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Innovative Manufacturing Engineering Systems Competence Centre

New training methods and their implementation in modern vocational education

Jüri Riives

NEDIA

PROJECT NO 2014-1-EE01-KA202-000490

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New didactical approach in mechatronics vocational education - NEDIA

PROJECT DURATION: 01.09.2014 – 31.08.2016

PROJECT NO 2014-1-EE01-KA202-000490

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Project objective

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As the paradigm of the industry has changed, the is a need to change the paradigm of teaching as well. So the virtual and real, the possibilities of internet, e-learning, work-place based learning, the best practices from different countries, the best coursed development methodologies etc should be integrated as much as possible.

Development and piloting of the methodology for modern learning and principles for competence and cooperation network in the field of mechatronics is the main objective of this project.

The project **helps partner educational institutions to become aware and implement new teaching methodologies** that would meet the needs of today's youth and allow them quickly and easily acquire knowledeg that is needed in today's industry.

Also the project **helps to create base to cooperation network which enables to make cooperation in designing courses and adapting new teaching methodologies and change information and knowledge.**

The project results are possible to broaden outside the project partners group, too.

Project main target groups

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- **Target group 1 – vocational educational schools**
- **Target group 2 – companies of the industry**
- **Target group 3 – qualification authorities**
- **Target group 4 – students**

Definition of mechatronics

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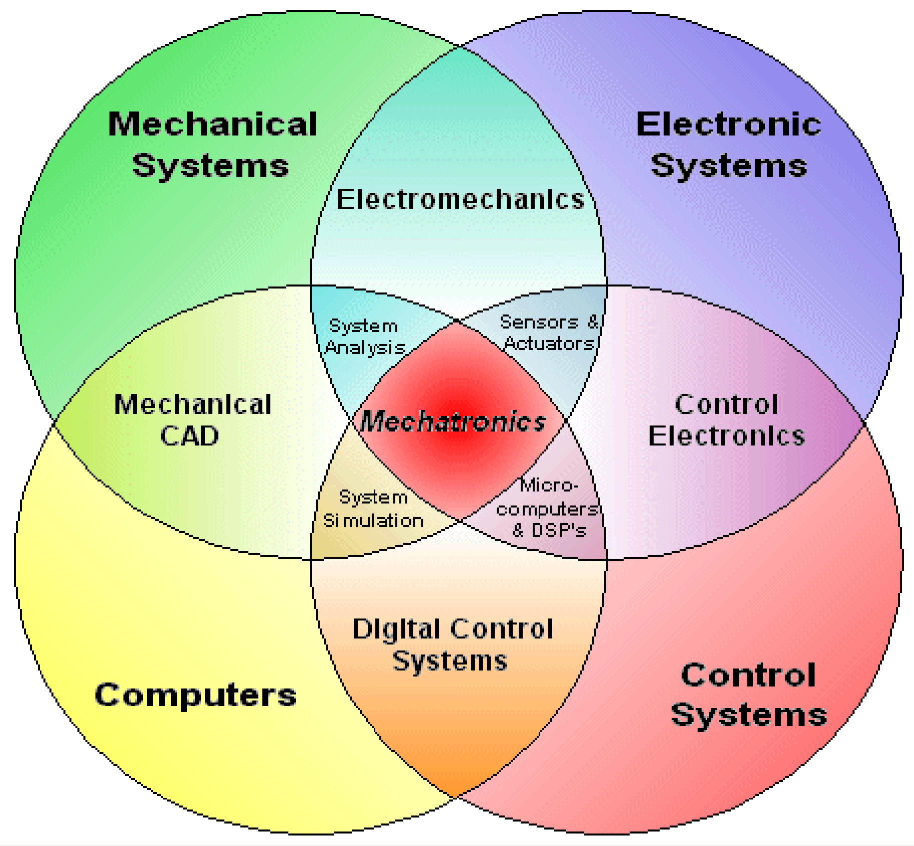
Mechatronics is an emerging field of engineering that integrates electrical engineering, mechanical engineering, computer science, control engineering and information technology. In layman's terms, mechatronics combines these areas of engineering to allow the design, development and application of "smart devices" in an integrated, cross-disciplinary manner.



Applications in mechatronics

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		DMU 60 FD (DMC 60 FD)	DMU 80 FD (DMC 80 FD)	DMU 125 FD (DMC 125 FD)	DMU 160 FD (DMC 160 FD)
Traverse paths (X / Y / Z)	mm	600 / 700 / 600	800 / 1,050 / 800	1,250 / 1,250 / 1,000	1,600 / 1,250 / 1,100
Milling / Turning table	rpm	1,200	800	500	400
Table / Pallet size	mm	ø 700 (630)	ø 800 (ø 800 × 630)	ø 1,250 (ø 1,100)	ø 1,500 (ø 1,400)
Load weight	kg	600 (500)	1,200 (1,000)	2,300 (1,800)	3,000 (2,500)
Pallet change time	sec.	9.5	14	16	22
Work piece measurements		ø 700 (630), 850, 600 kg (500)	ø 950 (900), 1400 (1330), 1200 (1000) kg	ø 1250, 1600, 2300 (1800) kg	ø 1530, 1640 (1740), 3000 (2500) kg

