Services and Innovation for Industry 4.0

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University of Bologna, Italy

Agenda

- 9:15 Introduction – Prof. Luca Foschini and Prof. Mauro Tortonesi
- 9:30 Regional Ecosystem – Prof. Antonio Corradi
- 10:00 Exploring Global Perspectives
  - 10:00 Cornell University – Prof. Ken Birman
  - 10:30 State University of Campinas – Prof. Nelson Fonseca
- 11:00 Coffee Break
- 11:30 Exploring Global Perspectives (cont'ed)
  - 11:30 Budapest University of Technology and Economics – Prof. Pal Varga
  - 12:00 University of Extremadura – Prof. Javier Berrocal
- 12:30 Final Panel and Closing Remarks
- 13:30 Lunch

Innnovation in Company education and Higher Education

RER recognizes a lot of Teaching Academies promoted by companies and tailored for workers with the goal of training and retraining
The efforts are a lot but maybe the experiences are very far form integration, making impossible the creation of a unified network among all possible materials and without any attempt of creating a unified and scalable effort

More connected the Technical education: RER hosts and promotes a lot of other initiatives for higher education after high school
ITS – Istruzione Tecnica Superiore (Higher Technical education) 2 years in technical areas, 34 offers
IFTS – Istruzione e Formazione Tecnica Superiore (Higher Technical education and teaching) – 1 year of technical education, many offers
All of them with a long stage period (a semester or less)

Now we have also University degrees
Lauree professionalizzanti – Professional degrees not connected with the Bologna process: No access to second level degrees
3 years in technical areas, 2 years very close to companies, 1 year stage

UNIBO Company education

University of Bologna aims at making an effort for retraining for companies, by using its experience:

- **making possible the access to classes for companies**
- **creating ad-hoc tutoring and special paths for workers**

We have already experienced some initiatives with some local companies, especially in specific projects financed by EIT Digital that promotes teaching within the large EU-financed digital innovation ecosystem (https://www.eitdigital.eu/)

In LEDAM https://site.unibo.it/ledam/en

we had a course that delivers Manufacturing knowledge and skills through an online, modular and asynchronous training structure, with contents designed to be assembled and accessed in a flexible way and tailored on the specific training needs and work commitments of each professional.

The training program is organized in 10 online Learning Paths (LPs) made available through EIT Manufacturing e-learning platform Skills.move.

SII40 Higher Education Initiative

**The SII40 has the goal of experiment innovative education based on the necessity of training students in an innovative way and also retraining already experienced people working in companies again in innovative forms
The main core is to favor the mindset transfer from people of very different background and far-away generations
Proposal of a mixed path toward Industry 4.0, with an initial separated training for any group, then a common path, together with an active participation to projects in teams**

Teaching components
- **International experts record classes (asynchronous access) and give also synchronous presentations afterward with classes**
- **Teams work together to define a project in Industry 4.0**
- **Additional material: pills, nuggets, story telling**

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LEDAM (LeDAM - Leveraging competences and skills of professionals in Digital and Automated Manufacturing processes) proposes course to deliver these selected knowledge and skills through an online, modular and asynchronous training structure, with contents designed to be assembled and accessed in a flexible way and tailored on the specific training needs and work commitments of each professional

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https://site.unibo.it/ledam/en

UNIBO Company education

LEDAM addresses together two main targets:
- Junior professionals (<3 yrs in the Company), to accelerate the alignment process of skills and consequently improve professional growth and professional development
- Senior professionals, to carry out a re-skilling action by integrating the missing skills in relation to the most recent technologies introduced in their manufacturing sector

The training program is organized in **10 online Learning Paths** (LPs) in two forms:
- **5 Learning Paths of about 1 hour each**, **delivering crash courses of 4-5 modules (nuggets) of about 15 minutes each**, with **basic theoretical contents** on the topics of:

- **Advanced Manufacturing** (Lean Manufacturing, Maintenance, Industry 4.0 & Automation)
- **Information & Communication Technology**
- **Quality Control & Safety**
- **Innovation Technology for Energy Saving and Sustainability**
- **Management, Innovation & Entrepreneurship**

