UNIVERSITIES OF THE FUTURE

Inspiring Practices *in* Education

from Industry 4.0 Perspective

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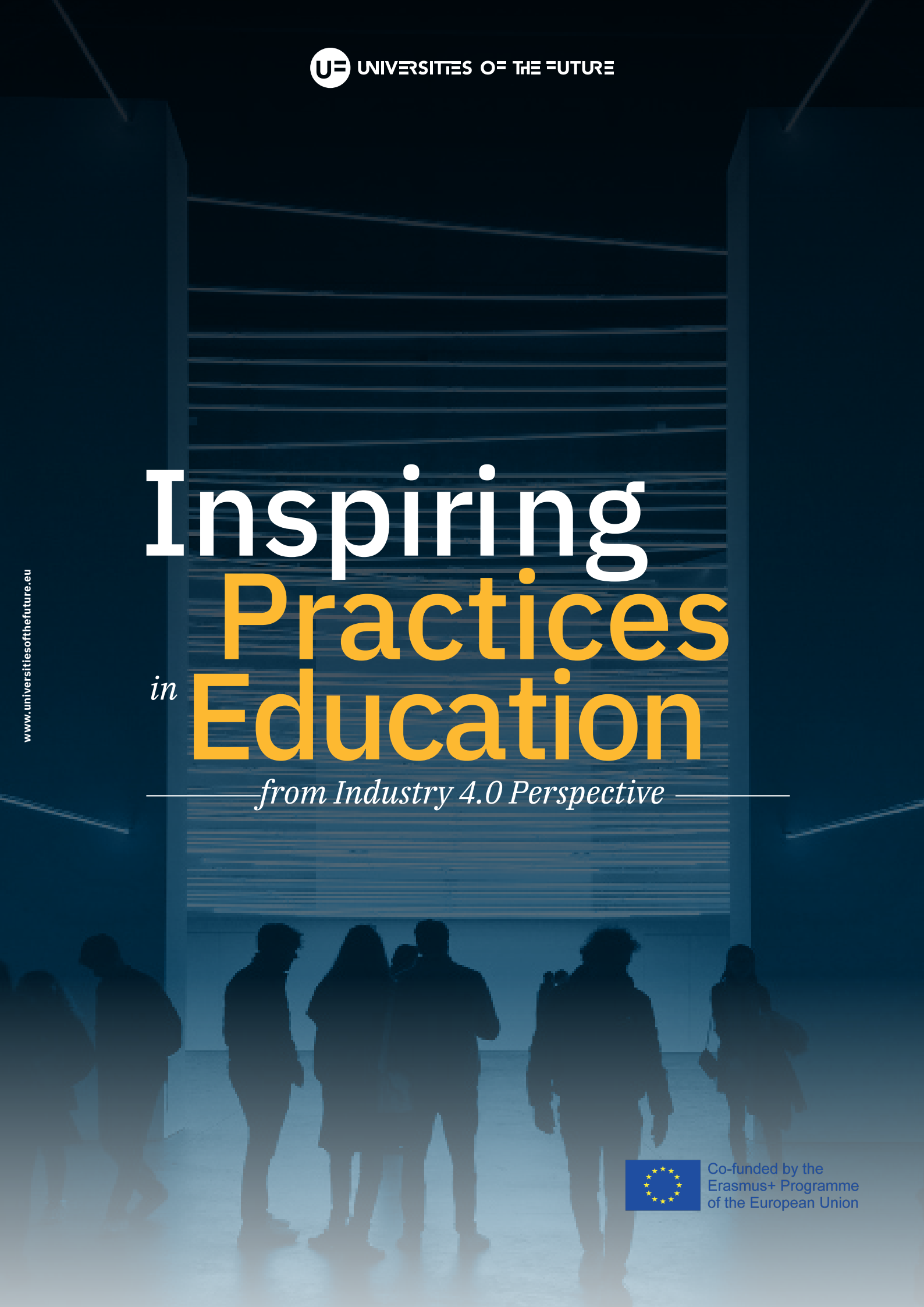

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1 Introduction

In this e-book, the reader can find selected benchmarks on educational good practices from Industry 4.0 perspective and a discussion on the possible implications for education. These and other inspiring practices are fully detailed in the Report on Best Practices, an outcome of the Universities of the Future Project (UoF).