Applications in mechatronics

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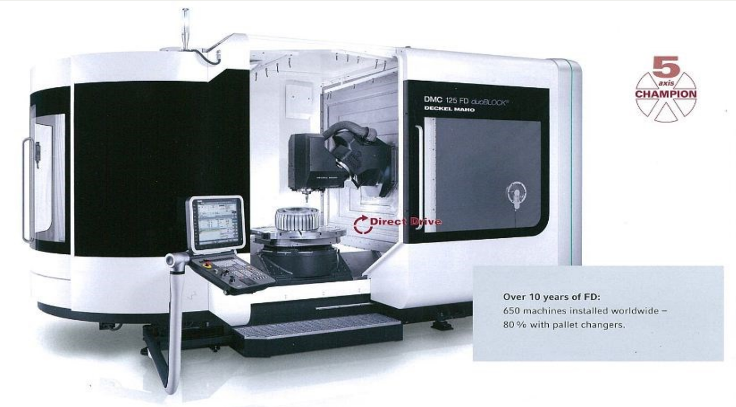

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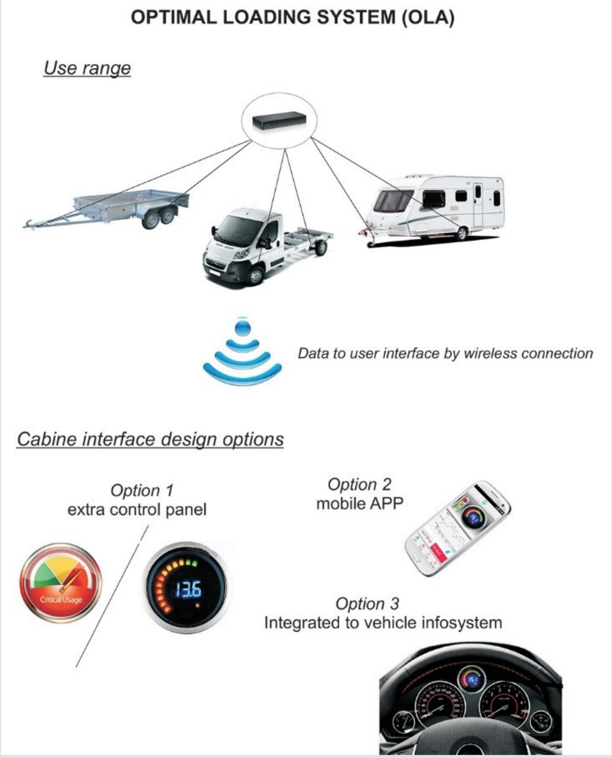
Applications in mechatronic



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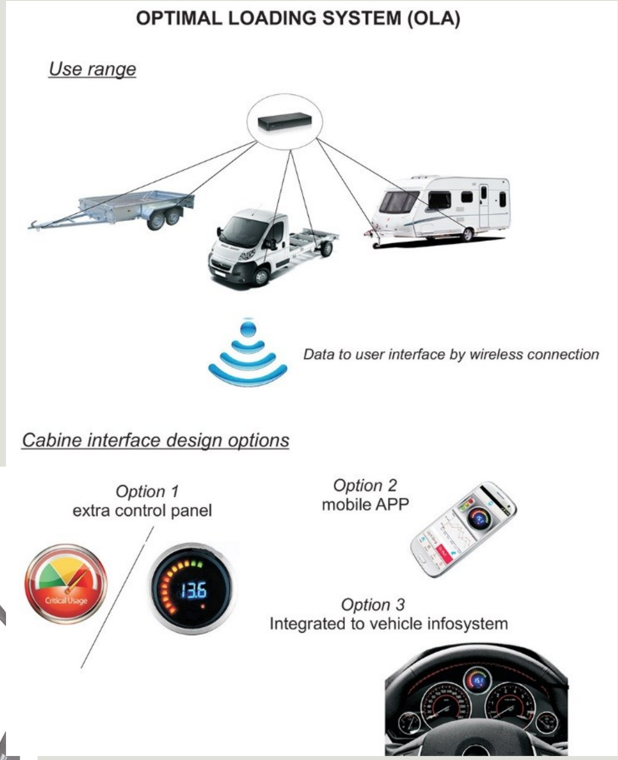
Applications in mechatronics