These 5 Learning Paths are delivered in a modular approach (each module can be accessed and completed autonomously) and **are flexibly adapted learner needs** (through the possibility of composing personalized learning paths) to answer the need of professionals for rapidly building and aligning skills on the most **recent technologies available** as well as on **Innovation &Enterpreneurship skills**

UNIBO Company education

5 Advanced Learning Paths of about 3 hours each:
- **Additive Manufacturing (Fraunhofer IAPT)**
- **Advanced Maintenance of Production Systems (INEGI)**
- **Automatic Lines and Robotics (INEGI)**
- **LCA, Eco-design and Energy Saving (UNIBO)**
- **Digital Twins and AR/VR Applications (UNIBO)**

Each Learning Path contains theoretical nuggets, case studies/hands on sessions, an I&E specialized nugget and a final assessment

LeDAM consortium involved University of Bologna as Coordinator, with the support of Fondazione Alma Mater, Fraunhofer IAPT (Germany) and INEGI (Portugal) as academic partners, and Bonfiglioli S.p.A. and Marposs S.p.A. as industrial partners

A total of 84 nuggets were uploaded from the Skills.move platform, where selected learners could consume them 24/24 7/7 during a pilot period

A total of 226 Learning Paths were completed by the end of 2022 and 1275 nuggets consumed

Overall, LeDAM offer were consumed beyond expectations, collecting a wide interest from professionals and companies in the Manufacturing Sector, especially in Italy (126 out of 179 learners came from Italy)

SII40 Higher Education Initiative Structure
(the whole course is delivered in a remote mode)

