



Co-funded by the
Erasmus+ Programme
of the European Union



Curriculum Development of Master's Degree Program in Industrial Engineering for Thailand Sustainable Smart Industry

Workshop Training on PBL

WP3 - Task 3.4 Training of staff on new tools and best practice exchange on modern teaching techniques.

Rui M. Lima, Diana Mesquita





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13 years of Project-Based Learning (PBL)

UNIVERSITY OF MINHO

RUI M. LIMA

DIANA MESQUITA

Training plan (4 days)

WP3 - Task 3.4 Training of staff on new tools and best practice exchange on modern teaching techniques.

- Description: “... the training session at UMinho will dedicate to active learning strategies in general, and specifically in Problem and Project-Based Learning approaches.”

Our concept: **Simulation!**

- 1 day of inspiration – industry + medicine case
- 3 days simulating a team developing a project



MSIE 4.0 – Portugal Meeting



2018.09.13	2018.09.14	2018.09.15
DAY 4 Training 2	DAY 5 Training 3	Day 6 Training 4
PBL training - principles	PBL training – assessment	PBL training – presentations
PBL training – design	PBL training – organization	Project next steps





MSIE 4.0 – Portugal Meeting



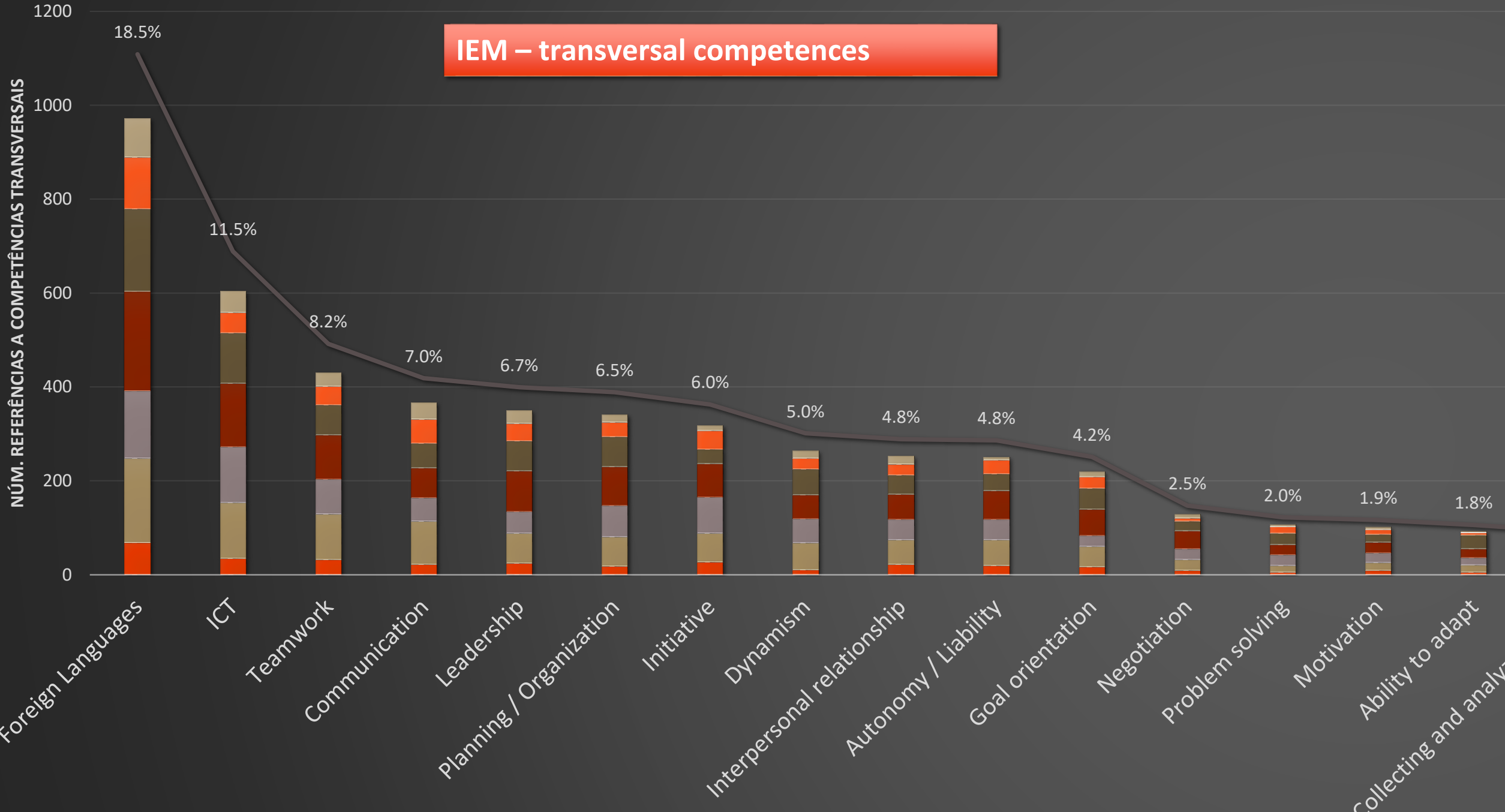
2018.09.13		2018.09.14		2018.09.15	
PBL training - principles		PBL training – assessment		PBL training – presentations	
09:00	Check in	09:00	Check in	09:00	Check in
09:30	Active learning (AL) principles Motivation / evidences / AL continuum	09:30	Conceptual framework for assessment Learning outcomes definition and assessment	09:30	Presentations
10:30	Coffee break	10:30	Coffee break	10:30	Coffee break
11:00	PBL principles and models Project types / Example of PBL@UMinho	11:00	Alternative methods of assessment Assessment for learning	11:00	Discussion and feedback of the proposals
12:30	Lunch	12:30	Lunch	12:30	Lunch
PBL training – design		PBL training – organization		Project next steps	
14:00	Project theme Selection of project themes: driven by learning outcomes or driven by problems	14:00	Planning the project Teachers project vs. students' teams projects Teacher role in PBL	14:00	Evaluation of training
16:00	Coffee break	16:00	Coffee break	15:00	Closing session
16:30	Aligning with curriculum Curriculum levels and processes	16:30	Organization tools - example		
17:30	End of session	17:30	End of session		



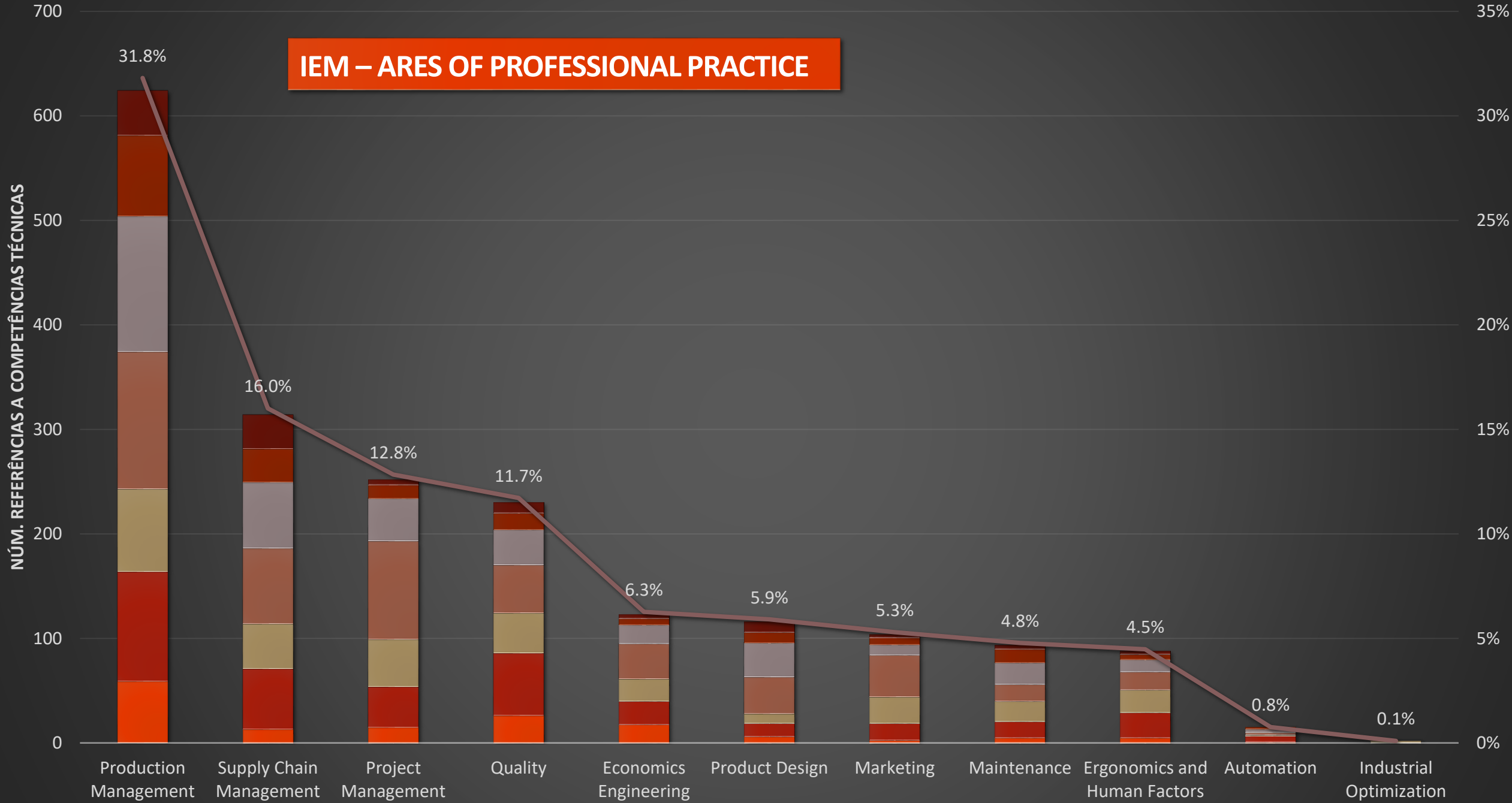
PBL at UMINHO

- Motivation for active learning
- PBL principles
- PBL at IEM - UMinho

IEM – transversal competences



IEM – AREAS OF PROFESSIONAL PRACTICE



Development of Competences

Teaching and Learning system based on the idea of **knowledge transfer**

transition

Teaching and Learning system based on the idea of **development of competences**

Capacity to mobilize resources (knowledge, abilities, experiences, values,...) in specific contexts, to formulate and solve problems.

Le Boterf (1997, 2004, 2005); Zarifian (2001)

Learning outcomes are “statements of what a learner is expected to know, understand and/or be able to demonstrate after a completion of a process of learning”.

CEDEFOP (2009)

Active Learning - key ideas

Active Learning – Meaningful Experiences

- Context – adequate environments
- Engagement – energy and motivation
- Relevance – why learn this?
- Critical thinking – evaluate their own learning
 - Felder & Brent (2009), Prince (2004), Prince & Felder (2006), Bonwell & Eison (1991)

EVIDENCES?

