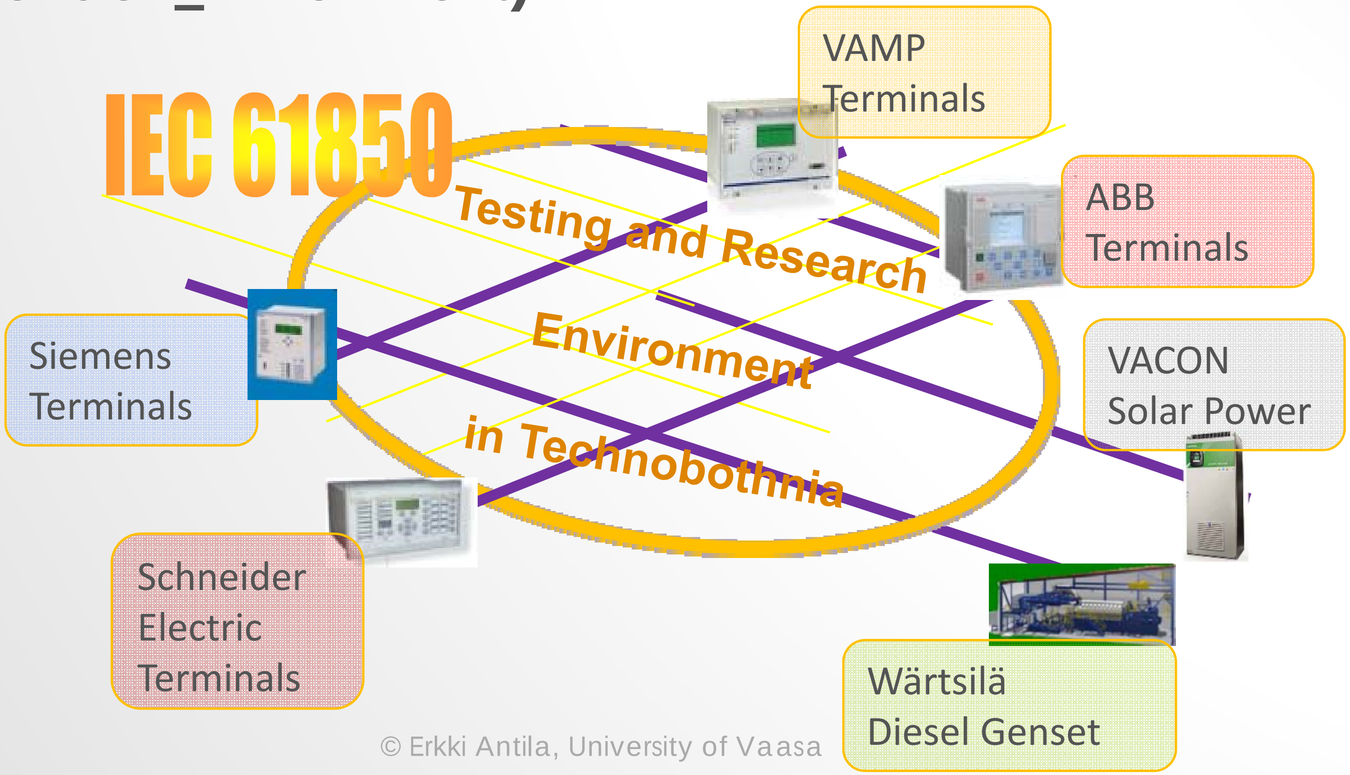
EXAMPLES

- **DEMVE (Development of the Education Services of IEC 61850 in Multi Vendor Environment)**



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PARTICIPANTS IN DEMVE -PROJECT