Homogenizing knowledge

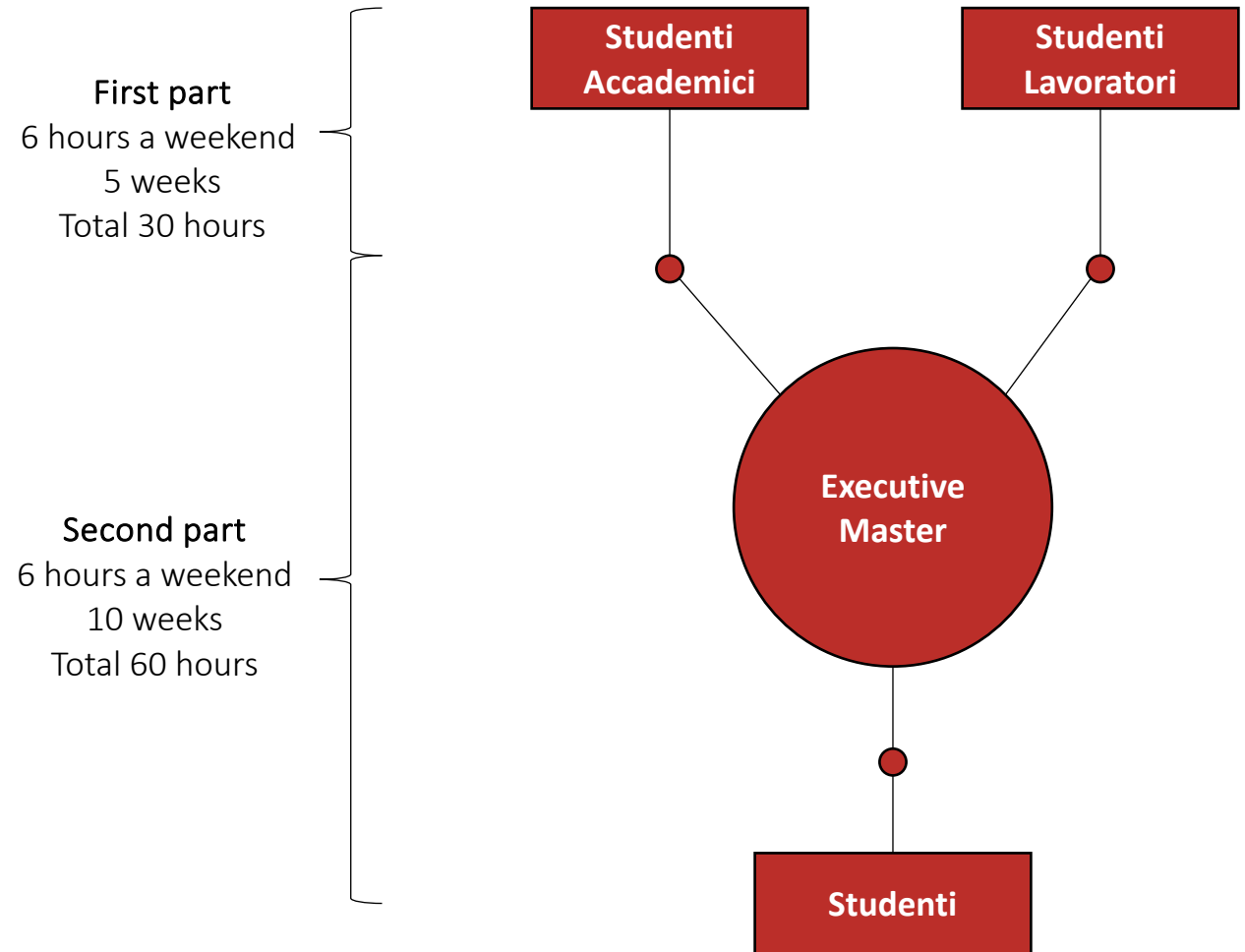Two paths, one **for students** and another **for workers**
For each path:
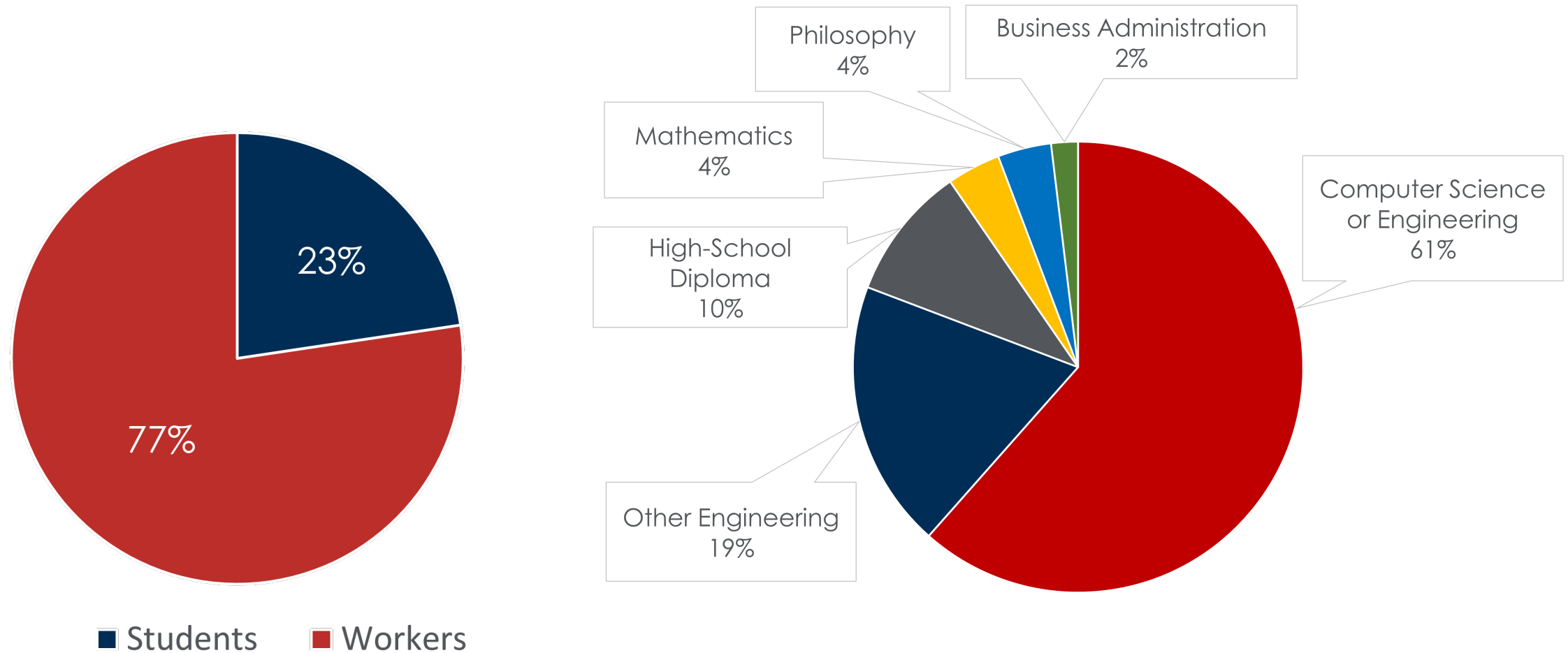- 10 modules 3 hours each by local educators/professors;

Master Executive

For each of the **10 weekends**:
- 1 module 3 hours by international experts / fellow professors;
- 1 module 3 hour by local professor;
- team work lavoro in small grounps of 2-3 people mixed (students and workers) **supported by tutor**.