Industry 4.0 basic components and their application in reality

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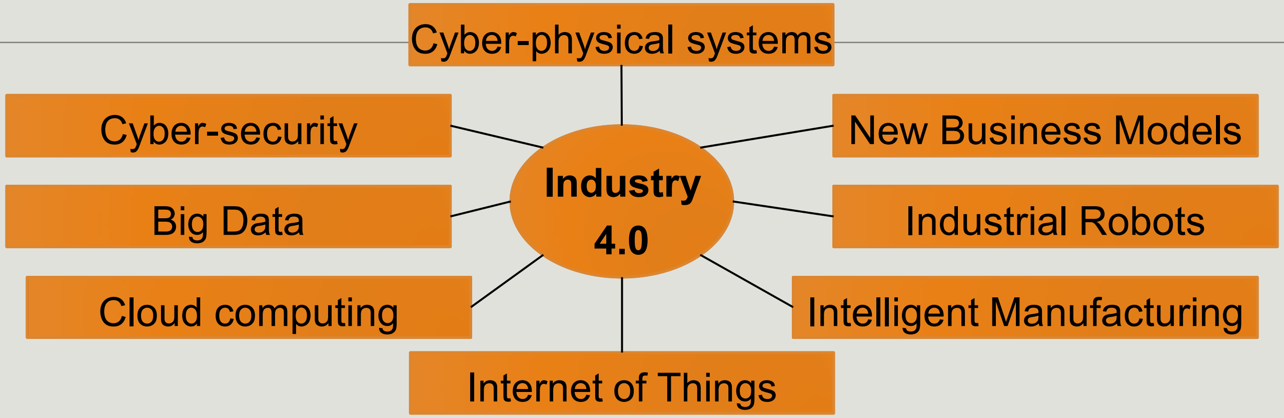
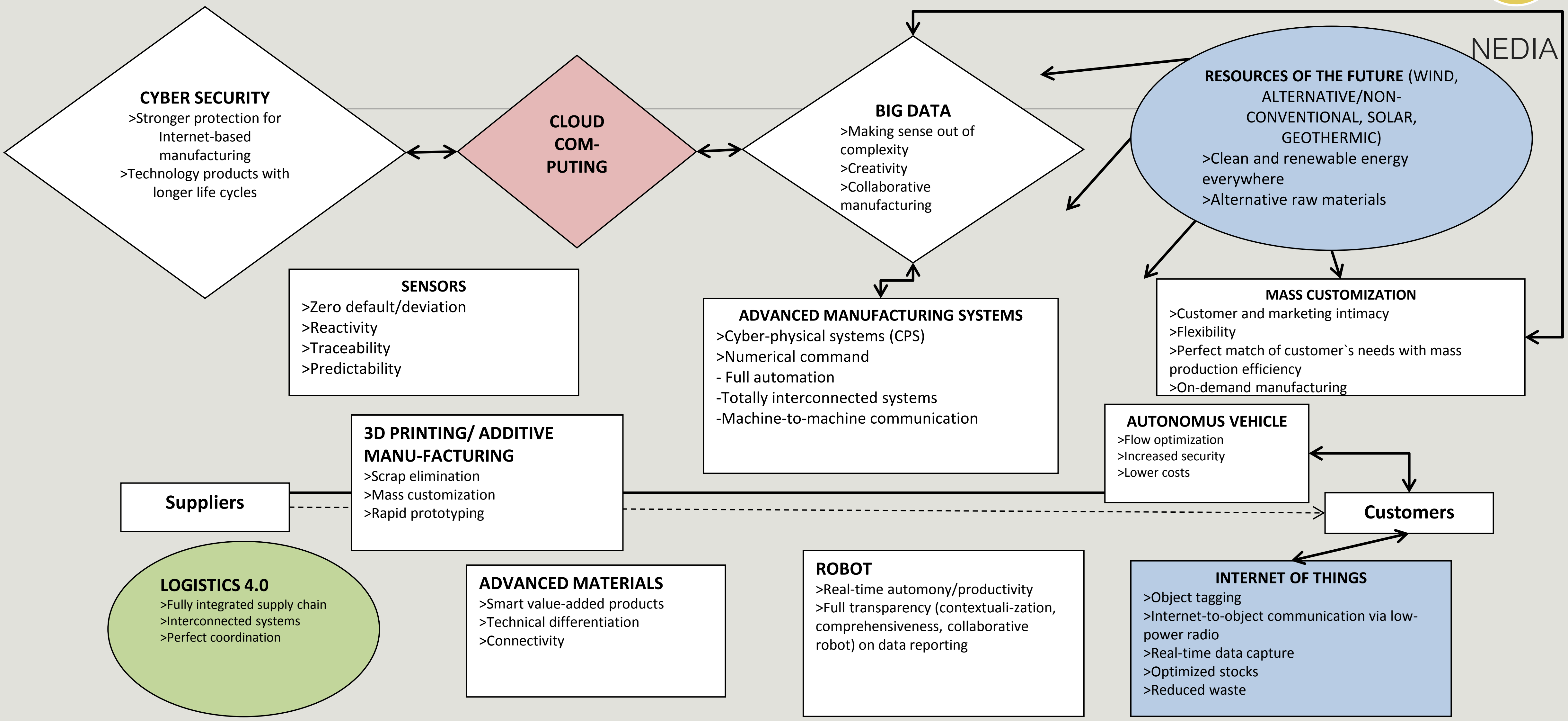


Factory 4.0



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CYBER SECURITY
>Stronger protection for Internet-based manufacturing
>Technology products with longer life cycles
CLOUD COM-PUTING
BIG DATA
>Making sense out of complexity
>Creativity
>Collaborative manufacturing
RESOURCES OF THE FUTURE (WIND, ALTERNATIVE/NON-CONVENTIONAL, SOLAR, GEOTHERMIC)
>Clean and renewable energy everywhere
>Alternative raw materials
SENSORS
>Zero default/deviation
>Reactivity
>Traceability
>Predictability
ADVANCED MANUFACTURING SYSTEMS
>Cyber-physical systems (CPS)
>Numerical command
- Full automation
-Totally interconnected systems
-Machine-to-machine communication
MASS CUSTOMIZATION
>Customer and marketing intimacy
>Flexibility
>Perfect match of customer`s needs with mass production efficiency
>On-demand manufacturing
AUTONOMUS VEHICLE
>Flow optimization
>Increased security
>Lower costs
3D PRINTING/ ADDITIVE MANU-FACTURING
>Scrap elimination
>Mass customization
>Rapid prototyping
Suppliers
Customers
LOGISTICS 4.0
>Fully integrated supply chain
>Interconnected systems
>Perfect coordination
ADVANCED MATERIALS
>Smart value-added products
>Technical differentiation
>Connectivity
ROBOT
>Real-time automony/productivity
>Full transparency (contextuali-zation, comprehensiveness, collaborative robot) on data reporting
INTERNET OF THINGS
>Object tagging
>Internet-to-object communication via low-power radio
>Real-time data capture
>Optimized stocks
>Reduced waste