Based on a meta-analysis of the data published in 225 studies, Freeman et al. (2014) refer that active learning increases the performance in exams... and lectures increase the failure rate in 55%.

Active Learning environments (examples)



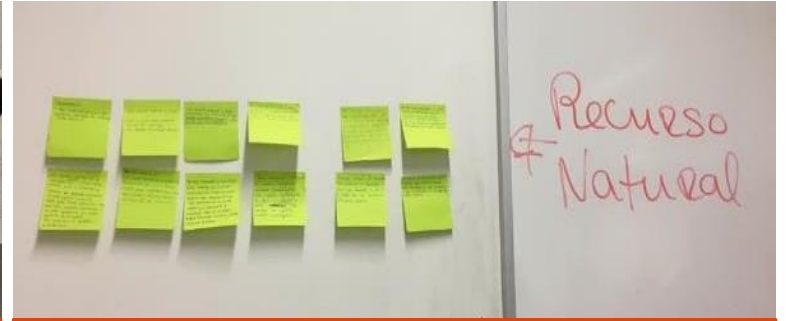
Brainstorming



Team building



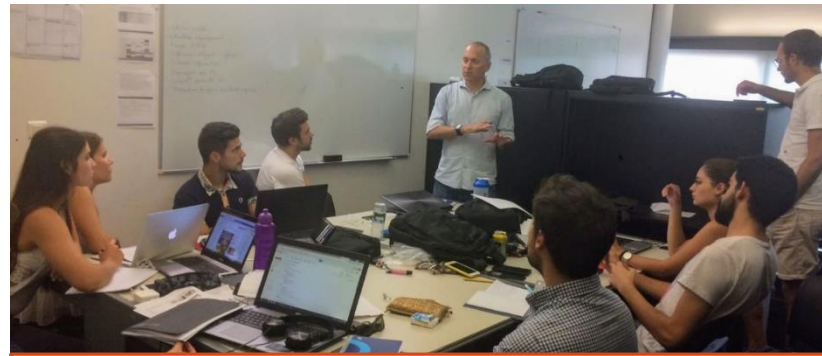
Gallery Walk



Think Pair Share



Flipped Classroom

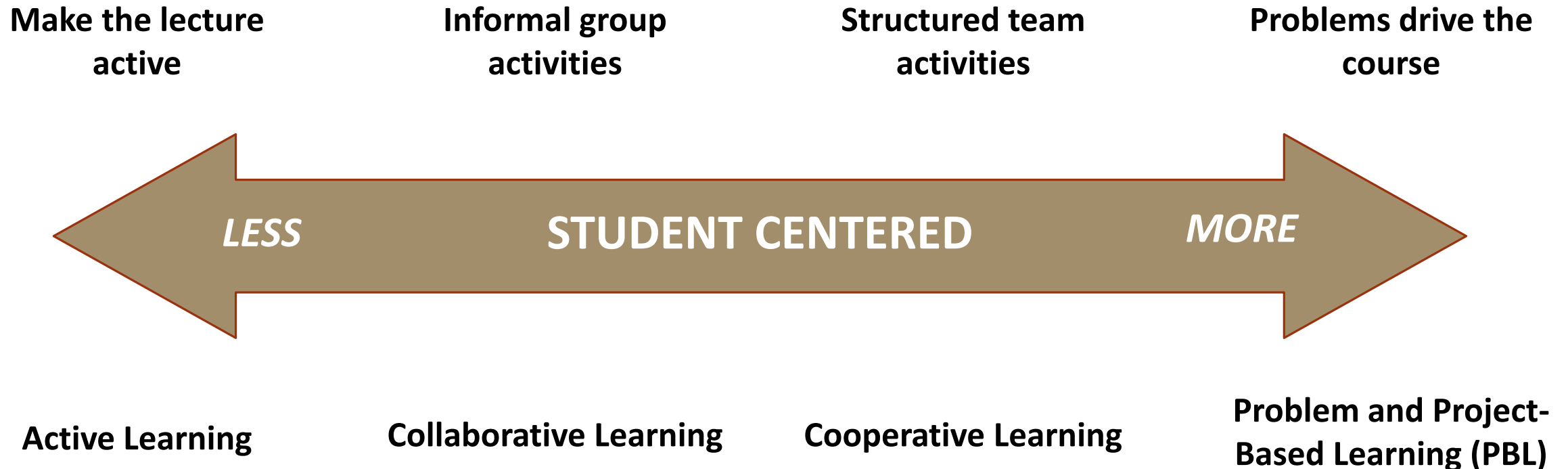


PBL – Problem and Project-Based Learning



Gamification

“The Active Learning Continuum” – Prince (2011)



Prince (2011) <https://www.asee.org/documents/conferences/annual/2011/plenary-michael-prince.pdf>

Goldberg, D. E., & Somerville, M. (2014). A Whole New Engineer - FIVE pillars OF CHANGE



Alegria
(Joy)



Confiança
(Trust)



Coragem
(Courage)



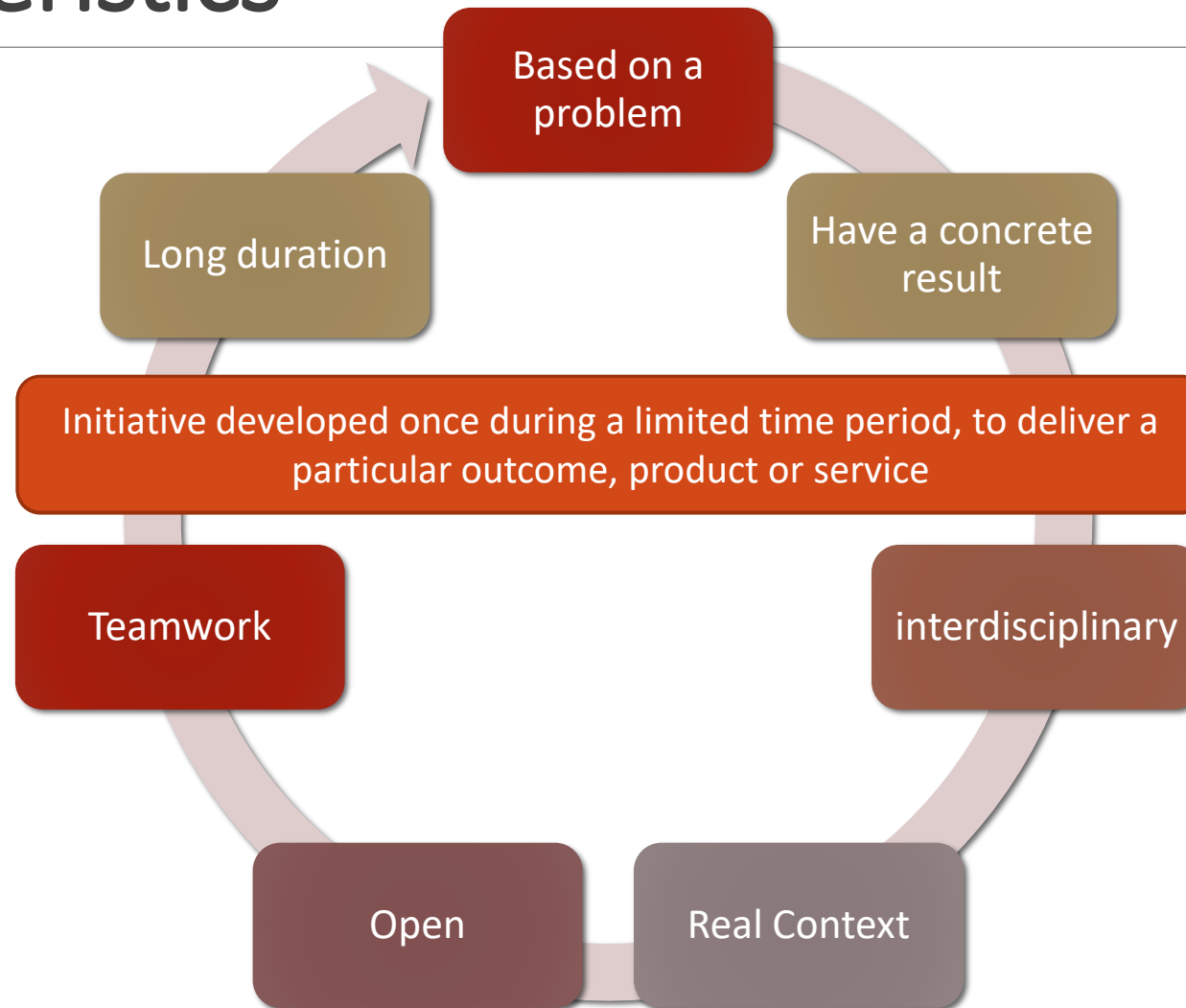
Abertura
(Openness)



Colaboração
(Collaboration)

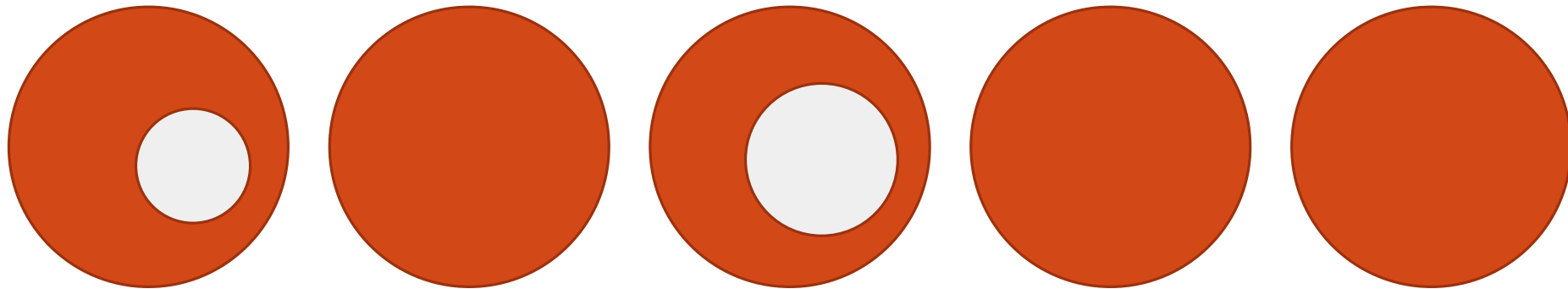
PBL – Project Based Learning

PBL - characteristics



Project types

An exercise of project



Course

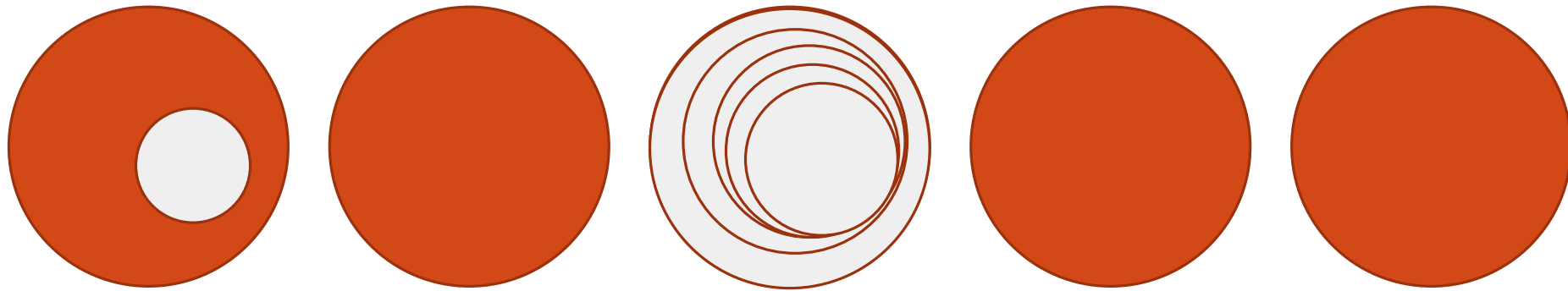


Project

Kolmos, 1996; Helle, Tynjälä, & Olkinuora, 2006.