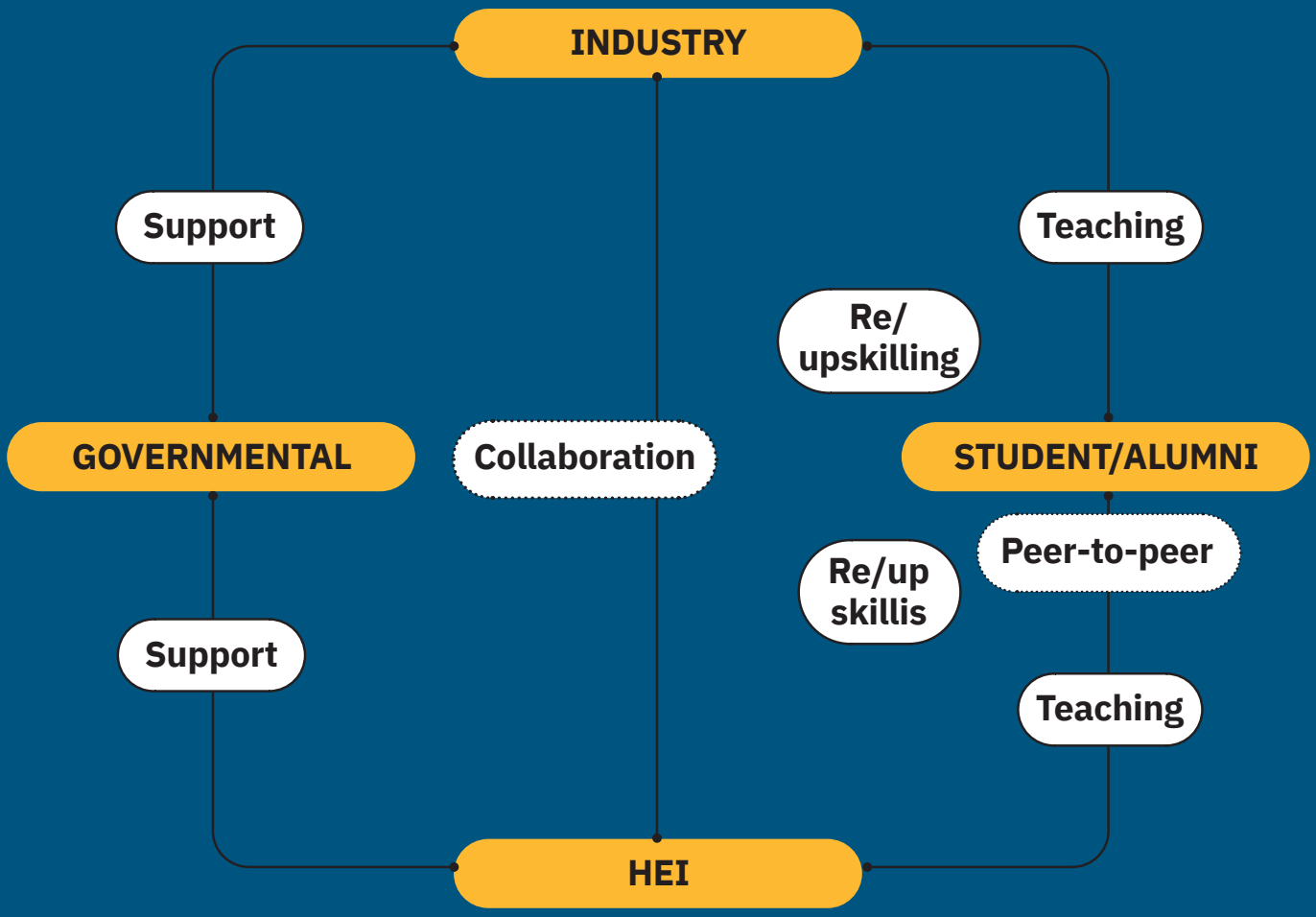
UoF is a Knowledge Alliance that gathers different players of the quadruple helix to act as amplifiers and connectors to the needs, concerns and expectations of the higher education communities (including students and alumni), industry, and policymakers. The Alliance is deeply committed to laying the foundations for the first movers in the upcoming industrial revolution and, together with the stakeholders, will co-create a multitude of ground-breaking educational resources, built on good practices and lessons learnt from good practices and collaborative work with different stakeholders.

This e-book gathers a set of benchmarks identified through a collaborative multicriteria approach. The consortium members invite the reader to explore these inspiring cases, which are grouped by the categories and subcategories to the left.