Where we are moving

more sophisticated and quickly changeable world

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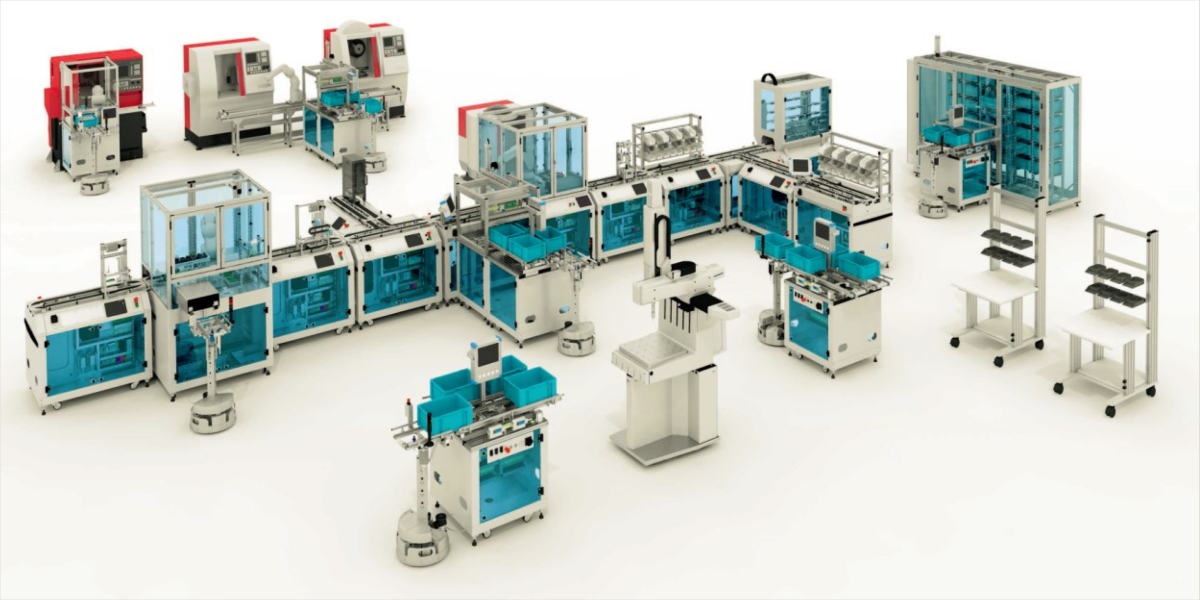
Massive using of robots in manufacturing

Industry 4.0



Main Novel Teaching Methods

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1. VISUAL LEARNING
2. DUAL LEARNING
3.CASE BASED LEARNING
4. PROBLEM BASED LEARNING
5. TEAM BASED LEARNING
6. EXPERIENCE BASED LEARNING

Visual Learning

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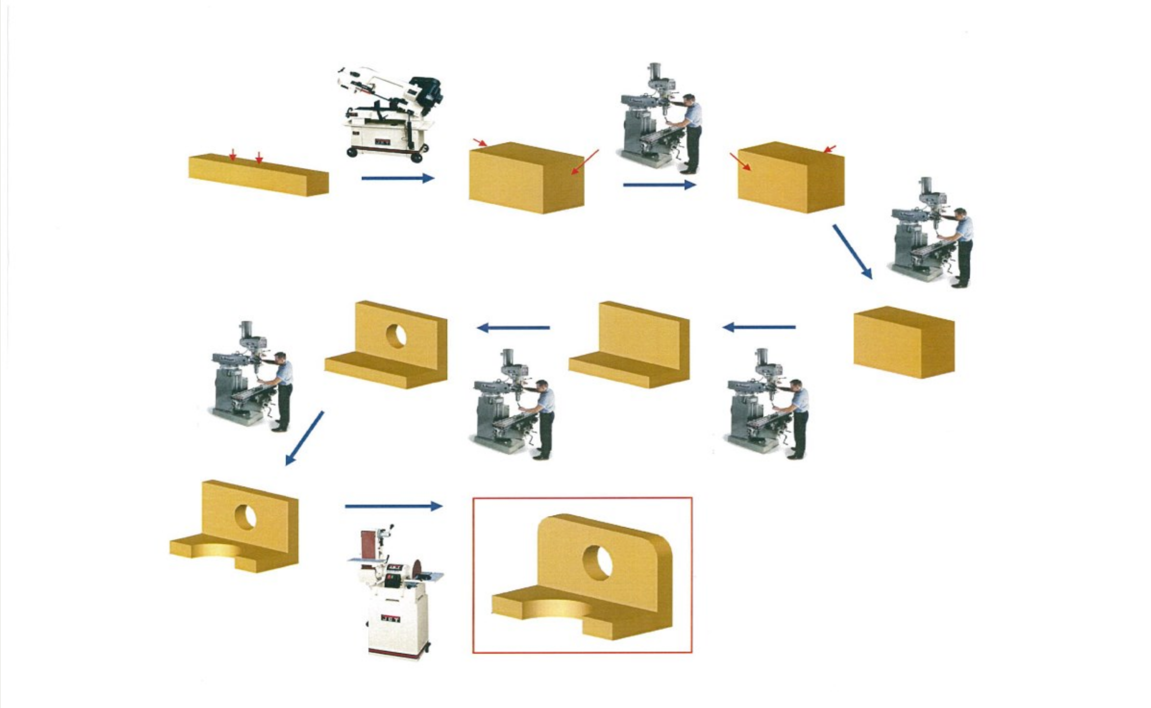
Better once to see yourself as hundred of times to hear from others