Project types

A course as a project



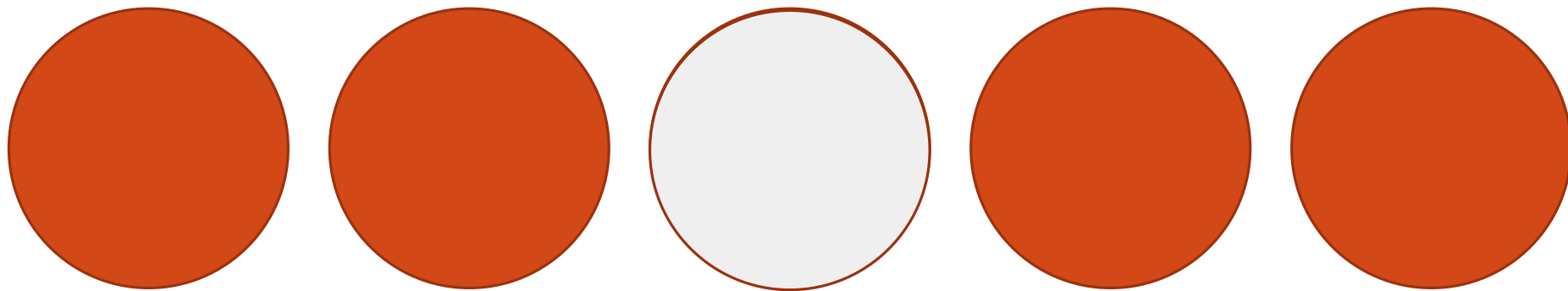
Course



Project

Project types

Interdisciplinary project approach



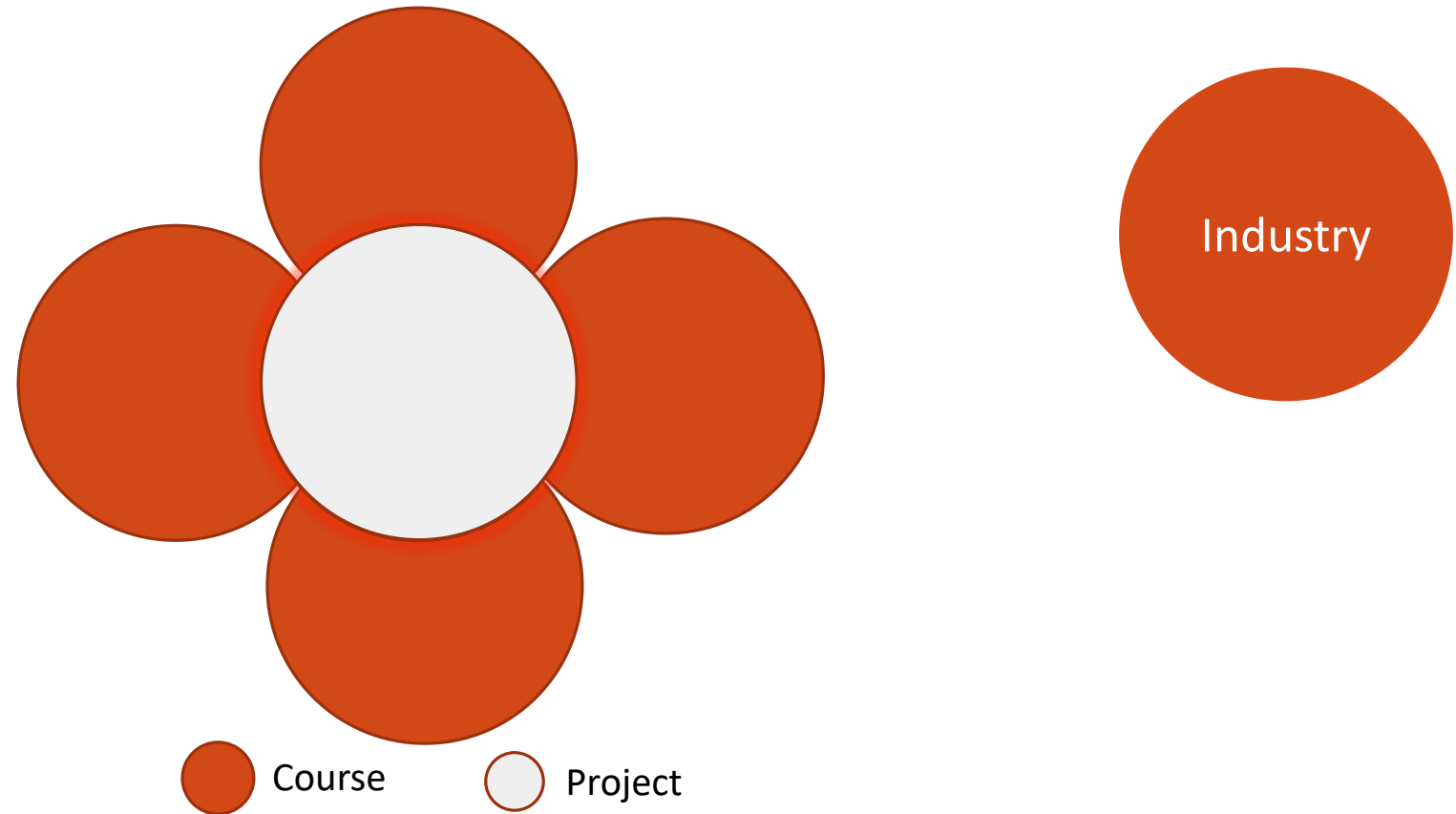
Course



Project

Project types

Interdisciplinary project approach



PBL@IEM.UMINHO – Project Based Learning

10 years of PBL the beginning

Teacher Training

- Peter Powell - PLE - *Project Led Education*
- Richard Felder
- Firmino, A. Flores, Natascha, ...

Proposal of a Bologna pilot project
funded by the rectory.

2004

Adaptation to the Bologna Process

2006/07 UMINHO IEM-IM

2004/05 2005/06 PBL – Bologna pilot
projects

Main Motivation

- Increase student motivation
- Increase the relevance of learning
- Develop professional skills

IEM – Professional Profile

INDUSTRIAL ENGINEERING AND MANAGEMENT

Design, improvement and management of systems composed of people, materials, equipment, financial resources, information and energy, running processes for production and delivery of products and services (IIE, 2012; APICS, 2009)

IEM – Job – Formation

Engineering
Systems

Information

Products

Systems

People

Materials

Production Systems

Services

Curriculum ?

Customers

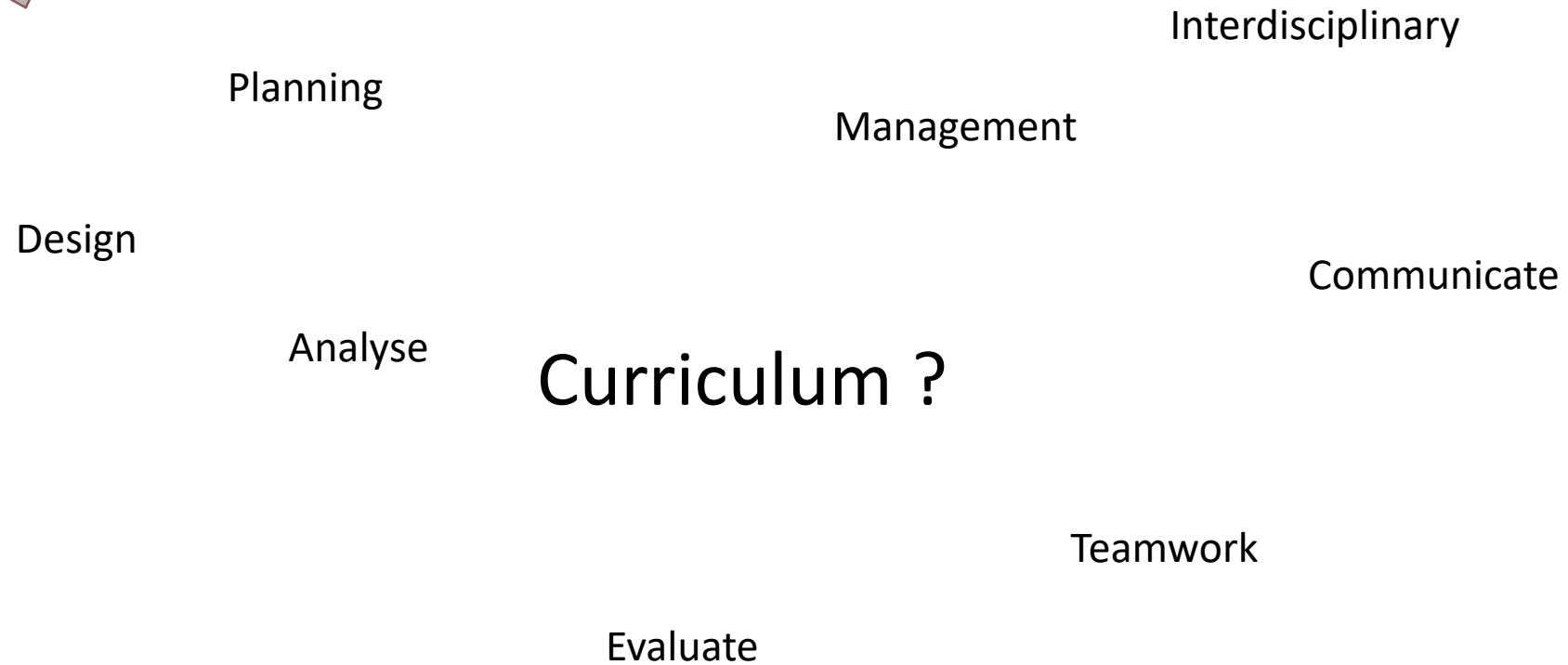
Organizations

Suppliers

Projects

IEM – Job – Formation

Competences



IEM – Job – Formation

Knowledge
Areas

Engineering Sciences

Project Management

Costs

Operations Research

Human Factors

Curriculum ?