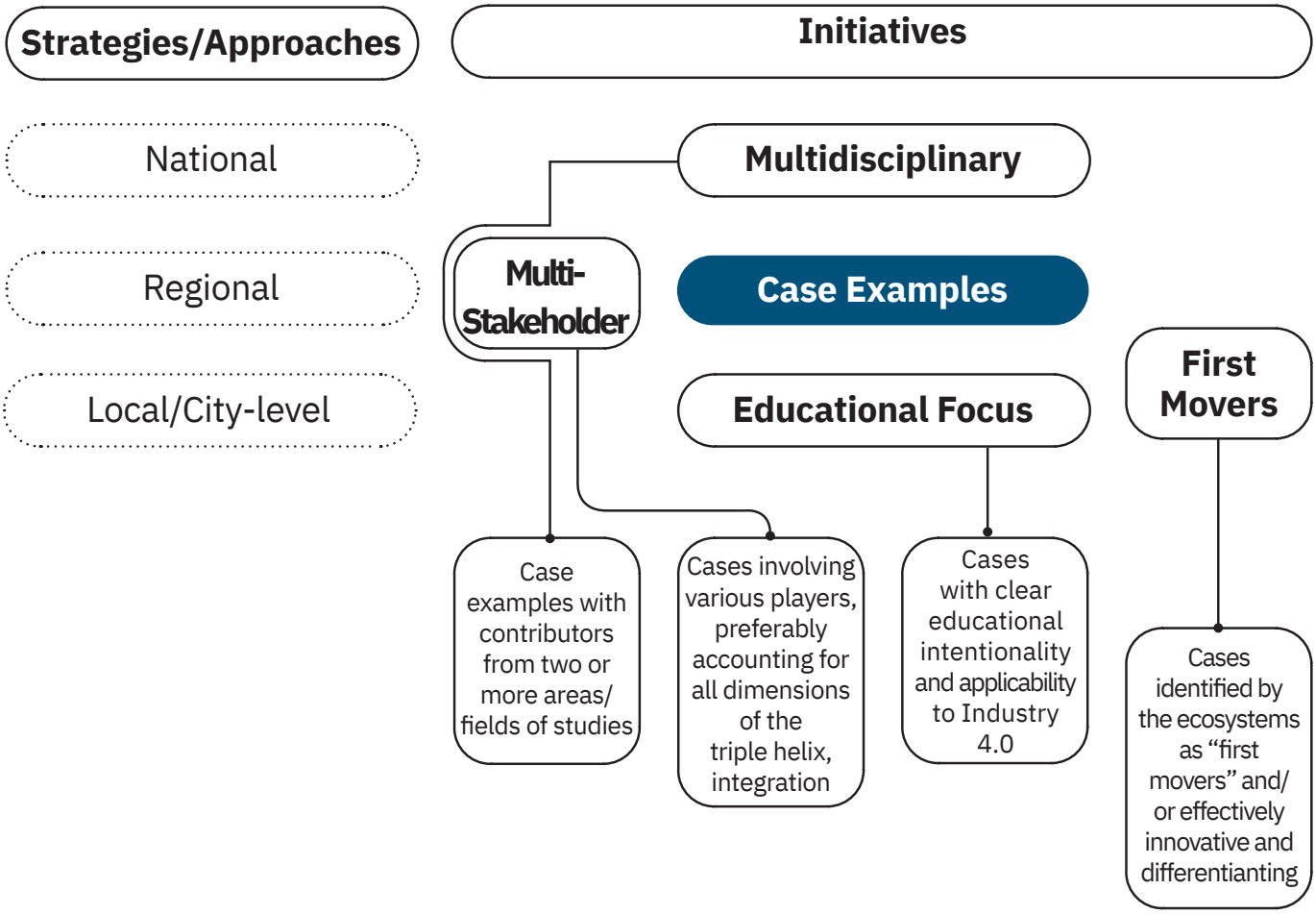
2 Methodology

The benchmarking process started by gathering information on potential cases, in order to understand the big picture of the current educational offerings and approaches from the perspective of Industry 4.0. The search proceeded with what was, in essence, a snowball sampling approach that was reflected in more than 50 interviews and 200 possible cases.

The initial listing covered different players and interactions.



Education-related case examples were prioritised according to their relation to Industry 4.0 and relevance for the project.



A list of additional attributes (namely linked to pedagogical trends and skills identified previously by the consortium[1]) was considered by the academic partners who studied the cases (Aalto University, P.Porto and Warsaw University of Technology) and ensured a holistic approach to the current world of education.