VAASA VASA

VASEK
Vaasanseudun Kehitys Oy
Vasaregionens Utveckling Ab

VAASAN SÄHKÖVERKKO
VASA ELNÄT

KATTERNÖ GROUP

ABB

Schneider Electric

VAMP

VACON DRIVEN BY DRIVES

WÄRTSILÄ

FINGRID

Helsingin Energia
Helen Sähköverkko Oy

e·on

Fortum

Energiateollisuus

adato

VIMPELIN VOIMA OY

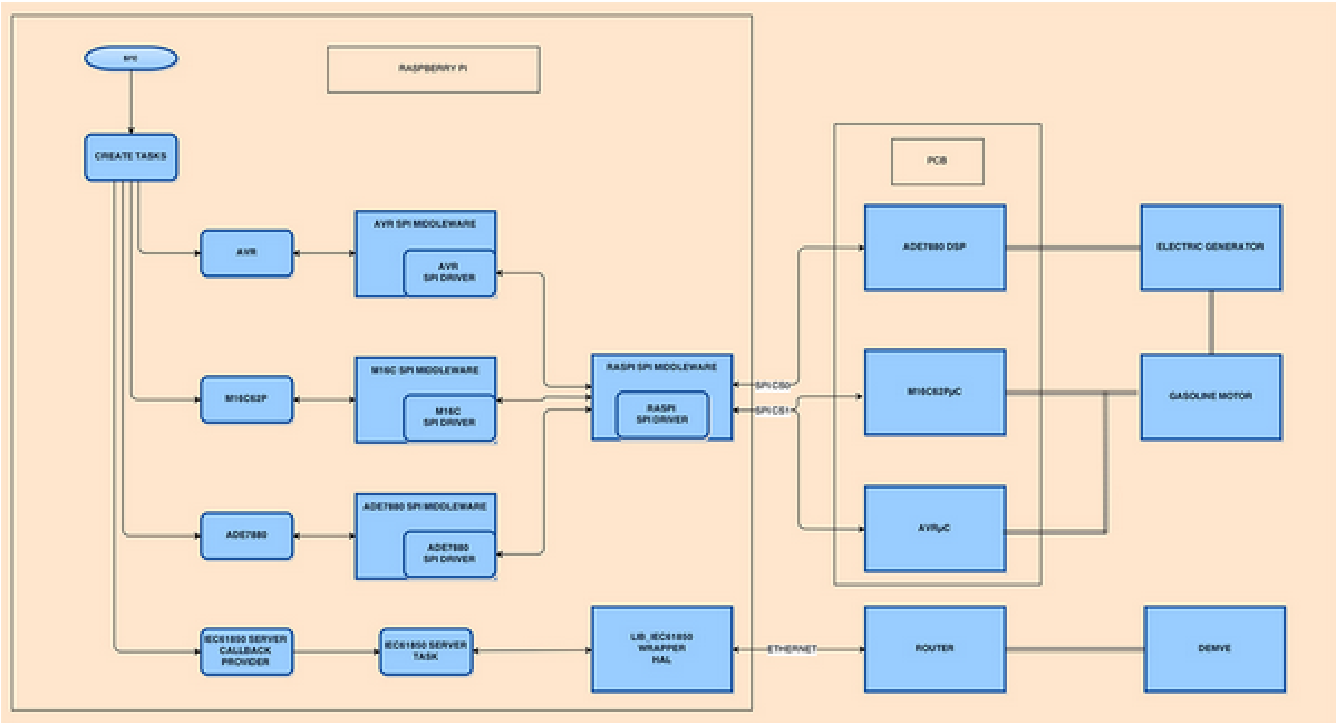
PROJECT GOALS

Training related to **IEC 61850**

- Configuring of IEDs for vertical and horizontal communication with IEC 61850
- Configuring of **substation automation** system/control system for IEC 61850 IEDs

- One of the major tasks in the project is to specify and implement a **multi-vendor** IED and control system environment for **training purposes**

MEASURE AND CONTROL ENERGY PRODUCTION



It consisted in two differentiated parts both with the same goal, two different systems operated remotely from DEMVE laboratory with ABB MicroSCADA by means of IEC61850 standard.

https://i2a.vamk.fi/index.php/measure-and-control-energy-production/

Industrial Innovation Academy

TESTING DEVICE FOR DETECTING AND PROTECTING POWER LINES IN SUBSTATION NETWORK AGAINST EARTH FAULTS AND TRANSIENTS

A research for VASPEC Oy in collaboration with Technobotnia and the school, where we were developing a testing device for detecting and protecting power lines in substation network against earth faults and transients. This includes harmonic currents measurements and analysis by means of a Renesas RX63N µController, an energy meter ADE7880, and the development of the testing environment by implementing the required hardware and a testing signal generation, fundamental and harmonics, to feed the line, implemented with MATLAB.

