Embedding enterprise in the higher education Curricula

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Overview

- **The importance of university and industry collaboration**
- **Industry 4.0 and Industry 5.0 and higher education developments**
- **Industry 4.0 and Skill 4.0**
- **Industry based curriculum design**
- **Strategies and programs to support industry-relevant skills of students**
- **Strategies to joint master' thesis at companies, and project assignments**

The importance of university and industry collaboration

- More complex industrial processes more knowledge and more skills (Kozák et al., 2018)
- Faster grow of joint Universities-Institutions Patents than University-owned patents (OECD report, 2019)
- More patents when industries are located close to universities
- Research contributes to innovation and entrepreneurship (OECD report, 2019)
- Start-up firms founded by students or academics significantly contribute to commercializing.
- Start-ups founded by PhD students and academic researchers are significantly more likely to patent than non-academic start-ups.

The Organization for Economic Co-operation and Development (OECD) is an international organization that works to build better policies for **better lives**.

Industry 4.0 and Industry 5.0 and higher education developments

- **Illustration of industrial evolution (Maddikunta, P. K. R., et al, 2022)**

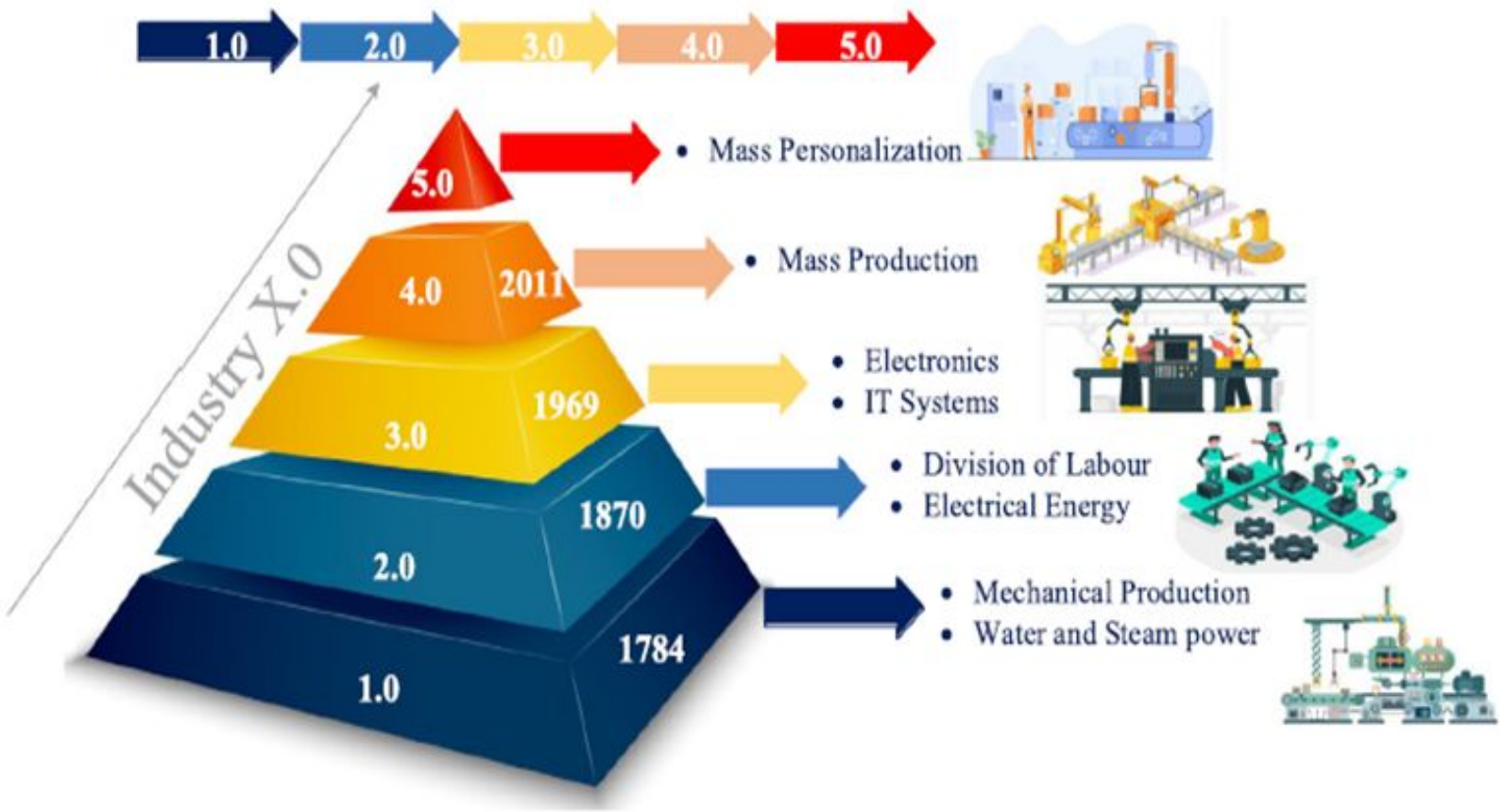
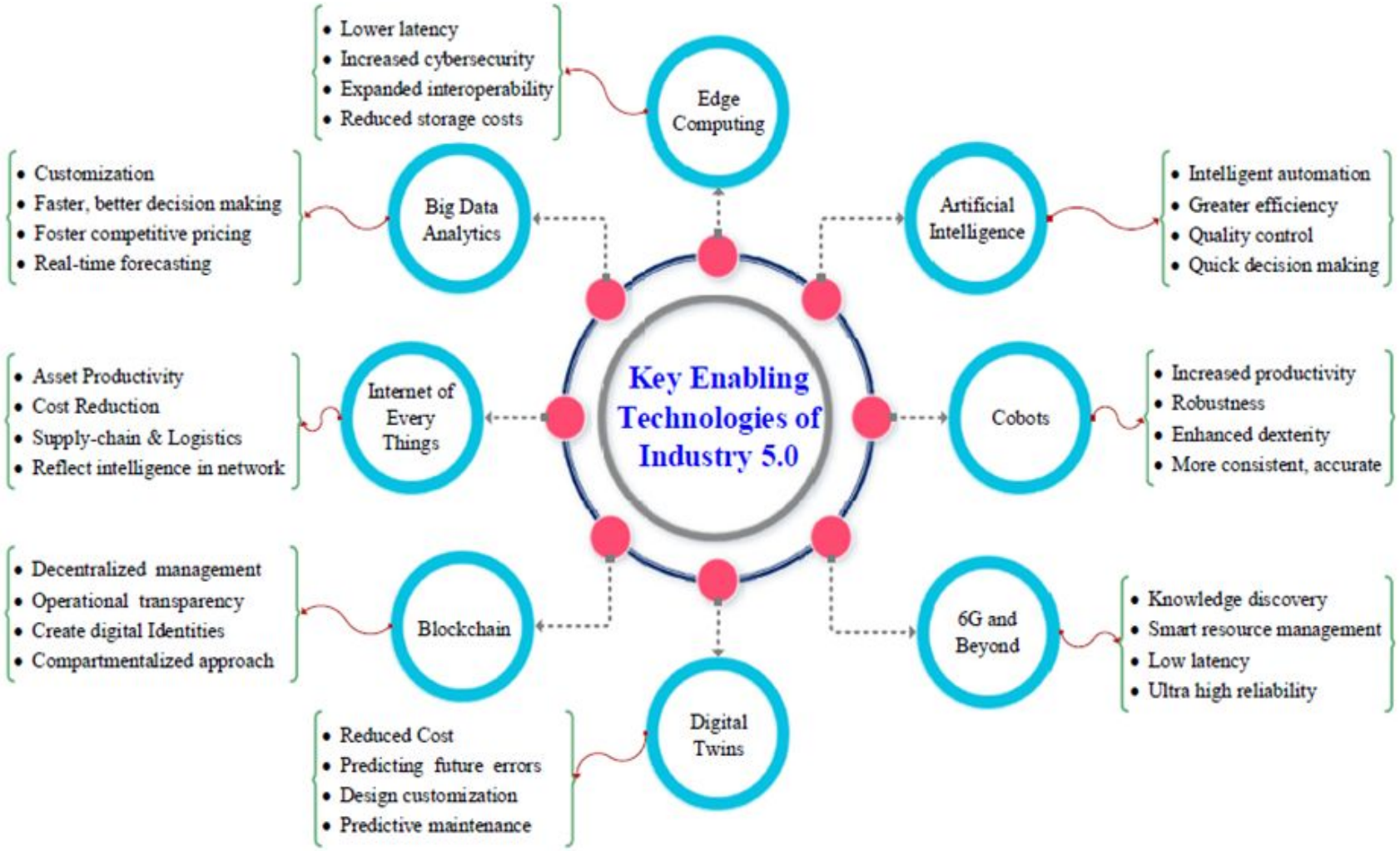