35 benchmarks were done and 15 are highlighted in this e-book. For a complete overview, the reader is encouraged to check the full report "Best practice in education from industry 4-0 perspective".

1 These trends and skills are summarised in the "State-of-the-Maturity of Industry 4.0" report, developed by the consortium and available at the project website.

3 Benchmarks

The cases described here are representative of a wide array of different educational components. They are divided into four categories according to their main responsible players: government, HEI, industry, or student/alumni, that are further divided into subcategories based on the types of initiatives covered.

Each benchmark includes an "INFO-BOX", that gives a short overview of the case. It lists all the players involved and all the applicable cases of a type of initiative. A short rationale why the case was selected is given as well as indications on what is taught, the level of multidisciplinarity, level of integration between players, and relation to Industry 4.0.

How to use the INFO-BOX?

Players Involved	Goverment	Industry	HEI	Students/alumni
Type	Workshop Course Programme Platform University	Network Training Company in the field of education Event	National strategy Re-skilling Up-skilling HEIs collaborating Industry-HEI	Collaboration Open education Free education E-learning Practical approach
Why?	Reasons that support the selection of the practice and its inclusion in the set of inspiring practices of the UoF project			
What is taught?	Tech	Business	Design	Soft Skills
Level of multidisciplinary	One discipline or several similar disciplines	Two or three disciplines		Four of more disciplines
Level of integration	One Player	Several players of one kind		Different kinds of players
Relation to Industry 4.0	Directly addressing		Addressing relevant skills	

Please note that while the benchmarks aim to be presented in an objective manner, they are based on the perspectives and information provided by the informants.

Governmental

National Strategy/Initiative

Finland's Strategy (Finland)

INFO-BOX

Players involved: Governmental
Type: Strategy
Why: Finland is known for its work on forecasting the future, and has set high goals for becoming a leader in Artificial Intelligence and in information policy, both relevant themes to Industry 4.0.
What is taught: tech, business, design, soft skills
Multidisciplinarity: Four or more disciplines
Integration: One player
Relation to Industry 4.0: Directly addressing

The transition of working life is seen as the biggest challenge in Finland. As work is changing, so are the needed competencies and education. Continuous learning is becoming a requirement, as skills need to be updated. In this benchmark, four different components are analysed, including, the National Transformation of Work Forecast, the Strategy for Artificial Intelligence, Finland's Information Policy, and the Future Review of the Ministry of Education and Culture.

The well-acknowledged megatrends are underlying the transformation of work. According to the Report on the Future, artificial intelligence is the biggest driver of change, as it generally moves the work people do towards highly specialized tasks, networked interaction and problem-solving. Finland has set becoming a frontrunner in applying artificial intelligence as a strategic goal. The technology is forecasted to have strong impacts on society as a whole, affecting all sectors. Finland's Age of Artificial Intelligence report outlines eight key actions to achieve this strategic goal.

The current Finnish government has a second aim: to become a leader in information policy. The information policy report on Finland's policy-level participation in the EU includes themes such as information security, data protection, gathering and combining of information, and information disclosure and storage.

The Future Review on education notes that even as the Finnish school system is excellent by international standards, there are signs of a lack of trust in the system. The system responds too slowly to changes in the future of work.

The main points of the strategy of the Ministry of Education and Culture are to raise the level of education to attract jobs to Finland. Providing possibilities for life-wide learning is seen as an important task in order to safeguard the possibilities against the threats the transformation of work and society create.

Key Takeaways

The Finnish strategy is based on the fact that society will change. The key strategic reactions are to focus on AI and information policy. The key actions are to increase cooperation between the private and public sector, and also within education. Fundamental ways in which HEIs can react to the changes include creating new degrees on emerging topics but also ensuring high-quality forecasting work together with relevant actors.

Indústria 4.0 (Portugal)

INFO-BOX

Players involved: Governmental, HEI, industry
Type: Strategy, re-skilling, up-skilling
Why: Portugal Indústria 4.0 is the Portuguese government national-level strategy to disseminate Industry 4.0 concepts and support Portuguese companies to become or/ and strengthen their role as international Industry 4.0 players, as well as to attract foreign investment to the start-ups and companies 4.0.
What is taught: Tech, soft skills
Multidisciplinarity: One discipline or several similar disciplines
Integration: Different kinds of players
Relation to Industry 4.0: Directly addressing