Production Management

Simulation

Quality

IEM – Job – Formation

Engineering
Systems

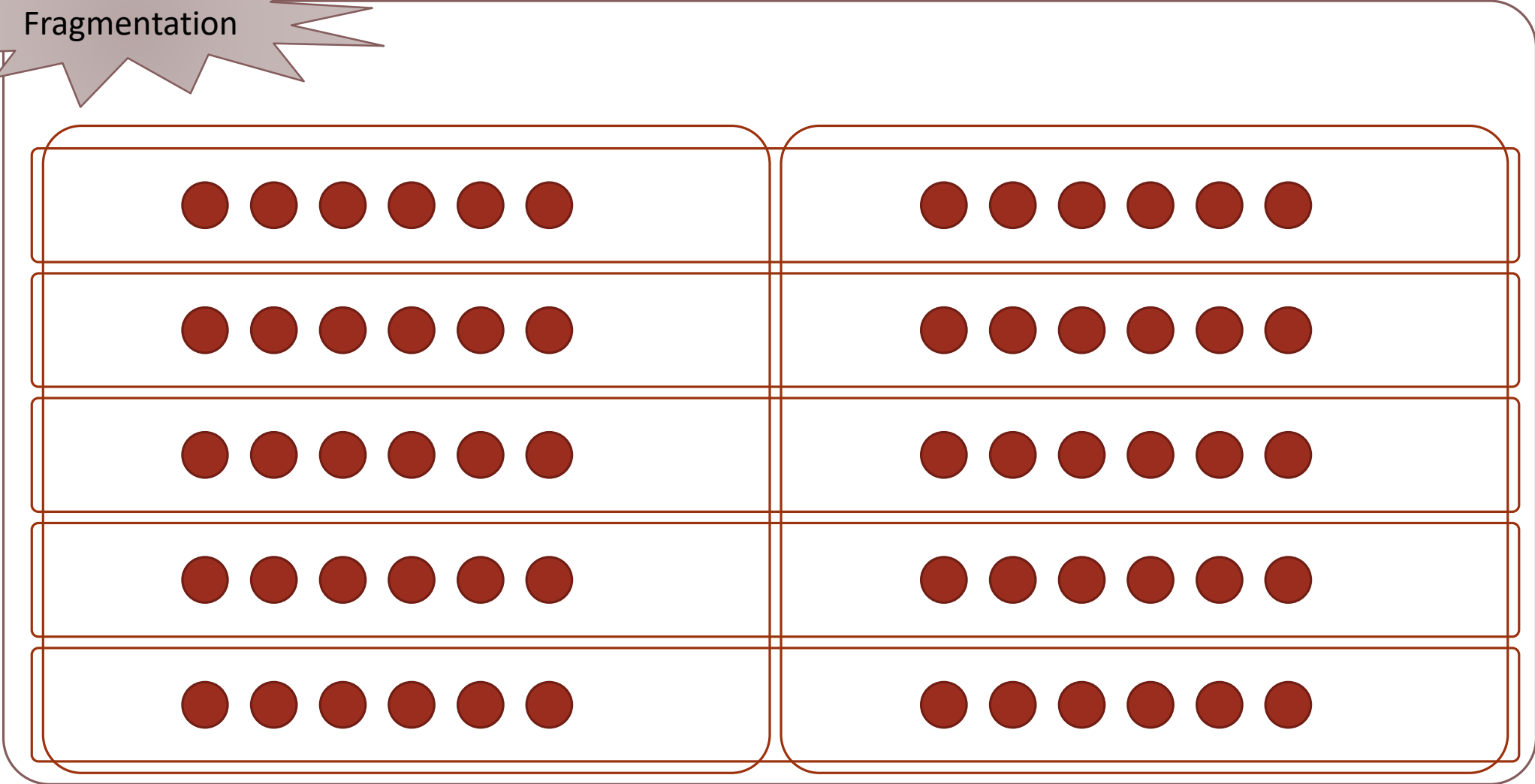
Knowledge
Areas

Curriculum ?