Illustration of industrial evolution.

 (Xu, 2020)

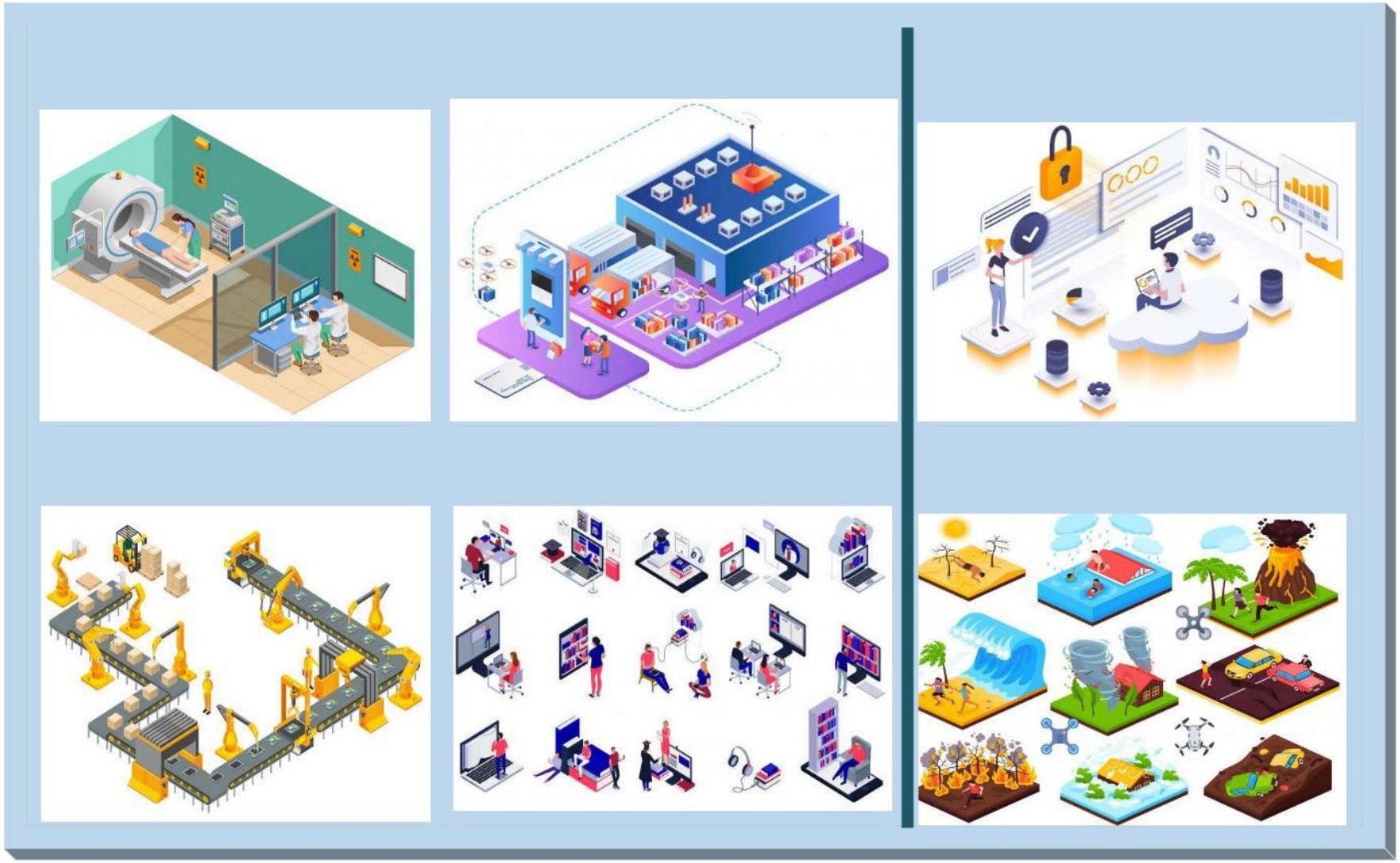

Nine Technologies Are Transforming Industrial Production
Autonomous robots
Big data and analytics
Simulation
Augmented reality
Industry 4.0
Horizontal and vertical system integration
Additive manufacturing
The Industrial Internet of Things
The cloud
Cybersecurity
Industry 4.0 is the vision of the industrial production of the future
Source: BCG.

- **Key enabling technologies of Industry 5.0. (Maddikunta, P., et al, 2022)**

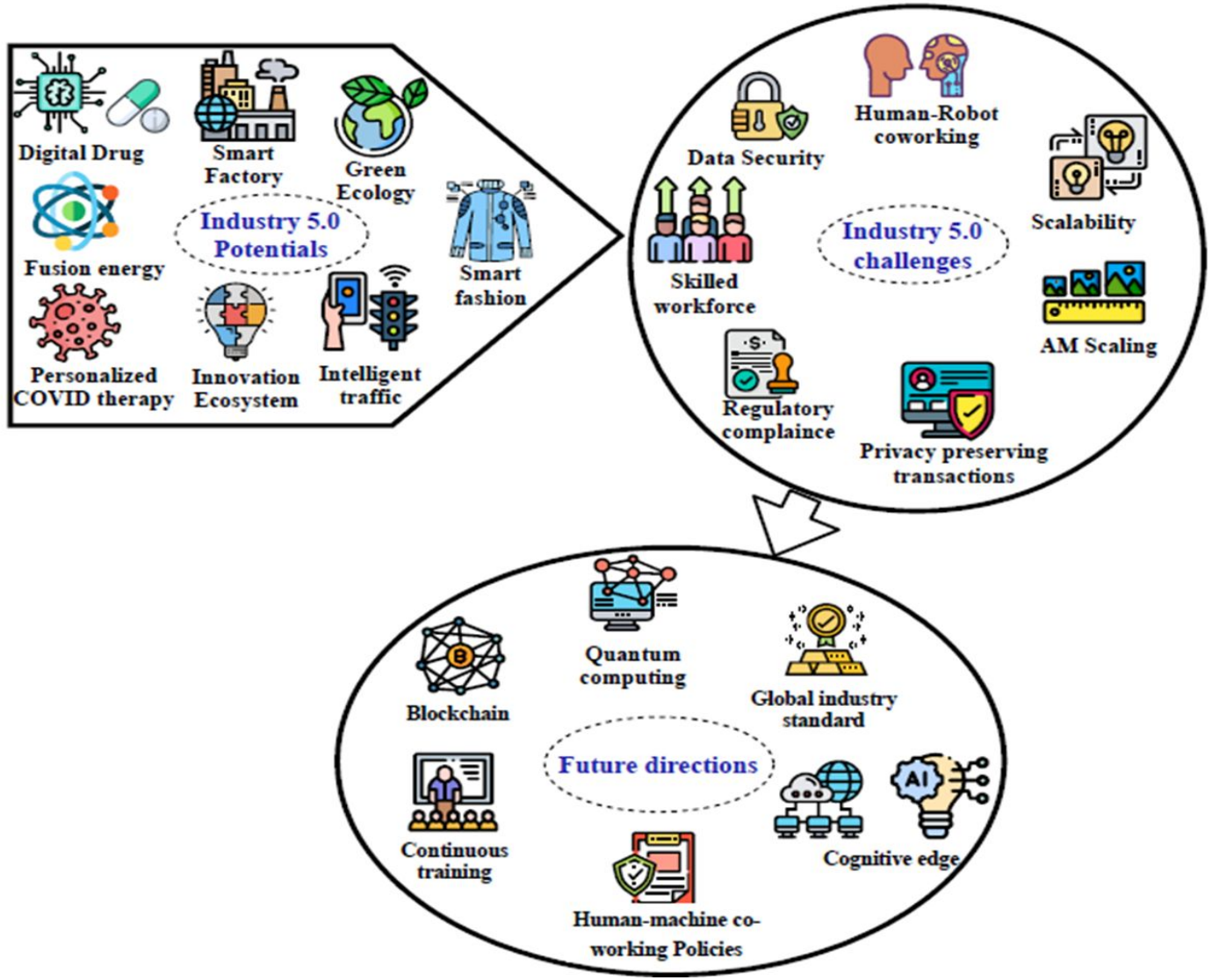


Key enabling technologies of Industry 5.0.