First part
6 hours a weekend
5 weeks
Total 30 hours

Second part
6 hours a weekend
10 weeks
Total 60 hours

Studenti Accademici

Studenti Lavoratori

Executive Master

Studenti

Distribution of student (first edition at UNIBO)

Students **Workers**

Philosophy
4%

Business Administration
2%

Mathematics
4%

High-School
Diploma
10%

Computer Science
or Engineering
61%

Other Engineering
19%

SII40   10

Course modules – International Experts / Fellow Professors

Industry 4.0

GUEST SPEAKERS:

- **Pal Varga** (Budapest University of Technology and Economics)
- **Shaofang Gong** (Linköping University)
- **Angelo Corsaro** (ZettaScale Technology)
- **Matthias Klumpp** (University of Göttingen)

Machine Learning

GUEST SPEAKERS:

- **Yehia Elkhatib** (University of Glasgow)
- **Kamal Medjaher** (National Engineering School of Tarbes)

Innovation Management

GUEST SPEAKERS:

- **Bruno Iafelice** (TVLP Institute)
- **Michel Condry** (Condry Investment)
- **Joe Weiman** (XFORMA LLC)
- **Pietro Micheli** (Warwick Business School)
- **Ann-Louise Andersen** (Aalborg University)

Cloud and Fog Computing

GUEST SPEAKERS:

- **Cristian Borcea** (New Jersey Institute of Technology)
- **Ken Birman** (Cornel University)
- **Flavio Bonomi** (Lynx Software)
- **Luciano Gaspary and Lisandro Granville** (UFRGS)

Robotics

GUEST SPEAKERS:

- **Stefano Carpin** (University of California MERCED)
- **Matteo Saveriano** (University of Innsbruck)

Cyber Security

GUEST SPEAKERS:

- **Fabio Pierazzi** (King's College London)

Local Teaching Staff

Academic professors

- Antonio Corradi (UNIBO)
- Giuseppe di Modica (UNIBO)
- Riccardo Venanzi (UNIBO)
- Lorenzo Rosa (UNIBO)
- Elena Bellodi (UNIFE)
- Michele Girolami (CNR Pisa)
- Andrea Sabbioni (UNIBO)
- Stefano Chessa (UNIPI)

- Armir Bujari (UNIBO)
- Riccardo Zese (UNIFE)
- Nicolò Romandini (UNIBO)
- Luca Foschini (UNIBO)
- Paolo Bellavista (UNIBO)
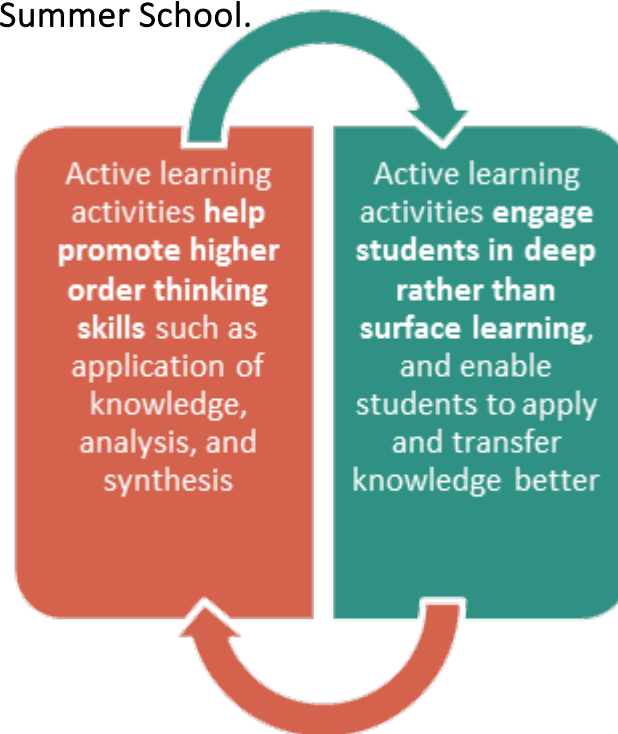- Marcello Cinque (Univ. Federico II)
- Roberto di Leva (UNIBO)