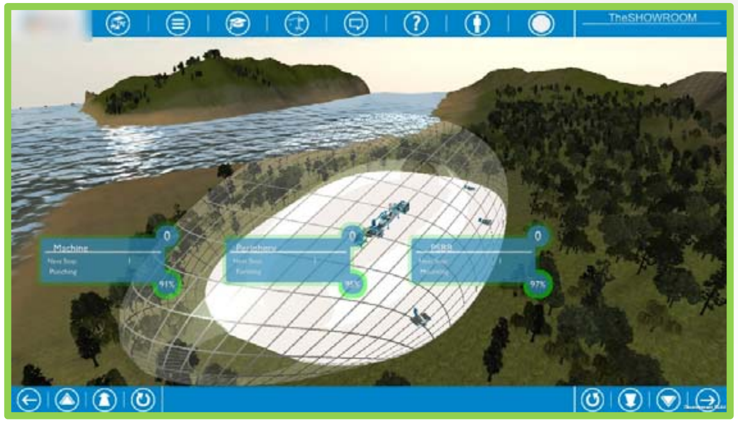
https://i2a.vamk.fi/index.php/testing-device-for-detecting-and-protecting-power-lines-in-substation-network-against-earth-faults-and-transients/

OTHER EXAMPLE

- Variety of Projects
  - Internal Projects
  - External Projects

- Virtual Factory Environment
  - 3D Environment for showcasing company products
  - **C#**, JavaScript (**JS**), **MySQL**, **Windows Azure**,
  - **3DS Max**, **Blender**, **Unity 3D**,

Screenshots from Virtual Factory Environment



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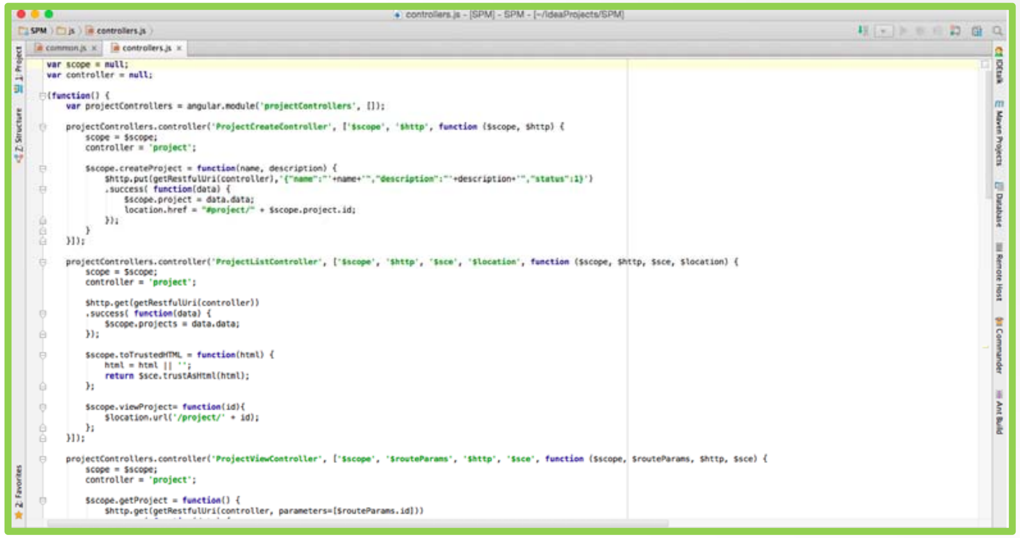
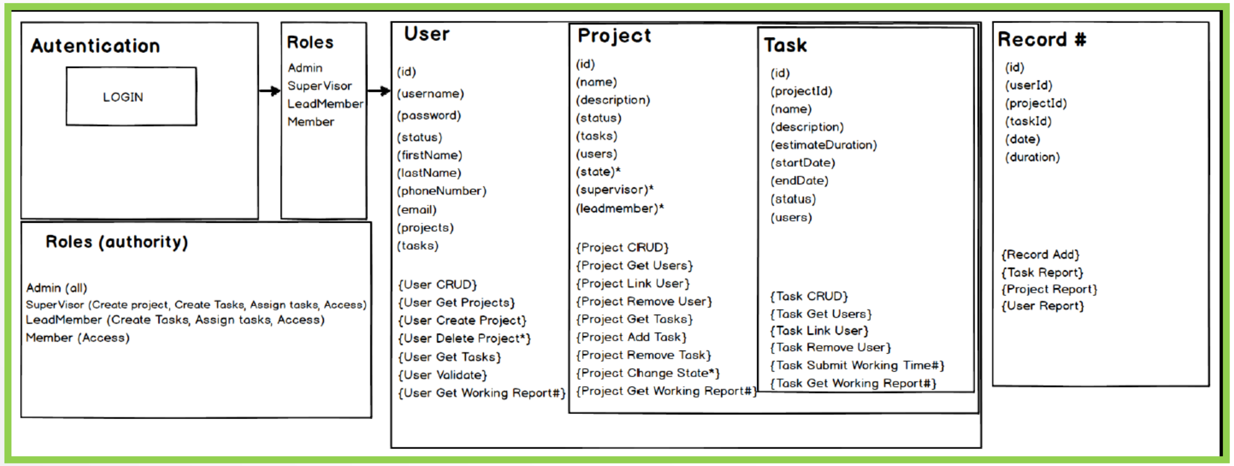
OTHER EXAMPLES