Industry 5.0 applications in education (Maddikunta, P., et al, 2022)



- **Industry 5.0 potentials, challenges and future directions.** **(Maddikunta, P. et al, 2022)**

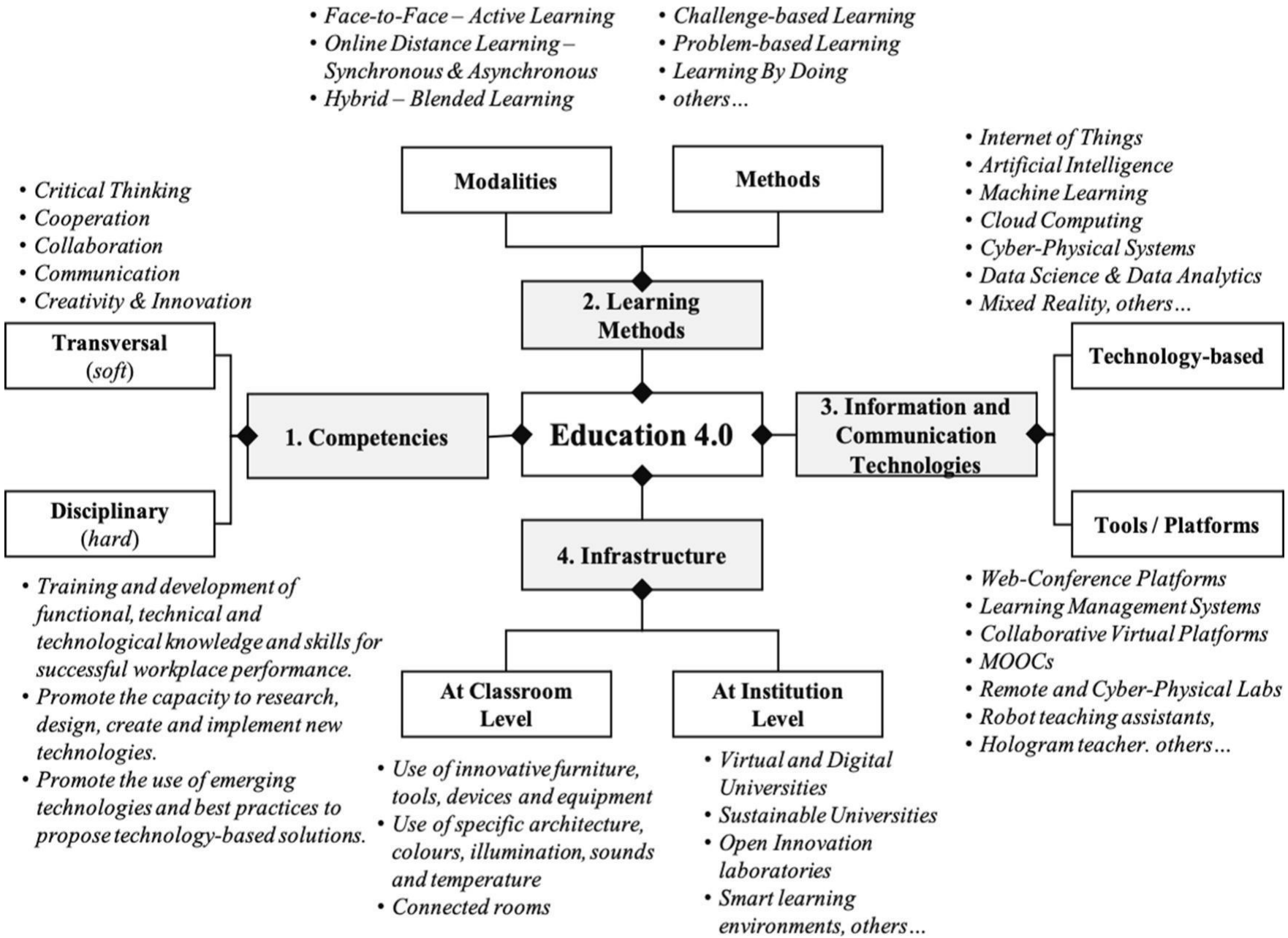


Paradigm shift in industry, education and operator (Bongomin, O., et al, 2020)

Paradigm shift in industry, education, and operator.