Educators from industry

- Elisabetta Bracci (JUMP Facility)
- Filippo Bosi (Imola Informatica)
- Mattia Gallegati (Imola Informatica)
- Michele Danieli (Imola Informatica)
- Davide Poggiali (Far Networks)

- Alessandro Chiarini (OROBIX.life)
- Marco Mazzoni (CONIO Inc.)
- Francesco Meoni (BI-REX)
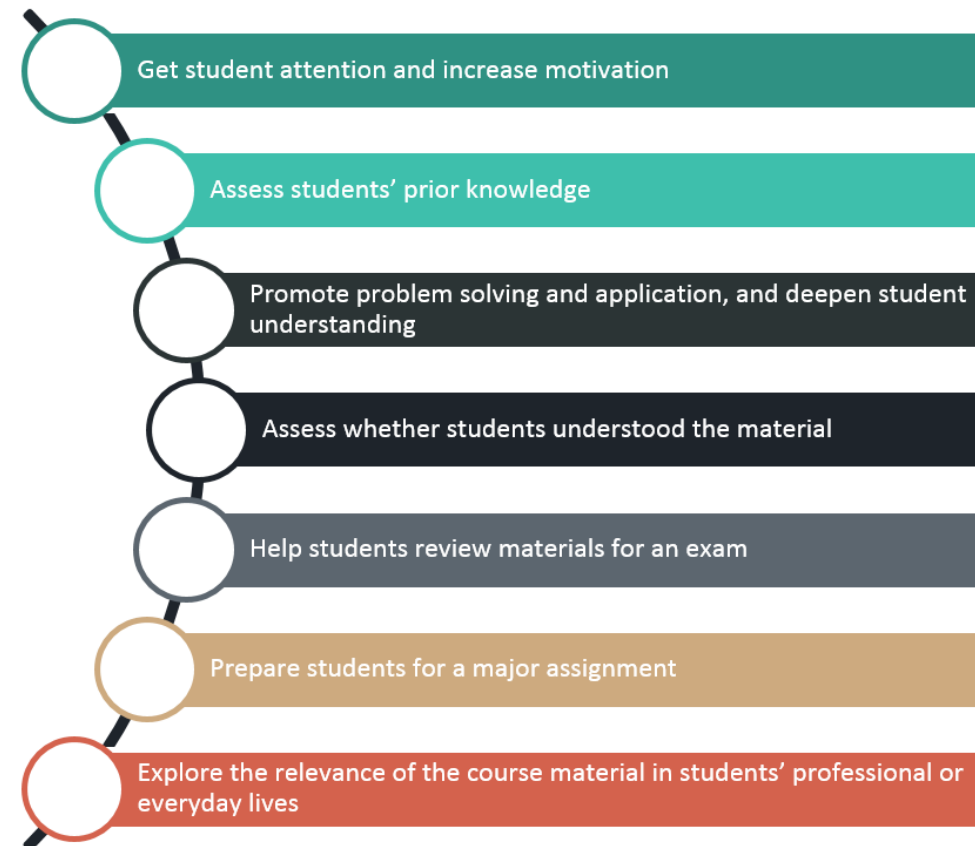- Piero Quaroni (Amazon)