Manufacturing

process : from raw

Material to final product



Videos making yourself, videos from Internet

Dual learning : from the theory to the practice

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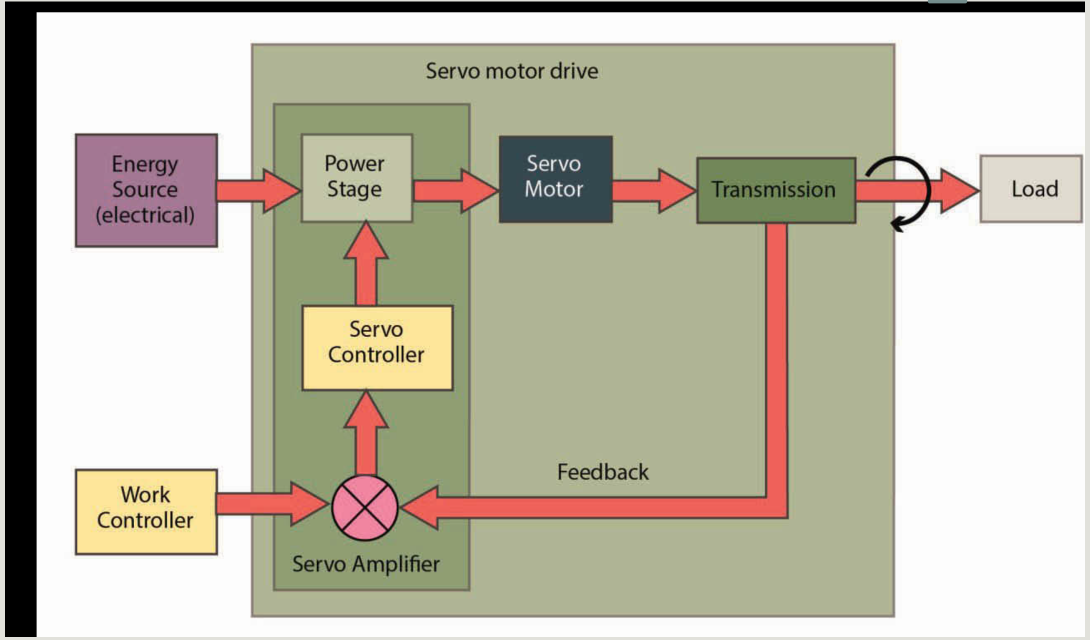
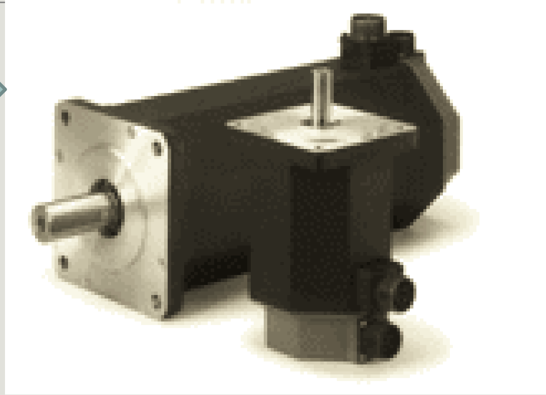
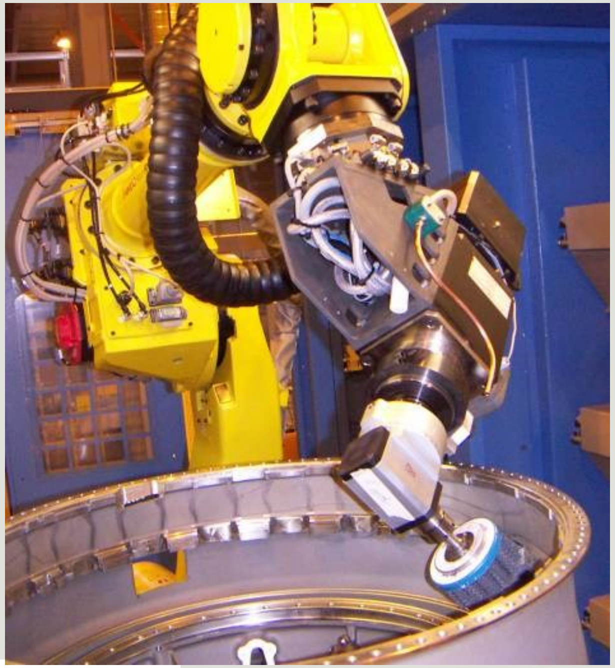
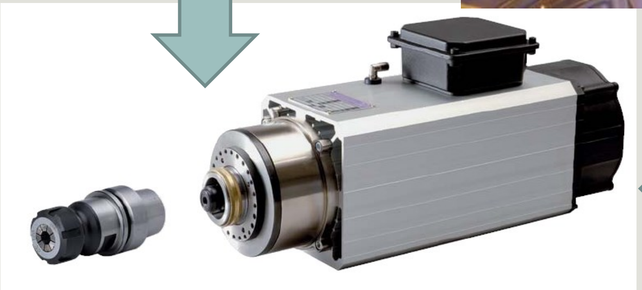