Industrial revolution	Education (r)evolution (methods)	Operator (r)evolution (techniques)
Industry 1.0	Education 1.0 (dictation and direct transfer of information)	Operator 1.0 (manual and dextrous work) (machine tools)
Industry 2.0	Education 2.0 (progressivism and openness to internet)	Operator 2.0 (assisted work with CNC)[1]
Industry 3.0	Education 3.0 (knowledge production and co-constructivism)	Operator 3.0 (cooperative work with robot)
Industry 4.0	Education 4.0 (innovation production and classroom replacement)	Operator 4.0 (work aided by human-CPS)[2]

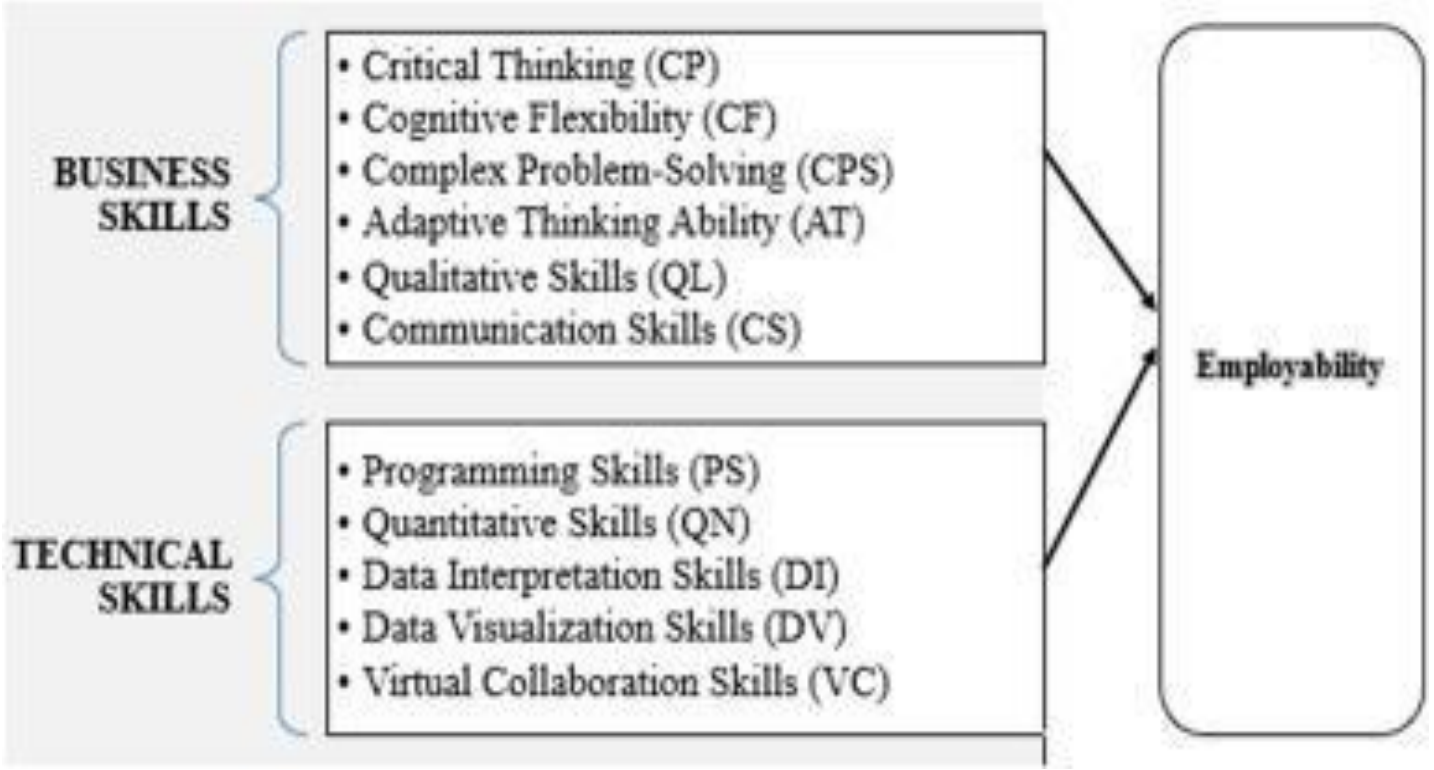
[1]CNC: computer numerical control and [2]CPS: cyber physical system. Modified from [219, 221–224].



(Miranda, J., et al, 2021)