Competences

IEM – Formation

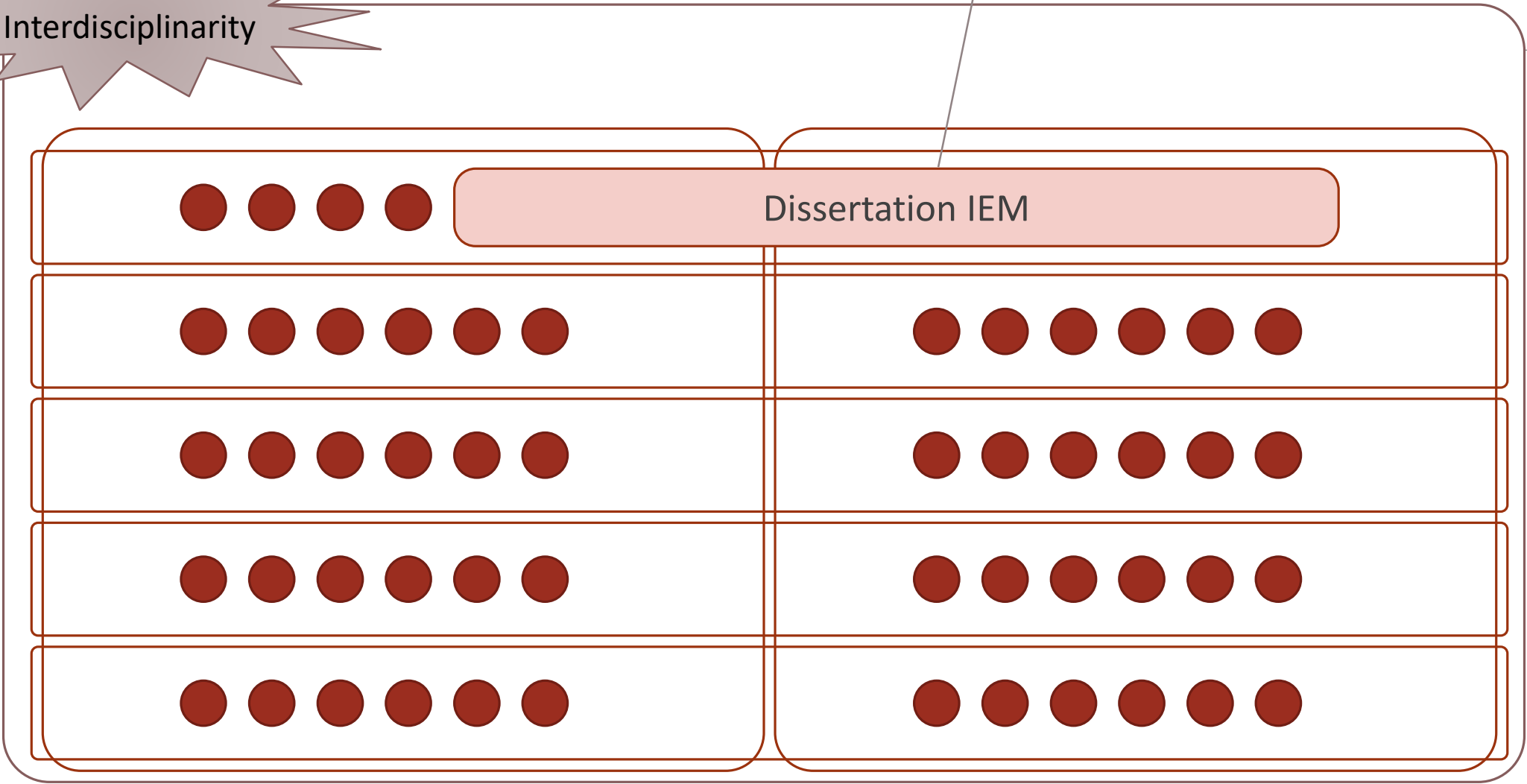
Fragmentation



IEM-IM – UMinho

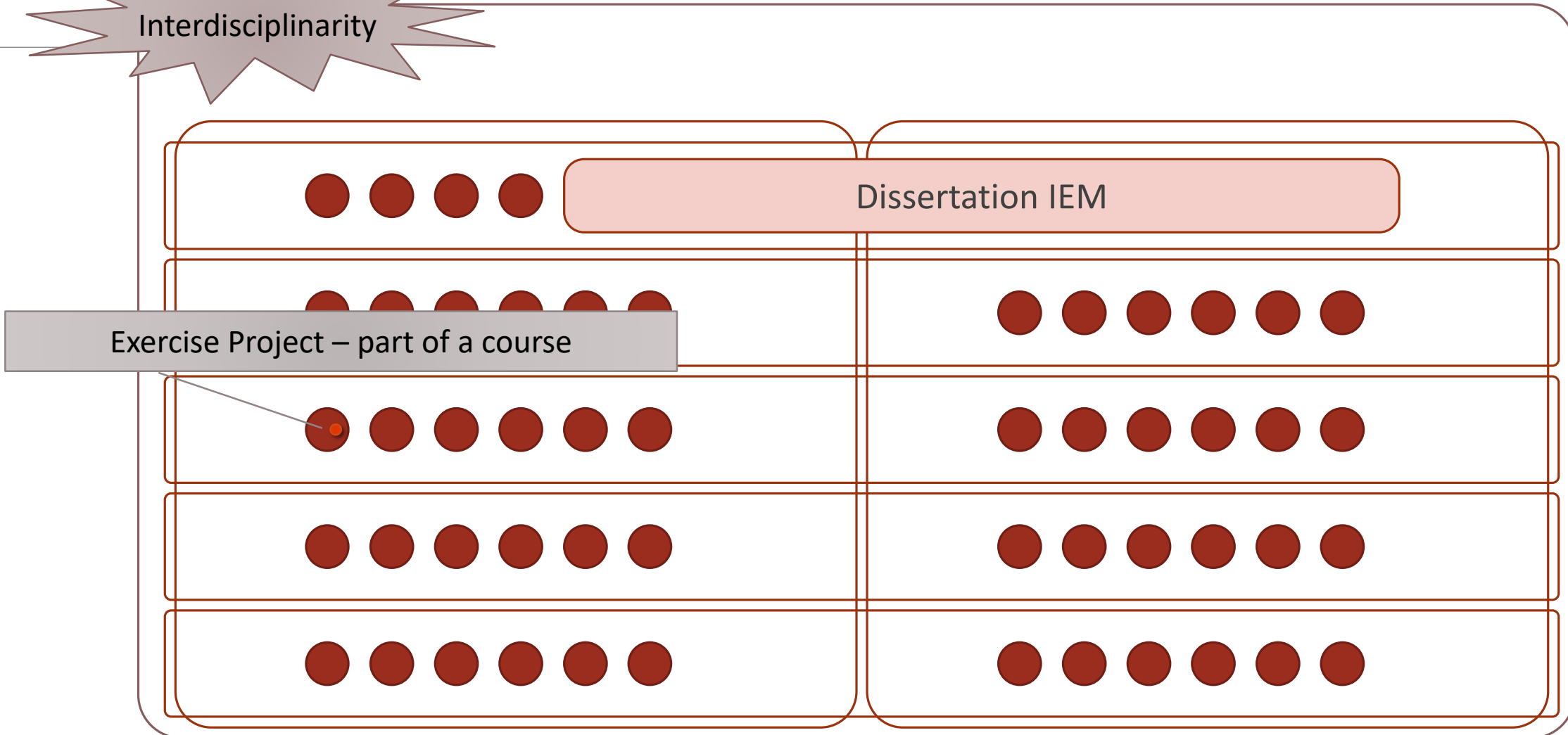
Interdisciplinarity

Component Project – complete course



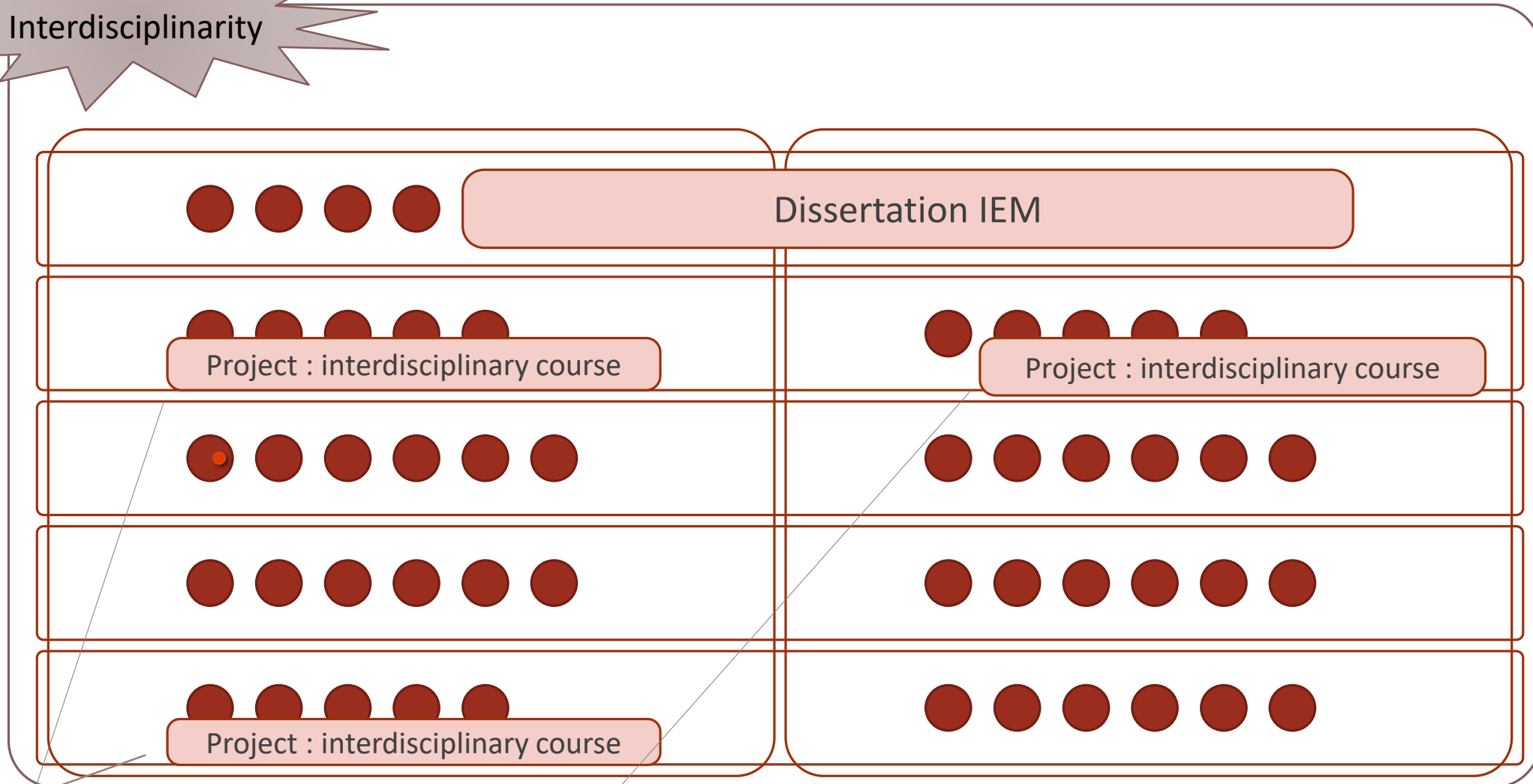
IEM-IM – UMinho

Interdisciplinarity



IEM-IM – UMinho

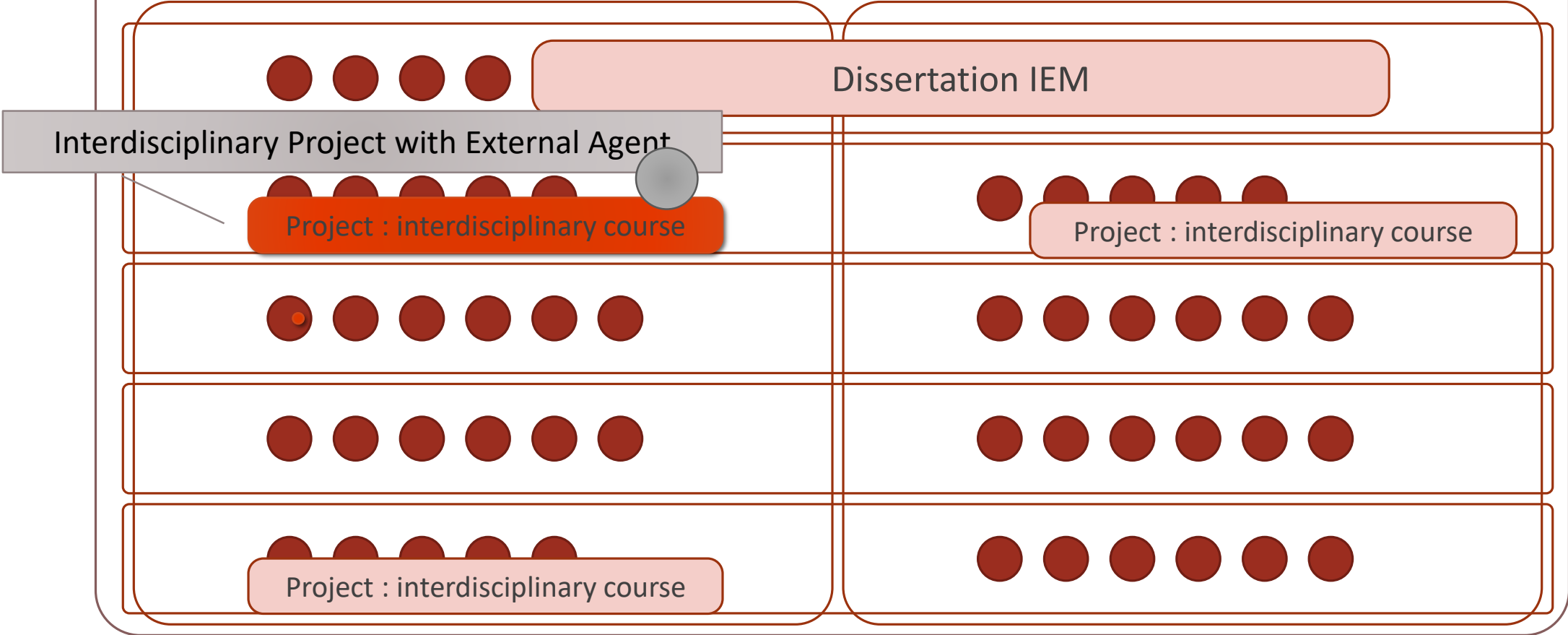
Interdisciplinarity



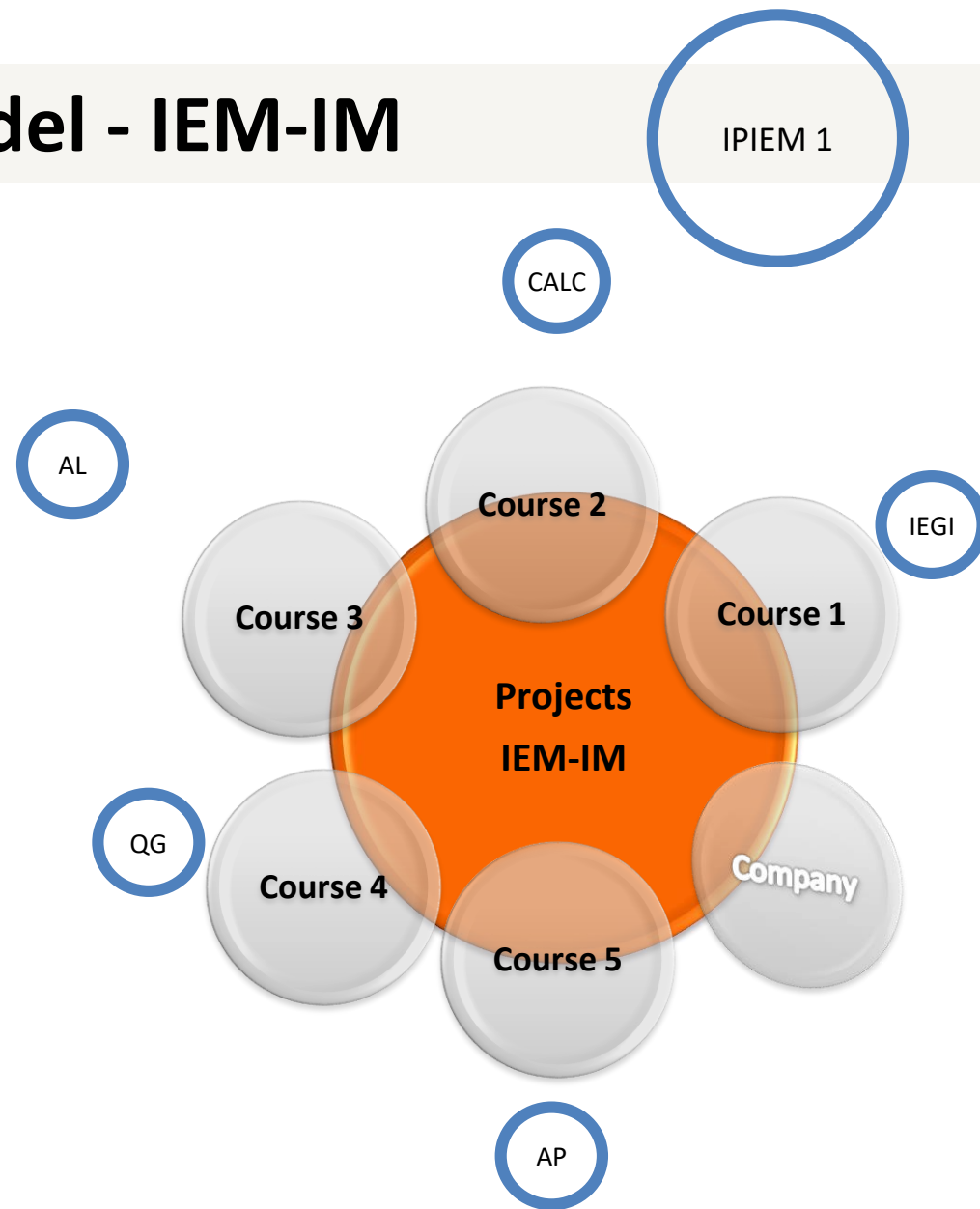
Interdisciplinary Project Approach

IEM-IM – UMinho

Interdisciplinarity



PBL Model - IEM-IM



Curricular Units – SEMESTER 1

AP - Algorithmics and Programming

CALC - Calculus EE

QG - General Chemistry EE

AL - Linear Algebra EE

IEGI - Topics of Industrial Engineering and Management

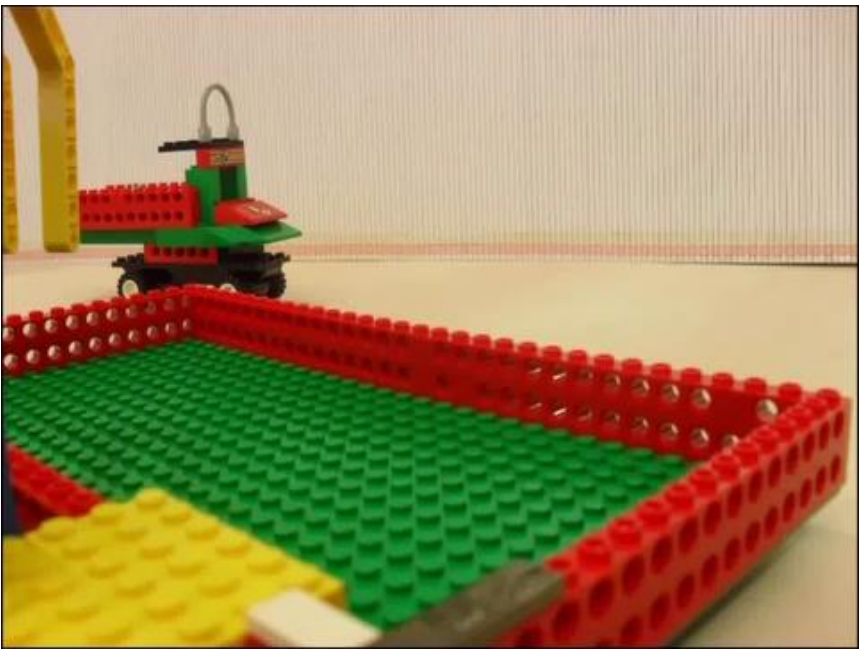
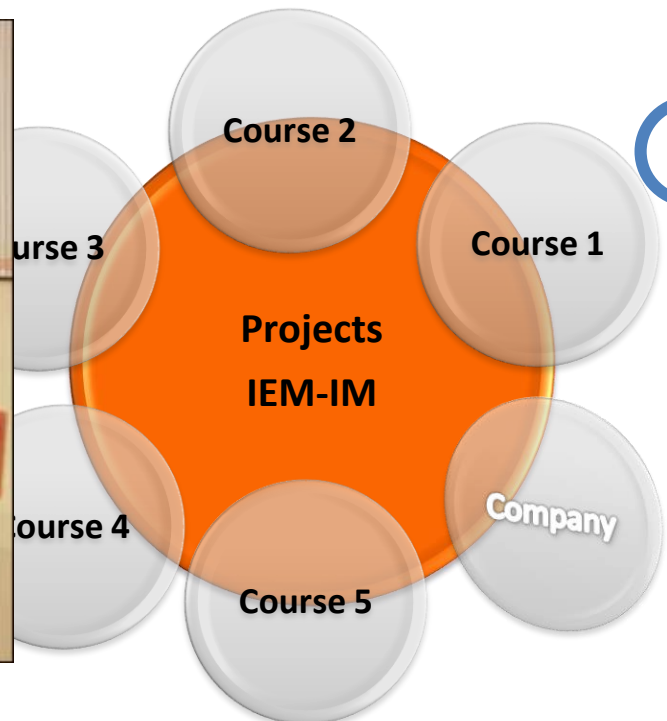
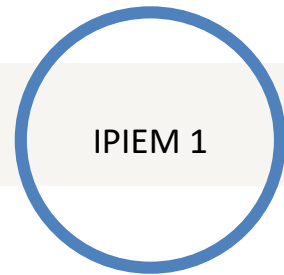