Different solutions





http://www.ab.com/motion/servo/fseries.html

Problem based learning/case based learning

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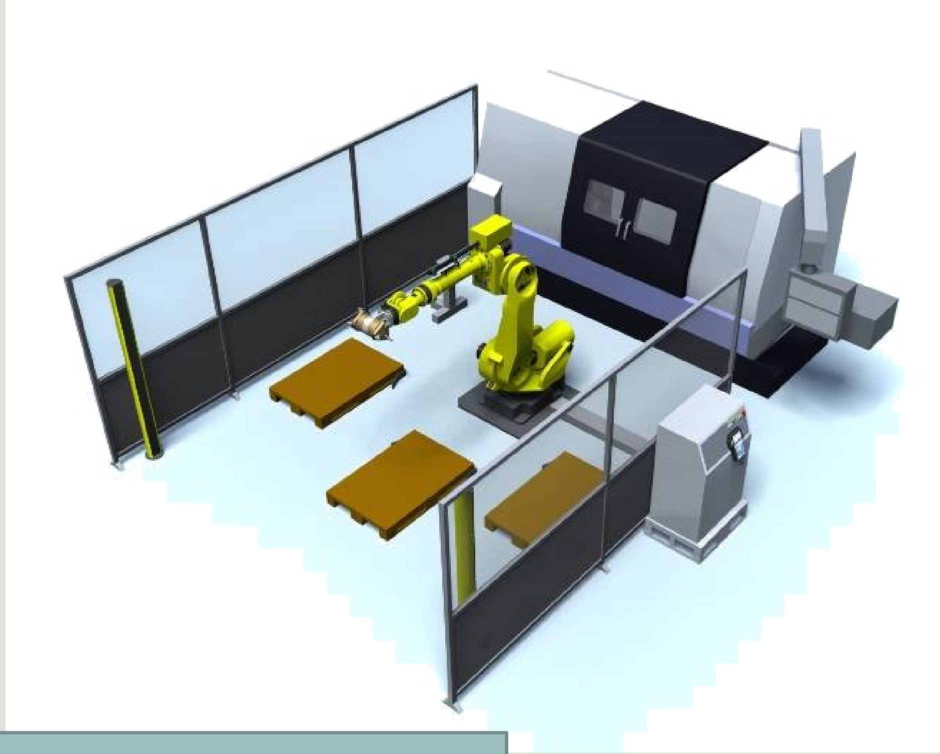
Main features of the case-based learning:

- Learner centred
- Collaboration and cooperation between the participants
- Discussion of specific situations, typically real-world examples
- Questions (also) with no single right answer
- Decision making and analysing the alternatives



Exercise 3

- Make your own solution
- Design paths and movements
- Make the program
- Run in the test mode
- Auto run (Ask permission before runing)

What are the initial data?

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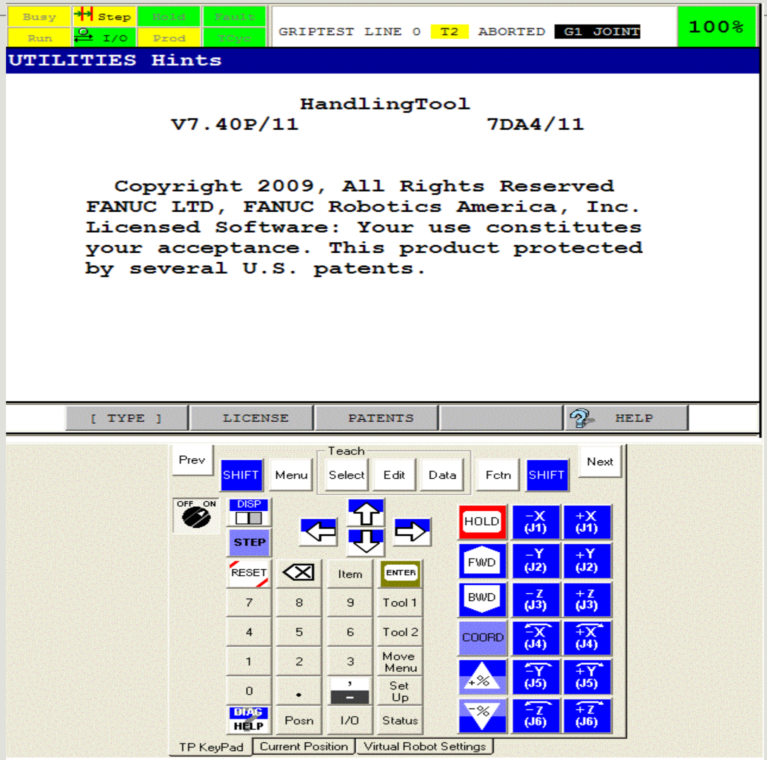
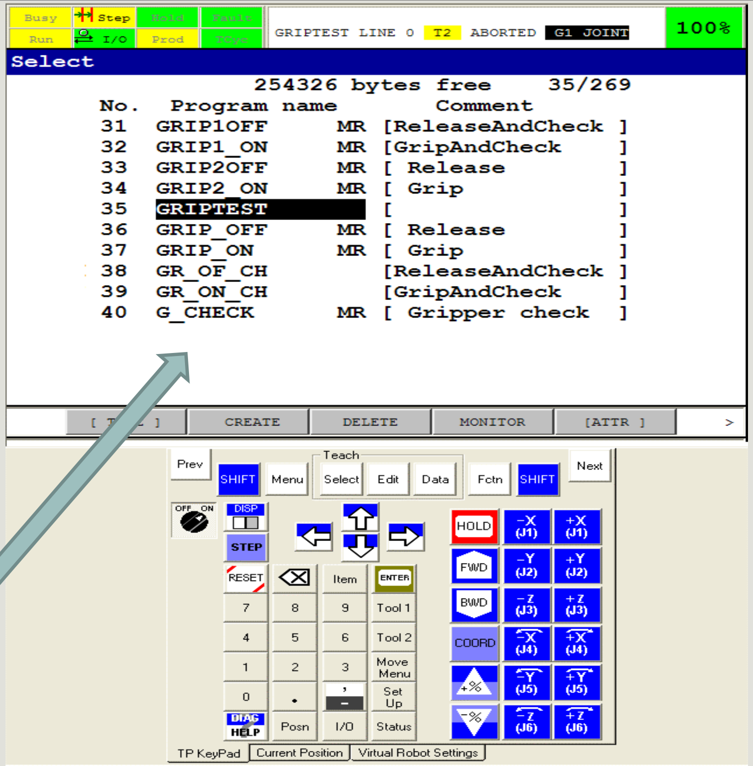
On-line robot programming teaching