Skill 4.0

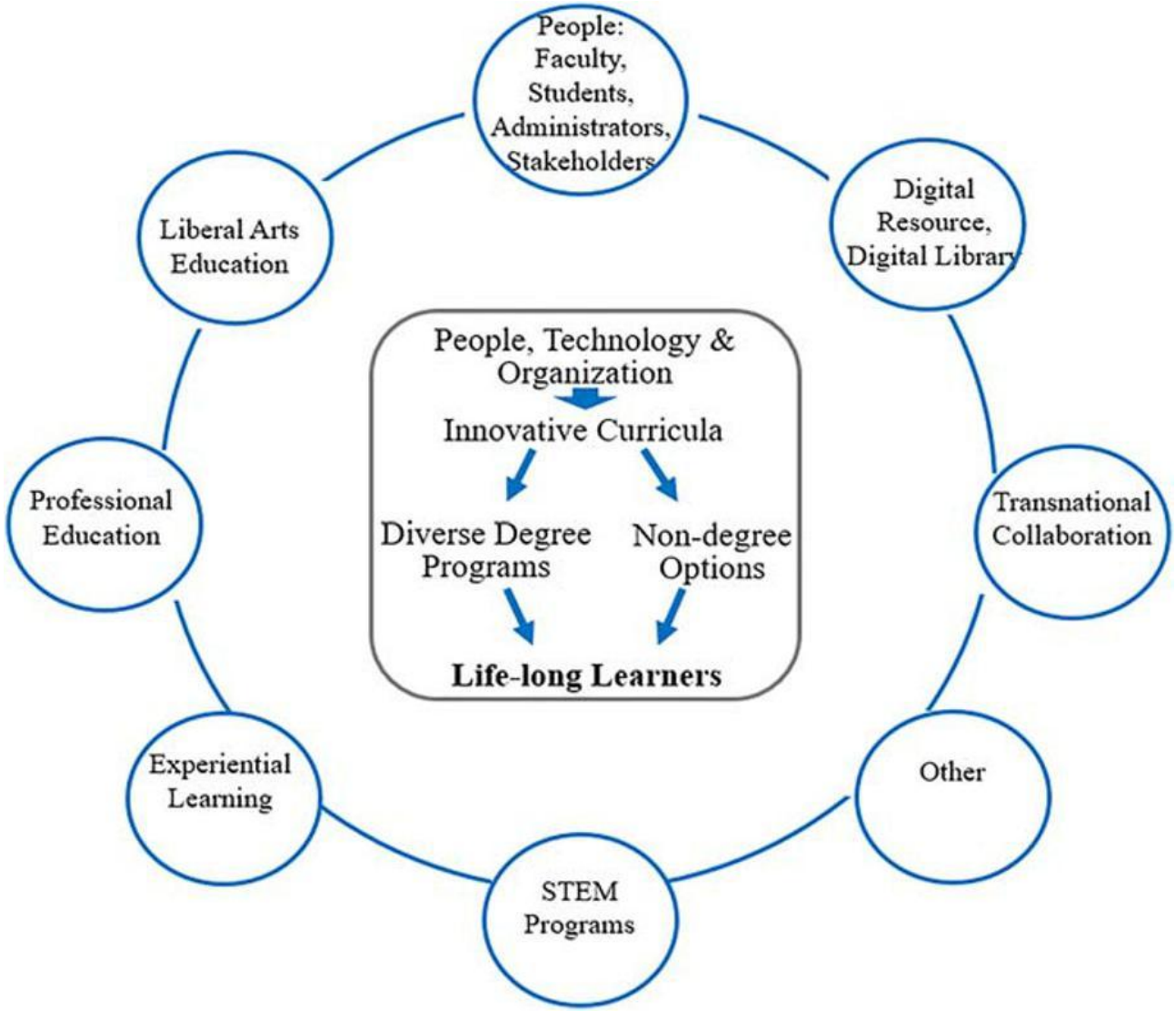
To deal with industry 4.0 one must have gained these skills at the time of their employment:
(Islam, M. A. (2022)



Industry based curriculum design

- **A system driven curriculum in the era of Industry 4.0**

(Li, L. (2020)



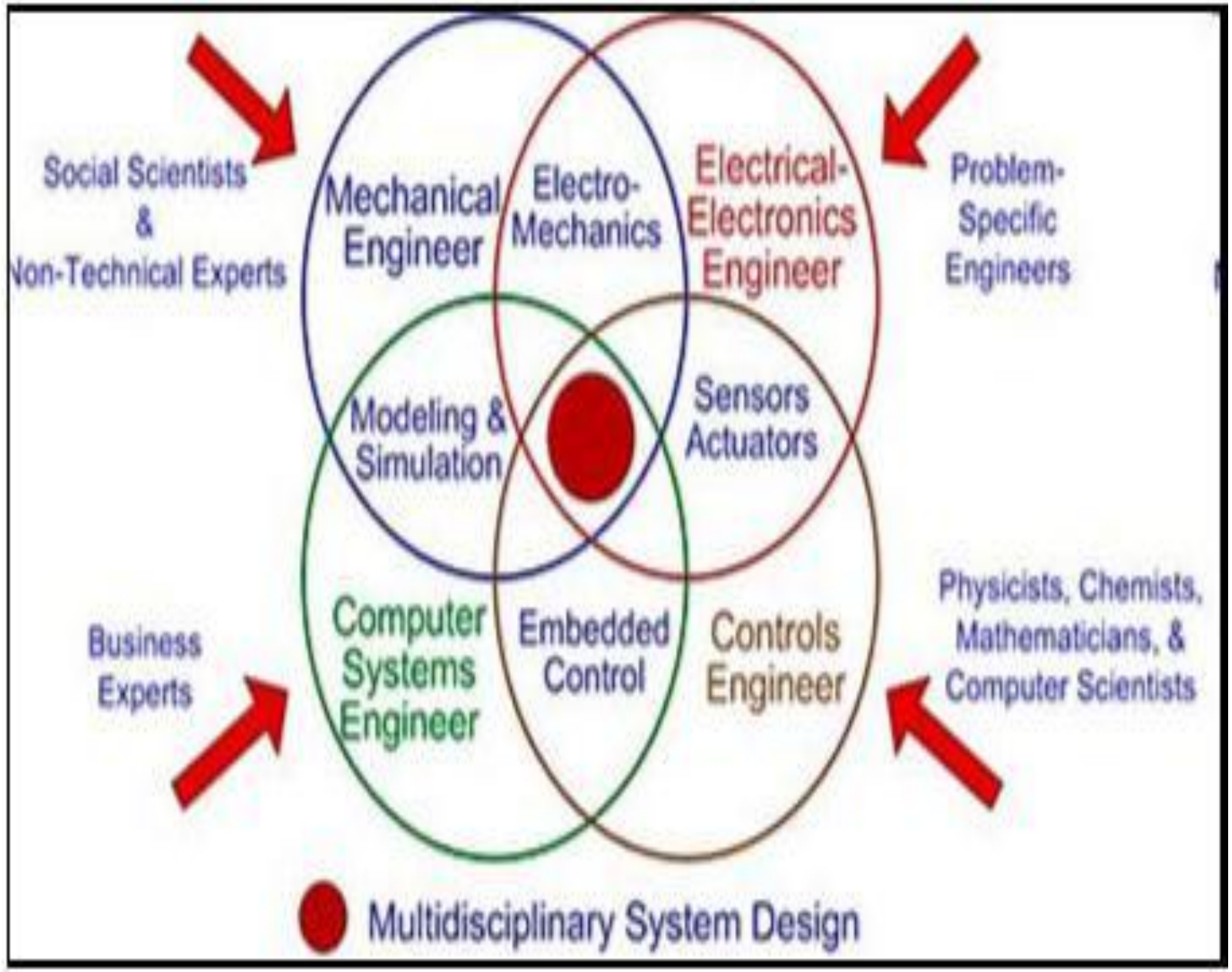
Strategies and programs to support industry-relevant skills of students