Active learning

Material provided to students *before the lesson* and **offline**, and then they have the opportunity in the classroom to rework and go to the bottom with targeted learning activities.
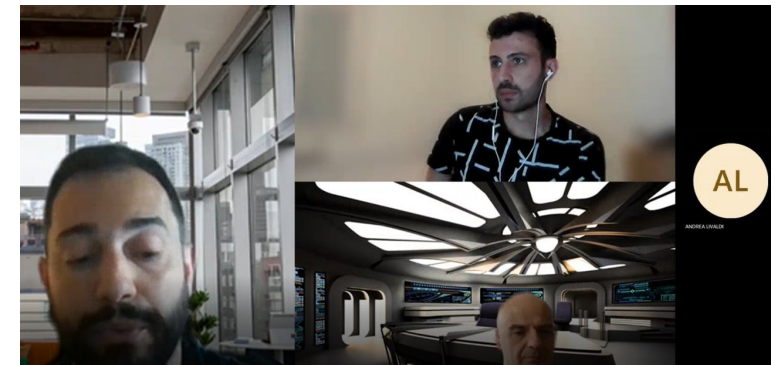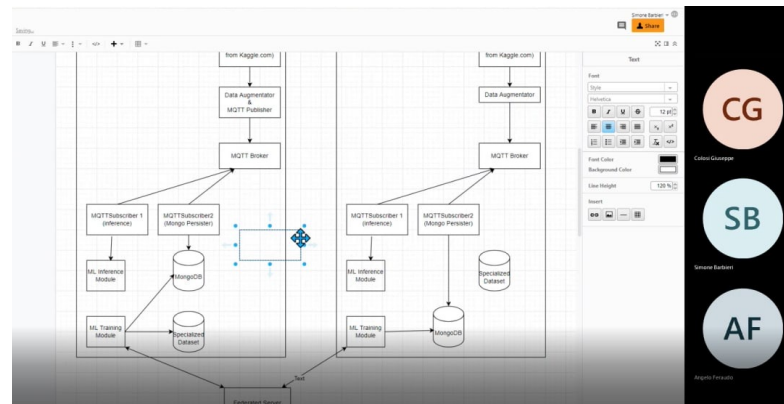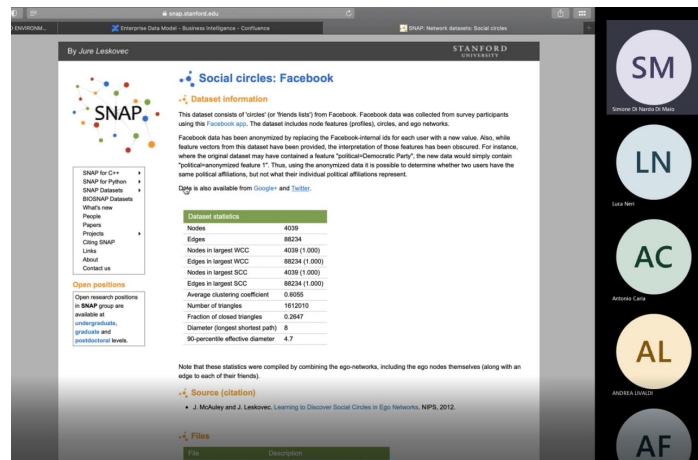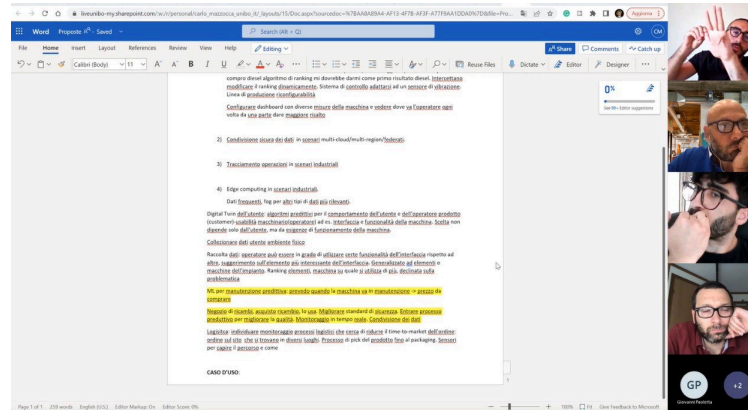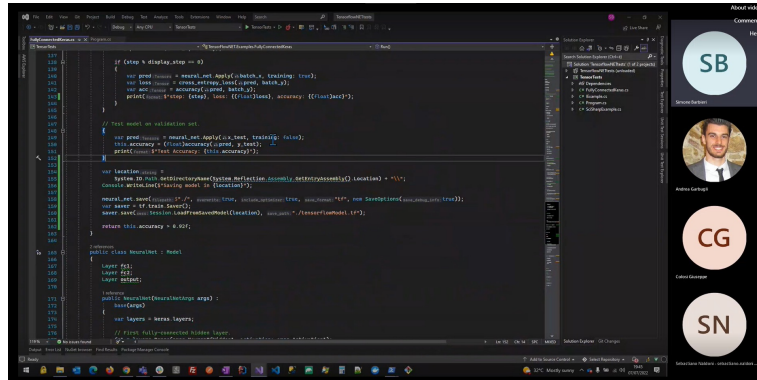
Tested and exploited extensively, also in initiatives in which we are directly involved such as the EIT Digital Summer School.