Press the Select key, and then reach the program menu

F2



Press Create ie F2- button

The efficiency of different teaching methods

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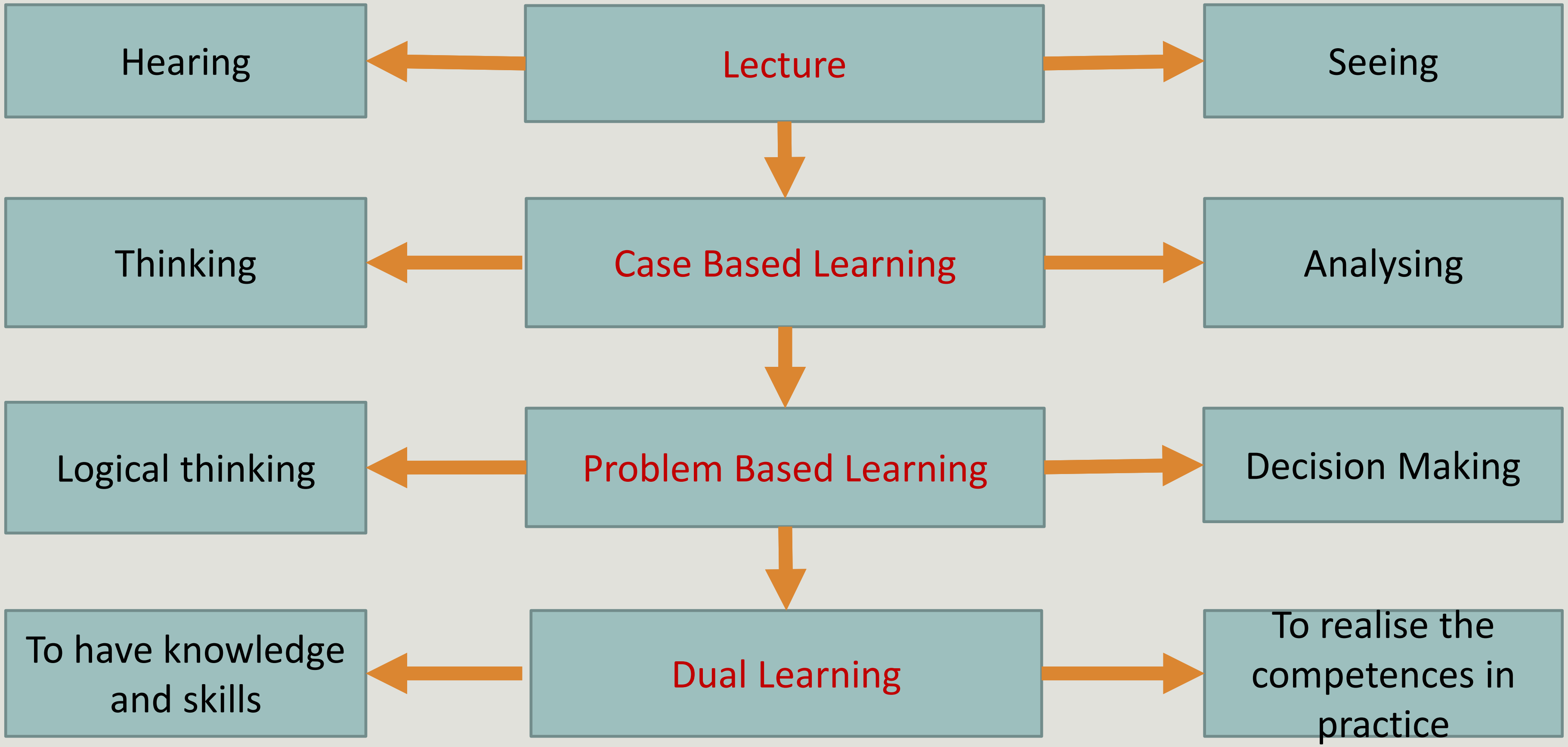