Key recommendations for knowledge transfer (OECD., 2019)

- OECD countries have implemented a variety of financial, regulatory and “soft” instruments to boost knowledge exchange between science and industry.
  - For instance: R&D and innovation grants, tax incentives with a focus on collaboration, and financial support to recruit PhDs or postdoctoral students, intellectual property (IP) rights regime, creation of spin-offs by researchers, and sabbaticals and mobility schemes for researchers, networking events, the development of guidelines, standards and codes of conduct.
  - New technological tools such as online communities of experts, open calls and crowdsourcing can be used

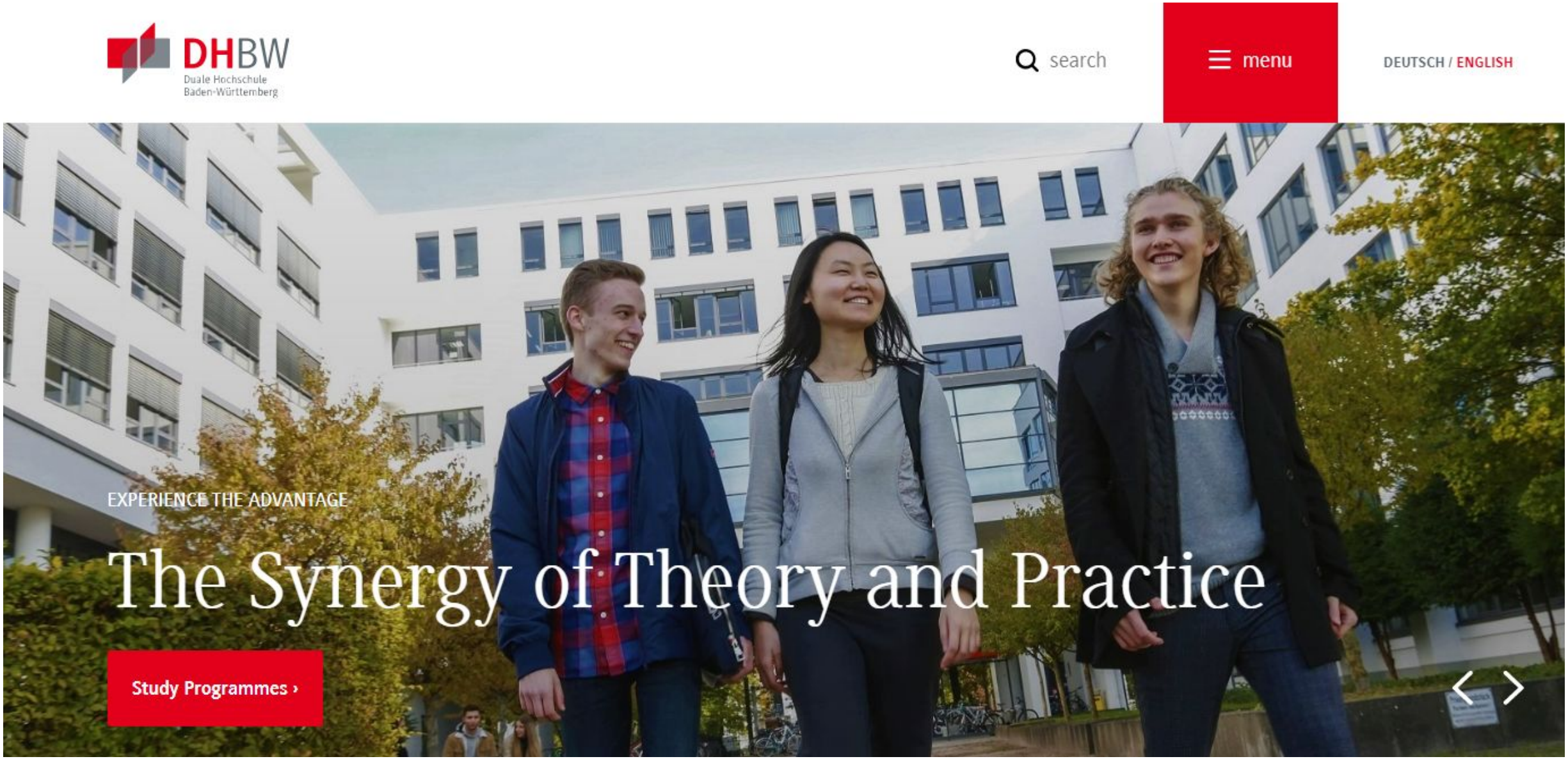
Multidisciplinary education for Industry 4.0