Main goals of active learning.

Active learning activities **help promote higher order thinking skills** such as application of knowledge, analysis, and synthesis

Active learning activities **engage students in deep rather than surface learning,** and enable students to apply and transfer knowledge better

Get student attention and increase motivation

Assess students' prior knowledge

Promote problem solving and application, and deepen student understanding

Assess whether students understood the material

Help students review materials for an exam

Prepare students for a major assignment

Explore the relevance of the course material in students' professional or everyday lives

Teamwork Meetings
# (facilitated by SII40 tutors)

Need for professionalism and technical support for
Virtual delivery of lessons and materials/support/teamwork

Virtual delivery, which is however professional and assisted by professionals in the sector, and with some **modules/interventions held in mixed mode**, especially webinars.
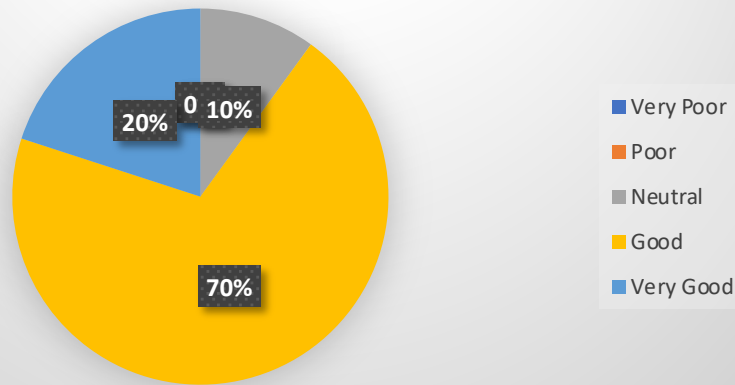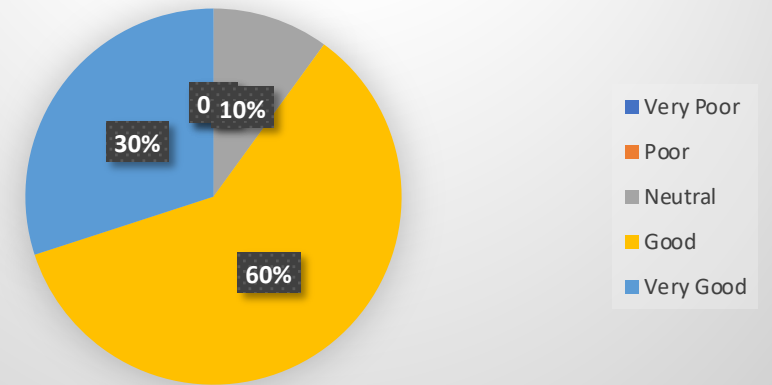
Some first data consolidated from student feedbacks

The "Y" shape of the course was

- Very Poor
- Poor
- Neutral
- Good
- Very Good

0% 10% 20% 70%
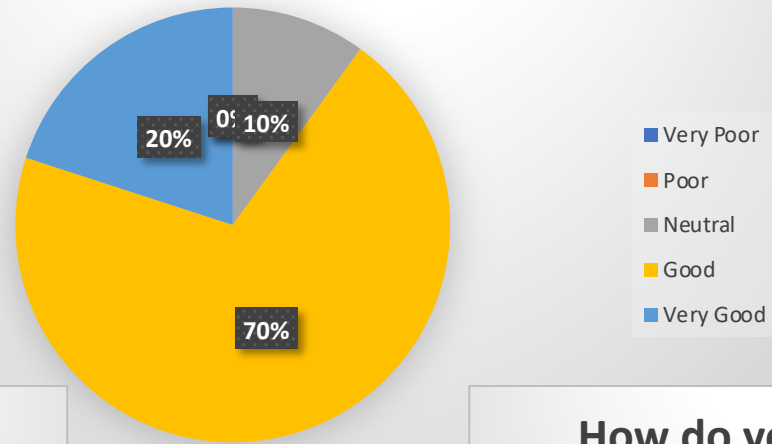
How do you evaluate the first part of the course? - Knowledge alignment