- Student Project Management System (SPM):
  - An alternate to ***Redmine*** → more suited towards the Academy
  - Internal Project
  - Long Term Project → Goal of becoming fully functional
  - Front & Back End team involved
  - **Angular JS**, **JQuery, Bootstrap** (CSS3), **HTML5, MySQL**, Enterprise JavaBeans (**EJB**), Java Persistence API (**JPA**),



Screenshot of the Source Code (up) and Function Structure (down)



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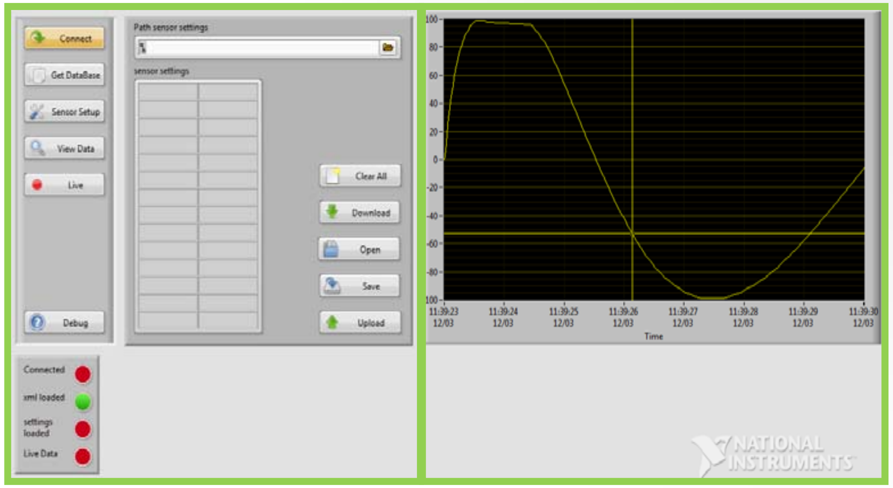
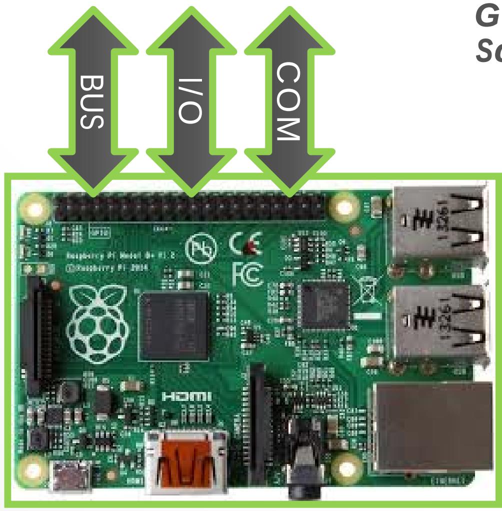
OTHER EXAMPLES

- **TUTON** – HW Prototyping:
  - Creating Modular Interfaces to support range of:
    - Sensors
    - Actuators
  - Constructed using:
    - Raspberry Pi
    - LabVIEW
    - Python





General Layout (L) and Screenshot of LabVIEW (Top)

CONCLUSION

- Engineering eduaction is under constant change at VUAS
- More involvment with regional development
- Curriculum not easy to change but possibilities to adapt it
- I2A support the curriculum to respond quiclky to industrial needs
- The aim is to prepare the engineers for year 2000

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THANK YOU FOR YOUR ATTENTION

Questions

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