IPIEM 1 - Integrated Project in Industrial Engineering and Management I

Activity

Classification of several best practices descriptions:

- Type of activity
 - Active Learning, Problem-Based Learning (PBL), Project-Based Learning (PBL), Flipped Classroom, Peer Instruction, Gamification, Team Based Learning, Work Based Learning, Research Based Learning
- **If PBL: type of projects**
- **Active Learning principles**
- **Description is clear?**
- **We would need more information?**

PBL Model - IEM-IM

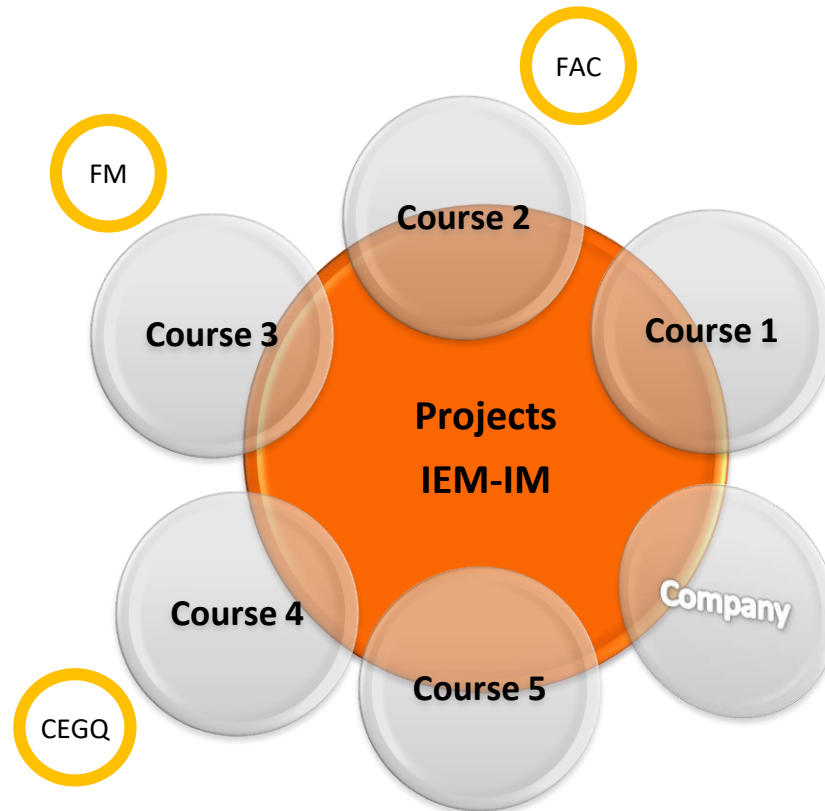


<https://youtu.be/ceTRq-bBINC>

Year	Theme
2004/05	Biodiesel Production System
2005/06	Forest Biomass Transformation System
...	
2009/10	Bioethanol Production System
...	
2010/11	Air2Water – portable device for water production from air humidity