- Very Poor
- Poor
- Neutral
- Good
- Very Good

0 10% 20% 70%

How do you evaluate the second part of the course? - Master Executive

- Very Poor
- Poor
- Neutral
- Good
- Very Good

0 10% 30% 60%
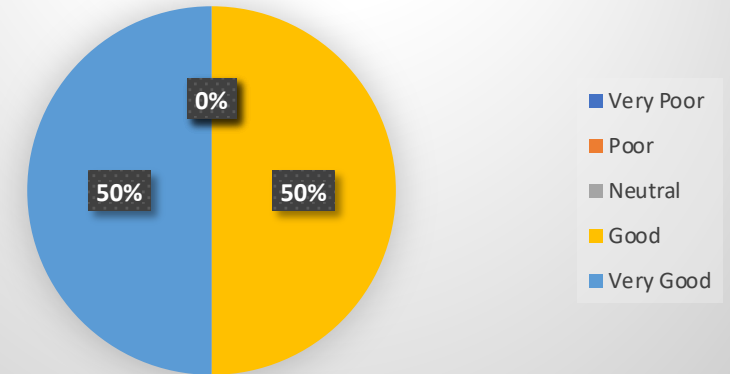
Some first data consolidated from student feedbacks

The content of the lectures was contributing to course objective

- Very Poor
- Poor
- Neutral
- Good
- Very Good

0%
30%
70%
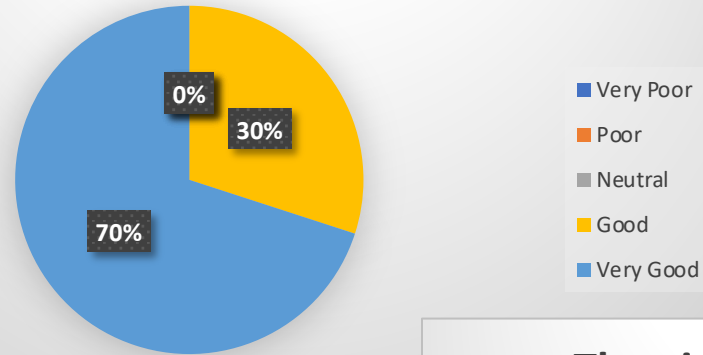
The theme was well covered

- Very Poor
- Poor
- Neutral
- Good
- Very Good

0%
50%
50%

The given material supported my learning

- Very Poor
- Poor
- Neutral
- Good
- Very Good

0 10%
10%
80%
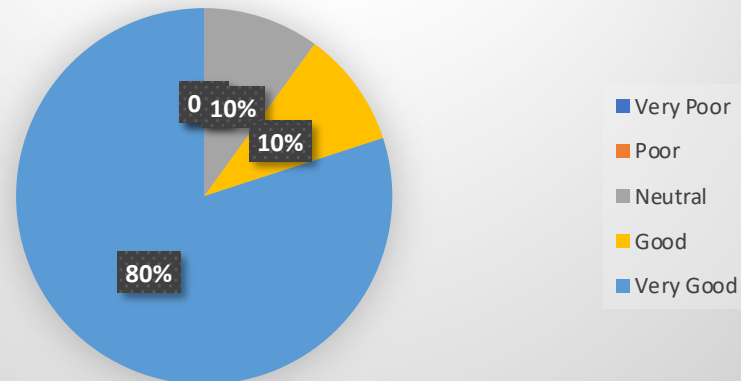
Conclusions and Future Work

- Conclusions
  - Wide participation of companies
  - Open materials and scalability/sustainability of initiatives
  - Removing constraints to facilitate student worker participation
  - Accompaniment with hands-on and tutoring

- Future Work
  - Other editions (UNIFE is ongoing, UNIPR and UNIMORE starting in September)
  - Educate the educators and increase their number **toward scalability**
  - New initiatives to increase attractivity by:
    - Best story telling and connection between the actors of the Regione Emilia-Romagna ecosystem
    - Professional use of social media for marketing initiatives

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