- Modern industries need specialists with skills across a variety of theoretical and practical disciplines. Today, advanced manufacturing incorporates knowledge of many different aspects of engineering to create complex intelligent systems
- Education institutions and universities have been urged to implement the methodology and elements of Industry 4.0 into the current syllabus to make sure that future graduates will not be taken by surprise with the evolving demands of the industry.
  - CPS are only one of important several current drivers of change in engineering education.
  - Multidisciplinary form of education requires changing the traditional way of teaching, launching new and modifying conventional courses to adapt them to the requirements of industry.
  - Changing the contents especially of basic courses such as Physics, Mathematics, Materials, Electronic, Electrical Engineering, but also Informatics an Communication Technologies.(Kozák et al., 2018)


Social Scientists
&
Non-Technical Experts
Mechanical Engineer
Electro-Mechanics
Electrical-Electronics Engineer
Problem-Specific Engineers
Modeling & Simulation
Sensors Actuators
Business Experts
Computer Systems Engineer
Embedded Control
Controls Engineer
Physicists, Chemists, Mathematicians, & Computer Scientists
Multidisciplinary System Design

- **Professional Education**: The role of professional schools is to equip our students with the skills and techniques that they can use to contribute to the economic development of the region, the nation and the world.
- Companies which are adopting digital technologies to realize Industry 4.0 are coping with how to upskill their current workforce and where to recruit new employees with the right skill sets.
- Diverse degree programs and non-degree certificates, seminars and short training courses can prepare our workforce to take on new job responsibilities made possible by Internet 4.0.

A very good example of last decade!



- **Baden-Wuerttemberg Cooperative State University (DHBW)**
- **is the first higher education institution in Germany to integrate academic studies with workplace training.**
- **Founded on March 1, 2009.**
- **Today the university continues to carry on the highly successful tradition of cooperative education.**
- **They have contract with about 9000 companies for joint program development**
- **The education program is developed jointly and according to the needs**
- **Almost half of the time the student have their class and their learning in the company**

The Virtual Collaborative Learning (VCL) Program of TU Dresden and Shiraz University (2018-2021)

- At first year, 15 Graduate Student from TUD, 15 from SU join the course based on a combination of Virtual, Multidisciplinary, Collaborative , Team based, Problem based Learning approach (working on finding solutions for a problem in an industry)
- Second year and third year, 10 from TUD, 10 from SU, and 10 from R&D of one large industry
- Chemical and Mineral - Iranian Industry
- Power and Energy Distribution Company of Iran

- With today platforms and experiences we all can do a lot!


Dr. Salimi

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Shiraz University

CERTIFICATE OF ATTENDANCE

This is to certify that

BAUDACH, PEGGY

successfully participated in the international virtual collaborative learning course

COLLABORATION IN THE VIRTUAL CLASSROOM

The course took place in the summer term 2021 and required approximately 150 hours of individual workload (5 ECTS).

Workload	• Kick-Off • Virtual collaborative case study group work online • Self-study and reflection
Objectives	In this course participants: • Gained knowledge about cross-cultural communication • Practiced collaboration in international virtual teams • Practiced collaborative problem-solving skills • Practiced English language for science and business • Applied theoretical knowledge in practical business situation • Learned to use Social Media for business oriented virtual collaboration
Activities	• Virtual team-building activities in a social network • Cross-cultural critical incidents analyses and development • Project management in virtual environment • Planning and organizing effective multinational virtual meetings
Outcomes	• Documentation of the collaboration process and results • Two presentations of self-developed project proposal • Self-reflection report on Collaboration in the Virtual Classroom

Prof. Dr. E. Schoop

Prof. A. A. Safavi, PhD

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COLLABORATION IN THE VIRTUAL CLASSROOM

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Prof. Dr. E. Schoop

Prof. A. A. Safavi, PhD

Strategies to joint master' thesis at companies, and project assignments

- **Set knowledge transfer policies that respond to industry and research needs (OECD., 2019)**

  - There is no "one-size-fits-all" policy approach to knowledge transfer.
  - The importance of specific knowledge transfer channels varies across countries, science fields and industry sectors, and over time with the maturity of science-industry linkages.

- Policies should support public research institutions in developing knowledge transfer activities that are aligned with their research strengths.

- Overemphasis on specific channels may neglect certain strengths, such as the potential to promote student entrepreneurship and academic spinoffs.

- Patenting and academic start-ups, while very useful for science-based sectors, are concentrated in leading academic institutions it is important that academic curricula are regularly revised to respond to emerging industry needs (e.g. strengthening digital skills, setting up more interdisciplinary programs).

- Policies should support strategic, long-term-oriented forms of co-creation.

- Policy initiatives relevant to co-creation include joint research laboratories, The two-way mobility of researchers across organizational boundaries (e.g. through industrial PhDs);

Channels for knowledge transfer (OECD. 2019)

(Formal channels)

- Collaborative research
- Contract research
- Academic consultancy
- Intellectual property (IP) transactions
- Research mobility
- Academic spin-offs
- Labor mobility

(Informal channels)

- Publication of public research
- Conferencing and networking
- Networking facilitated by geographic proximity
- Facility sharing between industry and public research
- Courses and continuing education

Examples of how several OECD countries have supported the development of joint research laboratories and public-private partnerships for co-creation include the following:

- The Catapult centers, launched in 2015, bring together businesses, scientists and engineers to work on late-stage R&D in strategic fields.
- Collaborative laboratories in Portugal (CoLAB), launched in 2018 (Encarnação, 2017).
- The French LabCom programme was launched in 2013.

- The Austrian Christian Doppler (CDG) Laboratories are established based on an industry challenge.

- In Hungary, the Centres for Higher Education and Industrial Cooperation (FIEK) programme (Hungarian National Research, Development and Innovation Office, 2019).

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