PBL Model - IEM-IM

IPIEM 3



Curricular Unit – SEMESTER 8

CAD/CAPP

FAC - Computer Aided Manufacturing

CEGQ - Advanced Quality Engineering and Management

FM - Reliability and Industrial Maintenance

IPIEM 3 - Integrated Project in Industrial Engineering and Management III

PBL Model - IEM-IM

IPIEM 2

Curricular Unit – SEMESTER 7

Ergonomic Workplace Analysis

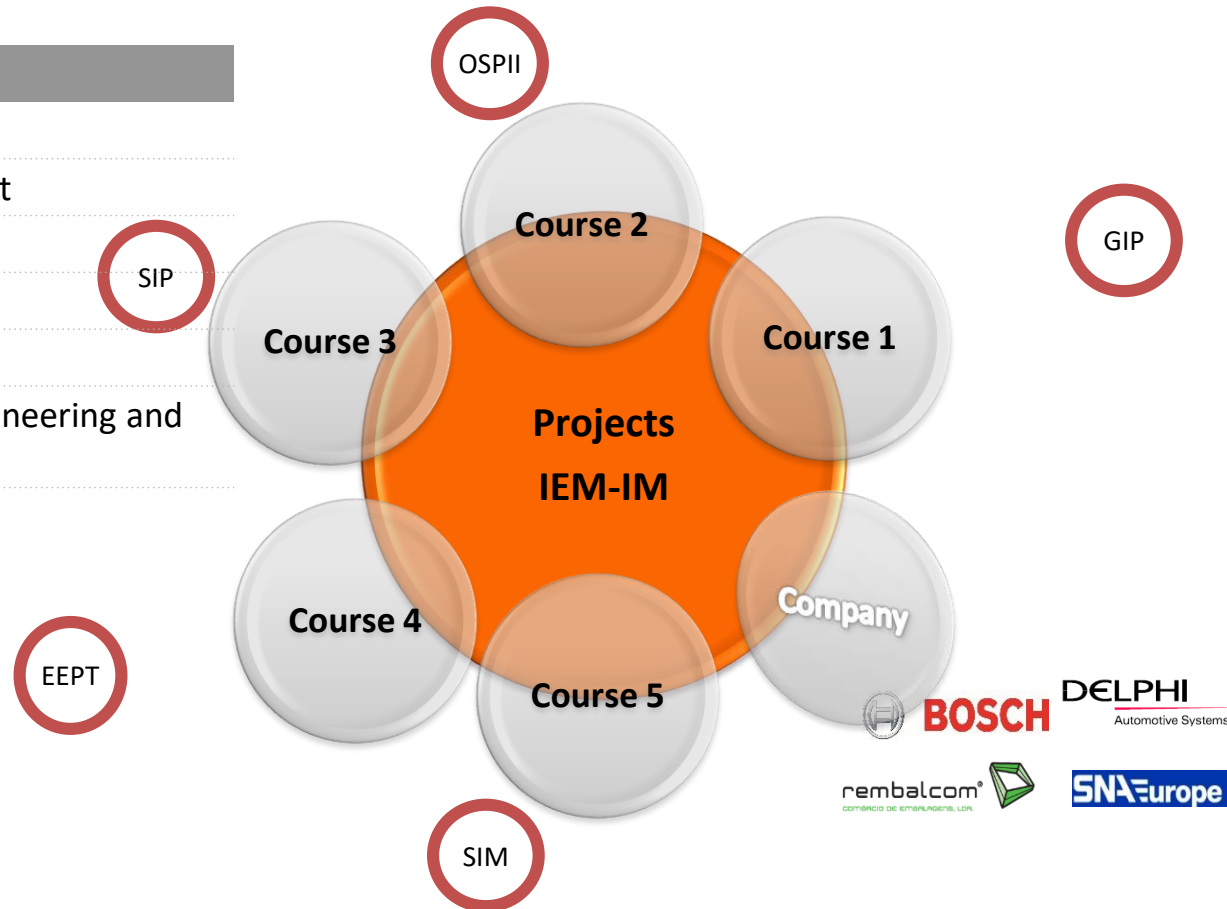
Integrated Production Management

Production Information Systems

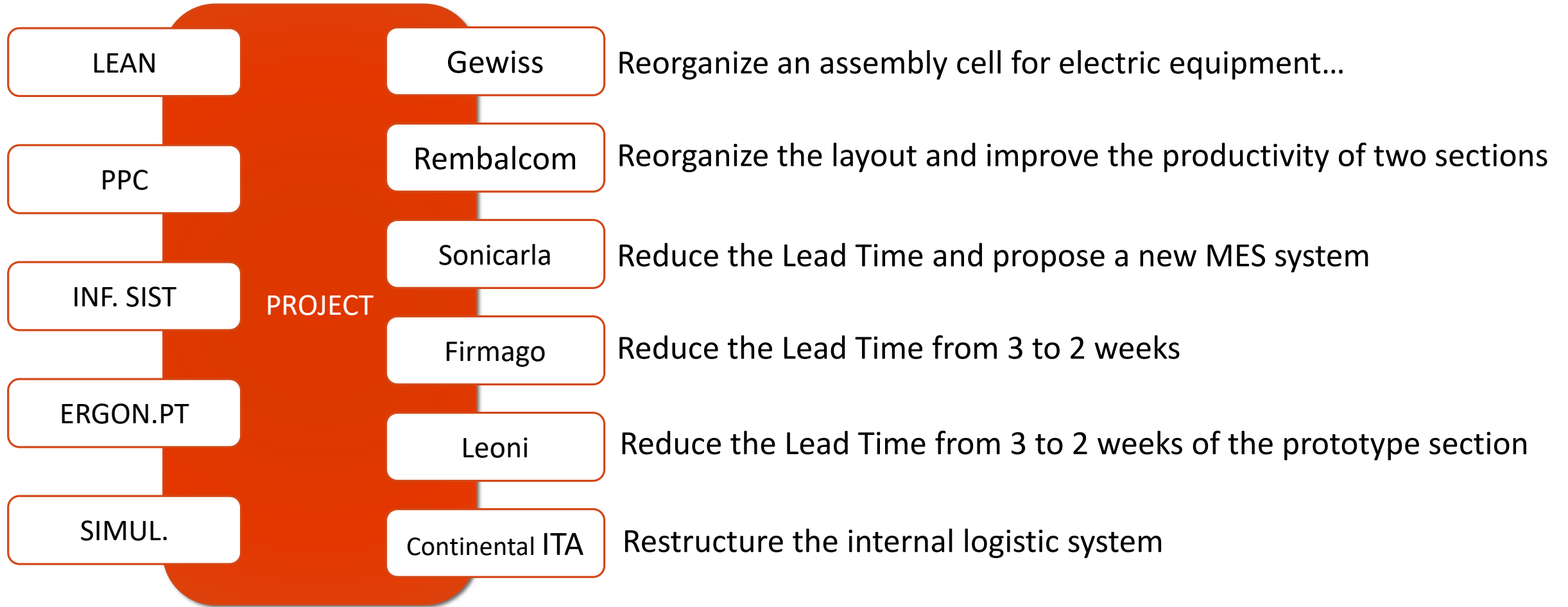
Production Systems Organization II

Simulation

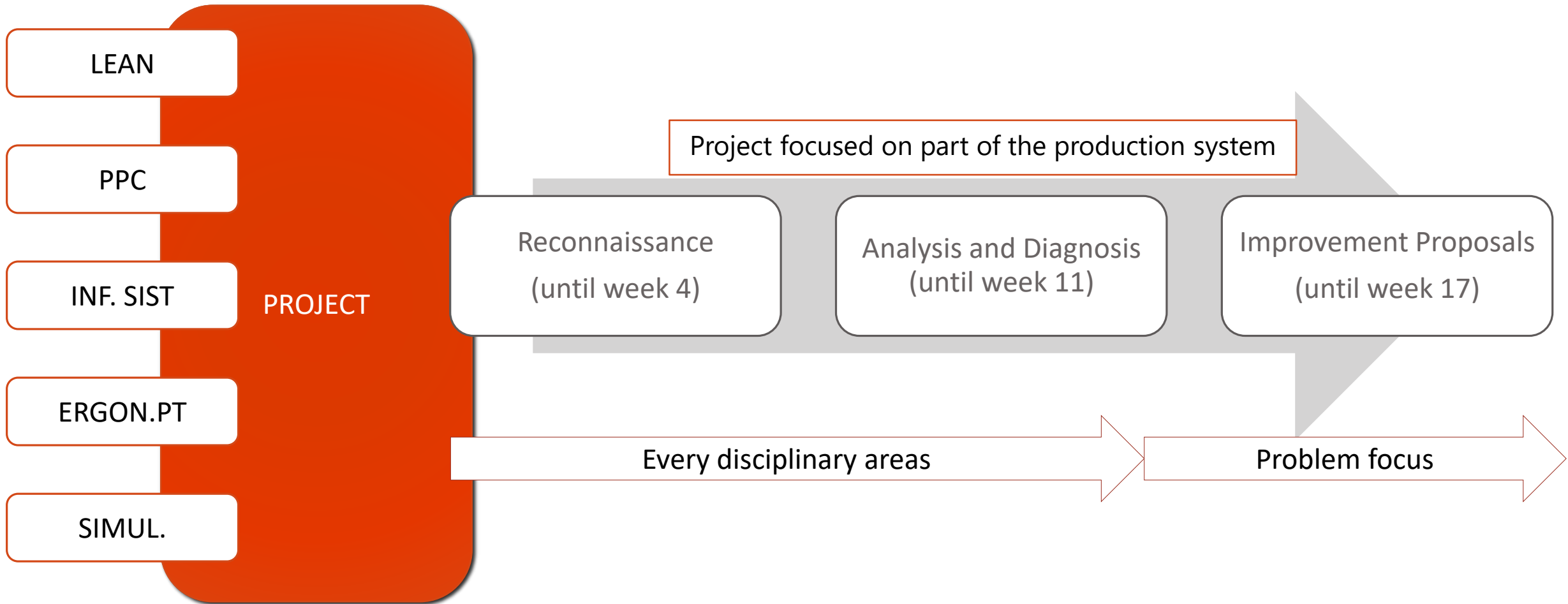
Integrated Project in Industrial Engineering and Management II



UMinho MIEGI_PBL – 7th Semester



UMinho MIEGI_PBL – 7th Semester





Video final do G1 4º ano MEGI : https://youtu.be/BTFnEzt_TGY

Alunos: André Martingo, André Gonçalves, André do Gonçalves, Nuno, Ricardo, António, Sérgio Marques.

ENGINNOVA Model

Engineering Projects of Innovation and Entrepreneurship



The company aim was the development of a new process for industrial water treatment. The proposed solution implied technical knowledge from the areas of biological, mechanical and electronic engineering.

Engineering Programs

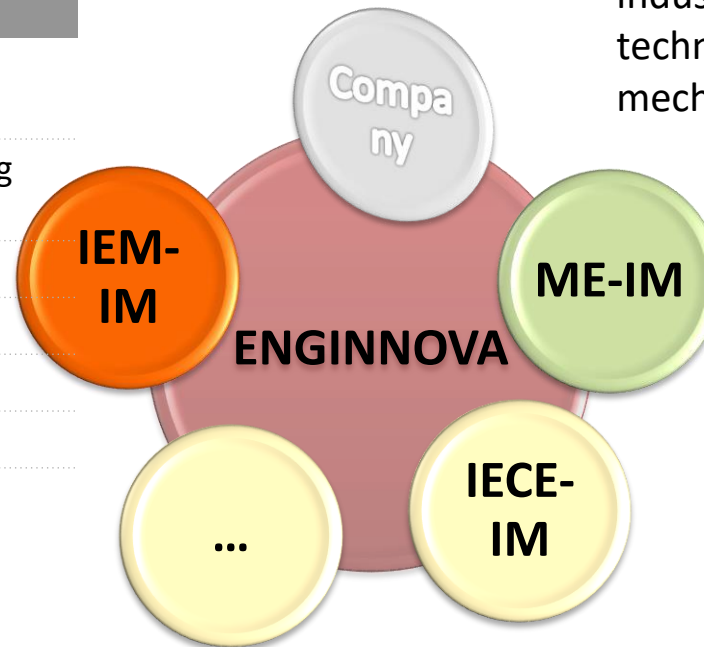
IEM-IM - Industrial Engineering and Management Integrated Master

IECE - Industrial Electronics and Computers Engineering Integrated Master

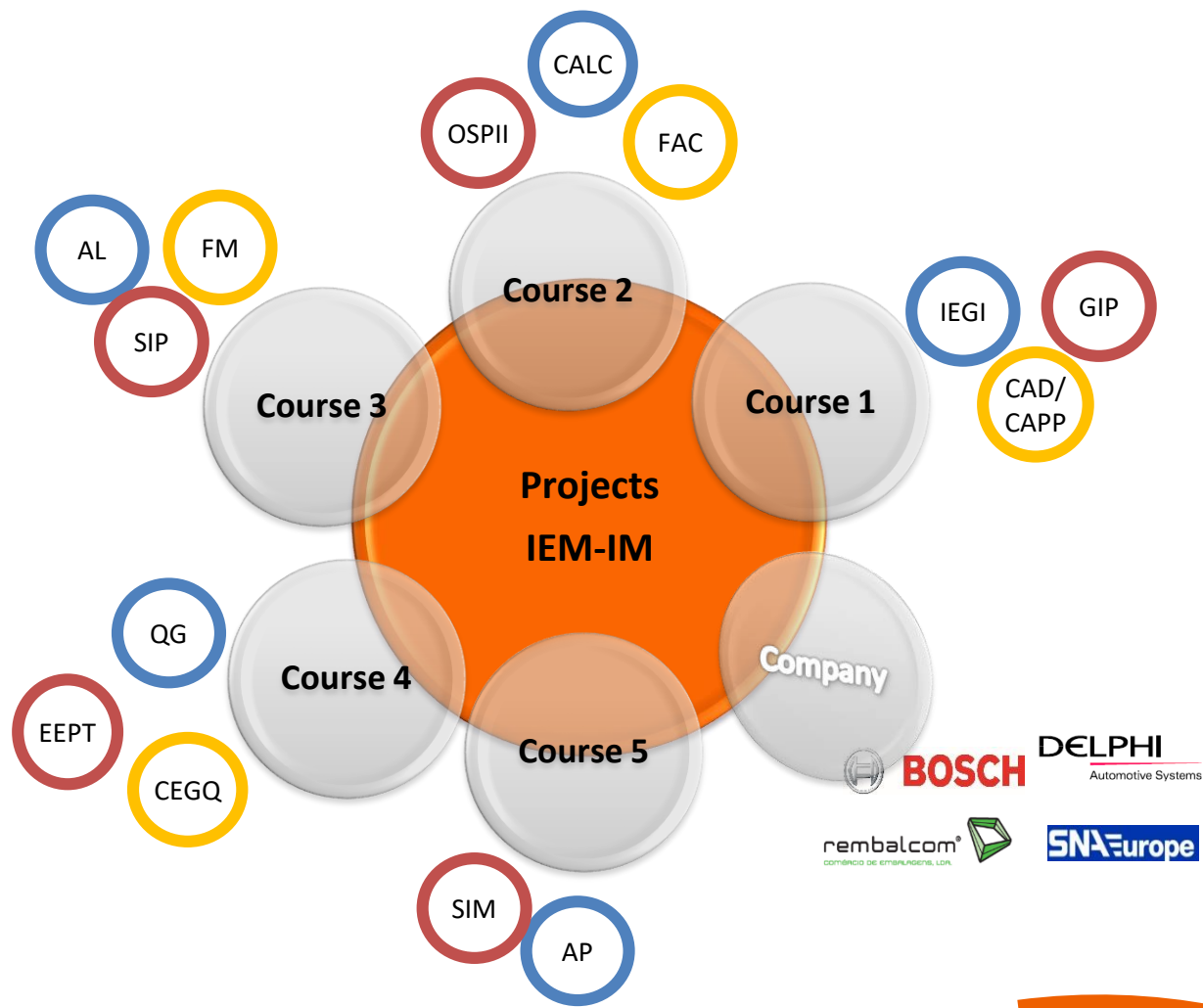
ME-IM - Mechanical Engineering Integrated Master

...