A Graph of basic components of the project

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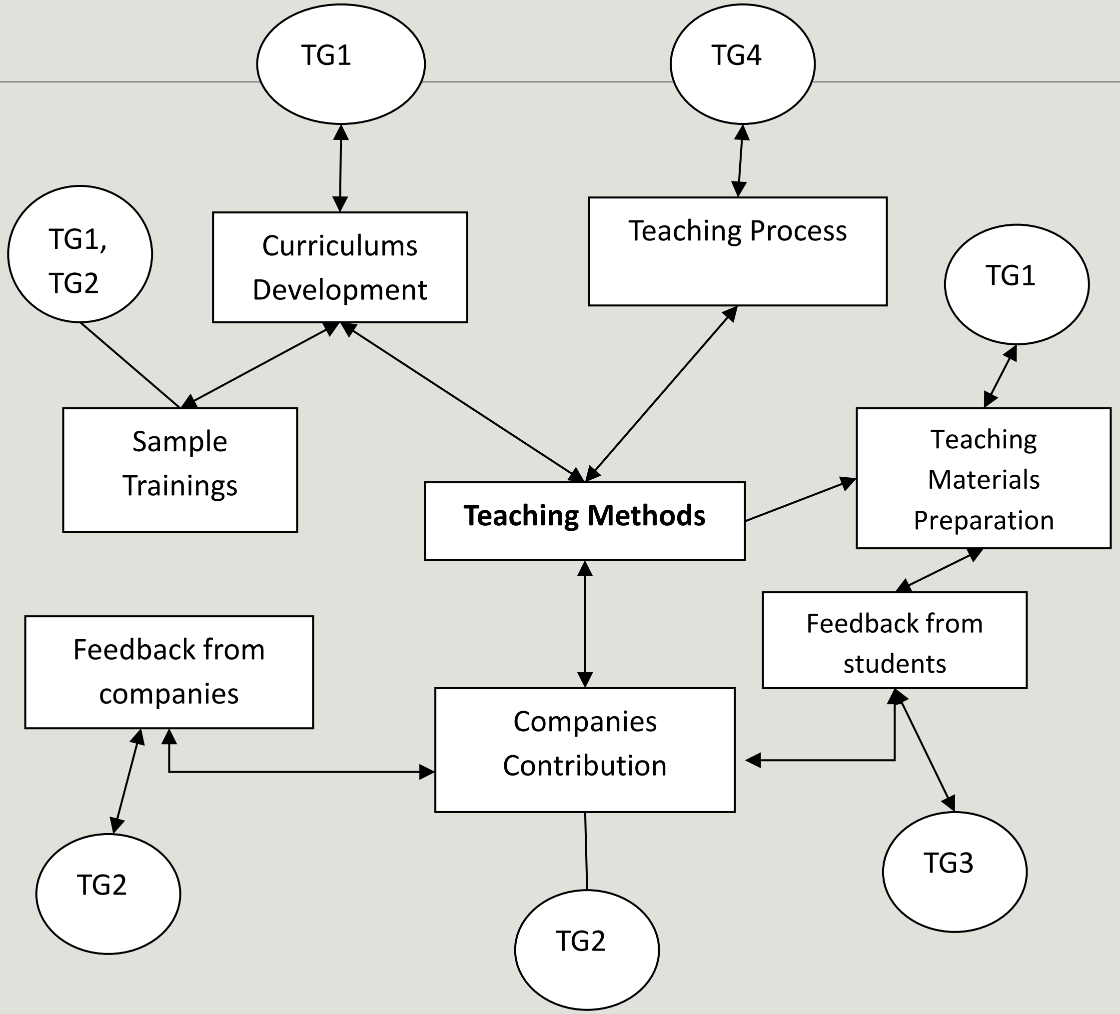
Target groups (TG) of the project:

- **TG1 – vocational educational schools**
- **TG2 – companies of the industry**
- **TG3 – qualification authorities**
- **TG4 – students**



Basic characteristics of three generations

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Generation	Basic characteristics	Innovation outputs
X-generation, 1965 – 1976	Effectiveness, independence, decrease of balance in work- and personal life	Mobile phone, cybernetics, personal computers
Y-generation, 1977 – 1997	Social activity, cyber literacy, tolerance, diversity, confidence, determination	Google, Facebook. Digital technologies in industry, Industrial robots, CNC processing, PLC technologies
Z-generation, 1997 - 2020	Mobility, media skills, on-line life, e-society, speed, multitude of things, the desire to achieve	iPhone applications, Industry 4.0, Cyber Physical Systems, Internet of Things, Multimedia workplace

Z-generation

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This generation can be characterized by hyper-networked world, need to be distinguished, everything has to be done quickly (due to computer games), having a good visual understanding (social media), the habit to deal with large amounts of information and data (Internet and digital world), internet of things (mobile cells are multifunctional and allow to deal with a great amount of operations) etc.

For what we must prepare in teaching process

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According to that, the present and the near future expectations of students are quite different from the expectations of previous generations of students:

- They expect freedom in every field, from freedom of choice to freedom of expression
- They like personal approach
- They examine everything new in detail
- From organizations, they expect respect and openness, when making their decisions, as well as selecting a job or designing their curriculum
- They want to be entertained at work and at studing process as well as in personal life
- They are focused on cooperation and development of relations
- They feel the need to do everything quickly, and it does not involve only video games

Main steps considering the teaching materials preparation

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1. The analysis of new smart teaching methods and about the situation of the teaching process in vocational education schools

2. Problem setting in preparation the new teaching materials (lecture in the field of mechatronics). Discussions between professional schools

3. The preparation of teaching materials: lecture plan, lecture material using the new smart teaching methods, presentation the output in a video base

4. Organizing the feedback from the industry and from the students

5. Conclusions to increase the efficiency of the teaching process

Revolutional Situation

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- Schools are not so ready
- Great amount of new information
- Need for employees with different skills and knowledge
- Students do not want to study according to traditional ways – annoying!
- Students want to become smart quickly and in easy way
- Back to kindergarten – studying through playing

Thank you!

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