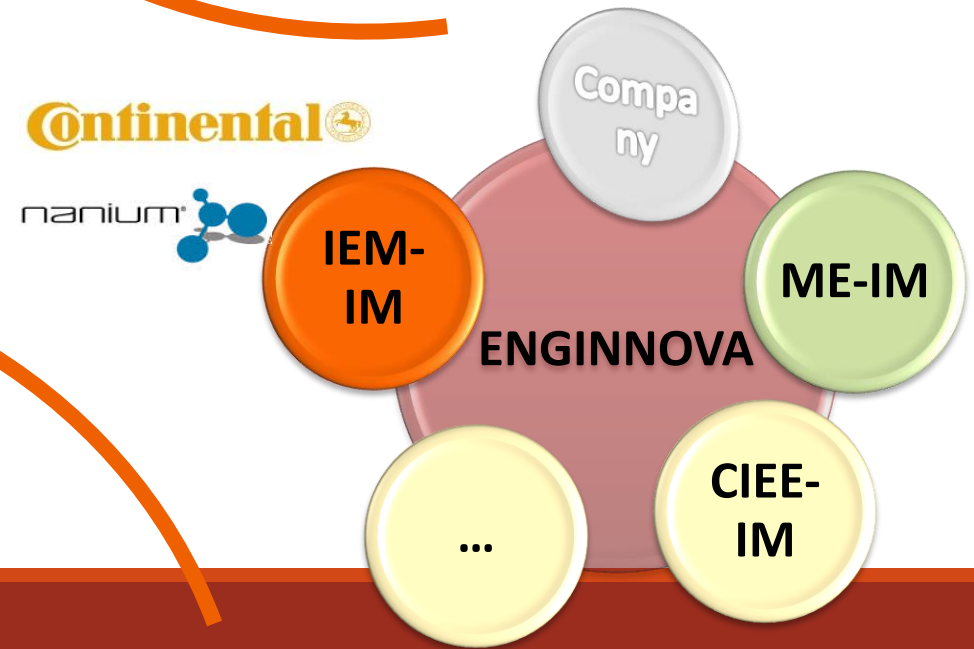
BE-IM - Biological Engineering Integrated Master



the team that worked at the semiconductors company had to adapt an automatic inspection machine designed to work with 200mm wafers so it could also work with 300mm wafers. This involved several modifications, both in mechanical and electronic aspects of the machine.



- Duration 17 weeks
- Teams of 5 to 9 elements
- Grading of one course can partially depend on project grade
- Coordination team with teachers, tutors and researchers
- Teachers with technical functions and tutor functions (teamwork support)



10 years PBL contributions

Research – gradually increasing

- Publishing articles
- Master Projects
- PhD projects

2007 - 2008

RT/C-47/2012
Introduction PIEGI1 course
Change of subjects

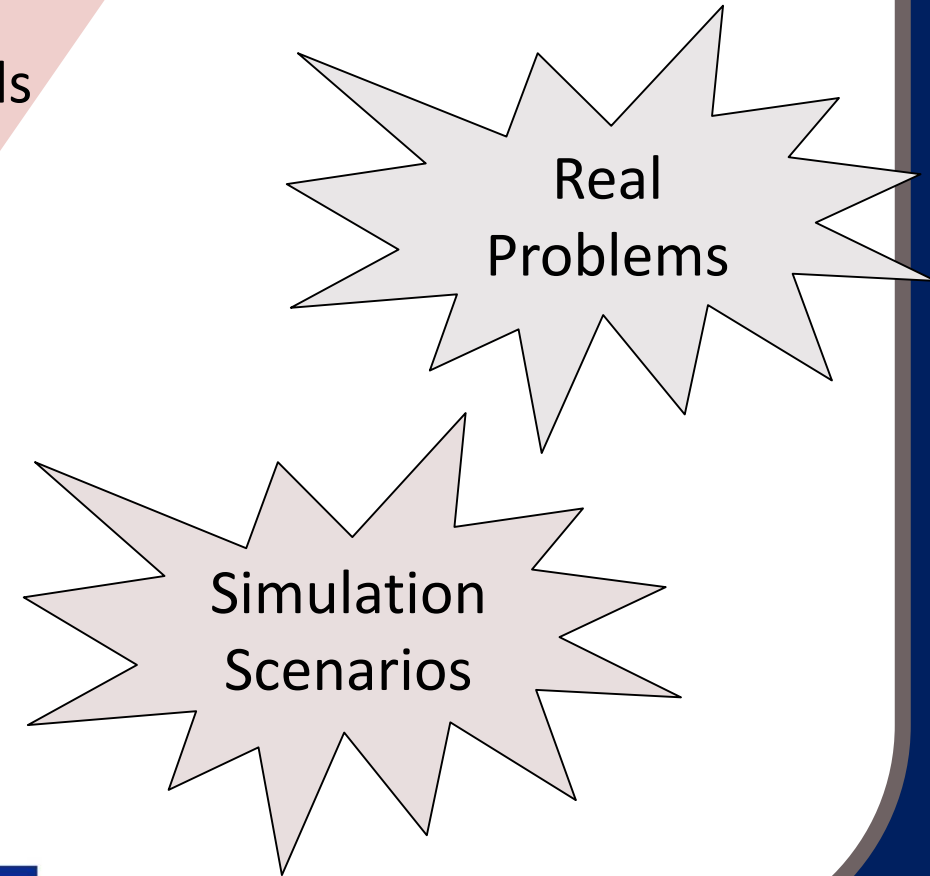
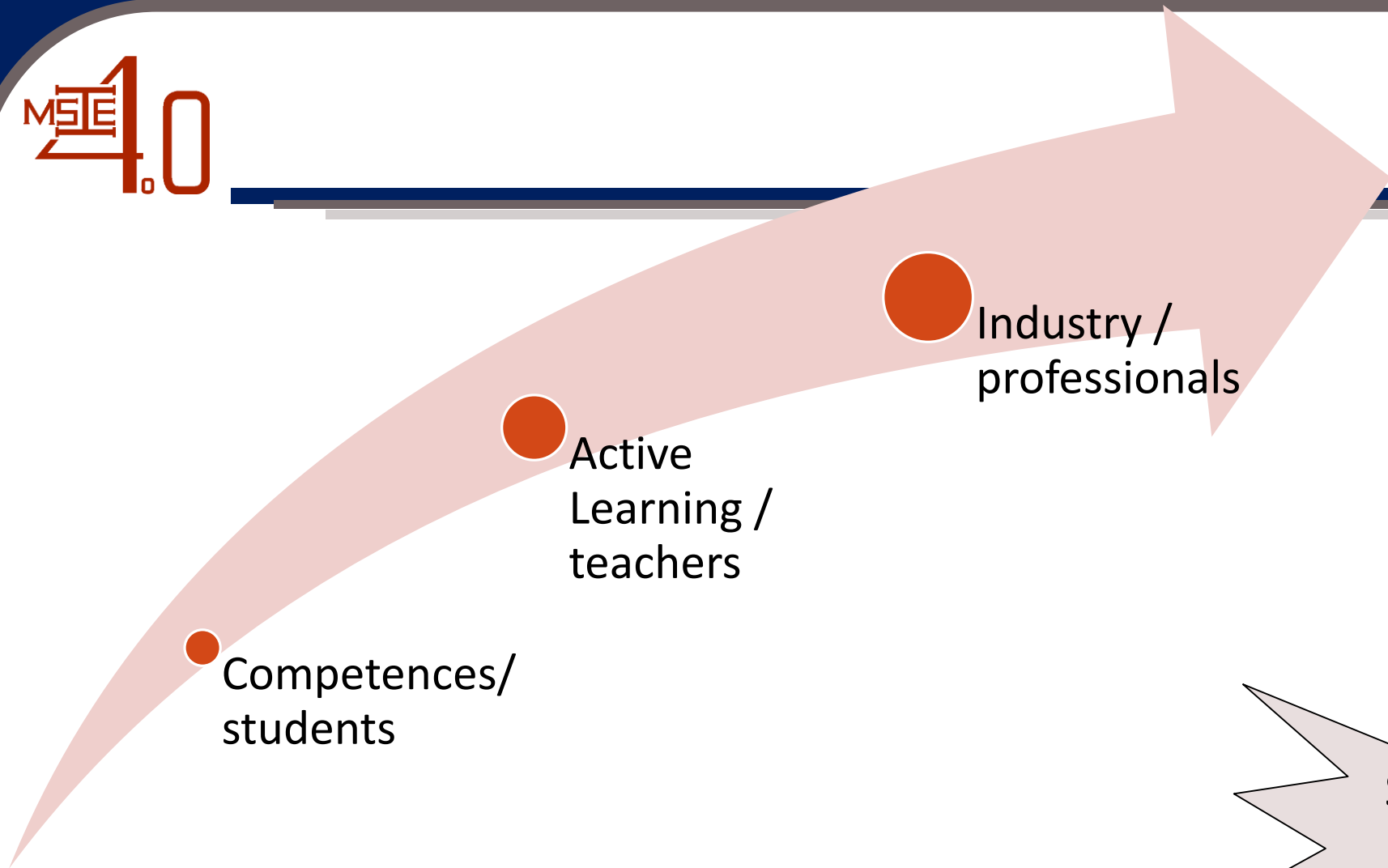
2012/13 Restructure of the Curriculum
to align with PBL objectives

2009 - PAEE



Results

- 63 teams, 449 students
- 24 companies, 41 teams, 298 students
- > 150 Final reports of students
- > 50 Prototypes for the 1st year: Lego Mindstorms
- > 500 Student Presentations
- Articles of students:
 - > 20 reports in article format
 - > 15 publications in international conferences



Some students' links – in portuguese

1st year 2005/06: <https://youtu.be/wS4qwPS7Uc0>

1st year 2010/11: <https://youtu.be/ceTRq-bBINc>

4th year 2005/06: https://youtu.be/BTFnEzt_TGY

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