Portugal Indústria 4.0 is an initiative of the Portuguese government aiming to accelerate the adoption of Industry 4.0 by the country's business community.
The strategy was built using a bottom-up approach and is reflected in three main objectives and 64 measures, divided into six strategic pillars: HR training and upskilling; technological cooperation; i4.0 start-ups; financing and investment incentives; internationalisation; and legal and standards adaptation.
There is a strong focus is on HR training and upskilling, the pillar that gathers around 22 measures that are intimately articulated with Portugal INCoDe.2030, the public policy initiative put forward by the government to enhance the digital competencies of different age and social groups.
Although Portugal is seen as having the infrastructures and the innovation capacity needed to take a lead in Industry 4.0, digital skills have been identified as one of the country's main weaknesses. Altogether, Portugal is faced with the challenges of finding the skills it needs to deal with Industry 4.0 and effectively applying these skills.
The expected impact of the strategy is to position Portugal as an international key player in Industry 4.0 by raising awareness on this technological, economic and social transformation, and by providing the tools to upgrade the Portuguese industry, training the country's workforce, and

Key Takeaways

Portugal Indústria 4.0 is the government-led national strategy for boosting Industry 4.0 in the country. It encompasses measures pointed at the development of skills, new methods, and digital applications in key strategic sectors of the Portuguese economy. Its distinctive, and possibly replicable, factors are 1) the bottom-up approach to its design and implementation, with the direct involvement of companies, associations and public bodies, 2) a realistic assessment of the industries' needs, 3) the public-private partnership put forward to fund these measures and ensure their implementation, and 4) the selected management model, which is assured by a non-profit business association, with no physical office.

Competence Centres (Poland)

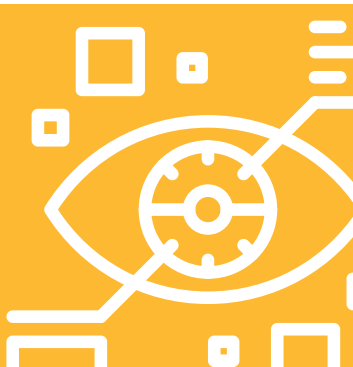
INFO-BOX

Players involved: Governmental, HEI, industry
Type: Platform, re-skilling, up-skilling, practical approach
Why: The competence centre is a central initiative (proposed by the Ministry), aimed at increasing the knowledge of entrepreneurs in order to transform industry in Poland.
What is taught: Tech
Multidisciplinarity: One discipline
Integration: One player
Relation to Industry 4.0: Directly addressing

In the era of the 4th industrial revolution, it is crucial for national economies that companies can to the changes fast.
The Platform for Industry 4.0 – Competence Centres – is an Initiative of the former Ministry of Economic Development (currently Ministry of Entrepreneurship and Technology), aimed firstly at identifying the potential of applying Industry 4.0, secondly making entrepreneurs aware of the existing opportunities, and thirdly a proposal tailored to the profile and needs of a specific company. Currently, there are three competence centres (Masovian, Silesian and Greater Poland Industry 4.0 Competence Centres) promoting Industry 4.0 technologies, supporting the assessment of the company's level of advancement, change of business models and integration of new technologies in the companies. These centres are investing in training staff and one of the major challenges is to provide teachers and lectures with access to up-to-date knowledge. The cooperation with the with the Ministry of Digitalisation is, therefore, of great importance.
Teachers and lectures (prepared by Warsaw University of Technology, Poznan University of Technology and Silesian University of Technology) are Industry 4.0 leaders and industry representatives can participate in different activities promoted by the centres (awareness-raising, promotional events, training courses, visits, etc.).

Key Takeaways

To be able to move fast to Industry 4.0, it is necessary to take measures both in educating university-level students and supporting companies. The competence centres provide an affordable way for participating companies to understand the concepts and to get moving towards Industry 4.0.



Higher Education Institutions

Workshop

D.school Pop-Outs (Usa)

INFO-BOX

Players involved: HEI, industry, student/alumni
Type: Workshop, event, industry – HEI collaboration, up-skilling, open education, free education
Why: The D.School Pop-Outs lower boundaries between different players
What is taught: Tech, business, design, soft-skills
Multidisciplinarity: Two or three disciplines
Integration: Different kinds of players
Relation to Industry 4.0: Directly addressing

D.School Pop-Outs (promoted at Stanford University) are short learning events organized outside the campus, typically over the weekend or over a few evenings.
These have some connection to design thinking but application areas vary from law to climate change to the ritual design, and everything in-between. The events have a workshop format, with some more theoretical perspectives or insights being applied on case studies or mini-projects by participant pairs or teams. Participants do not receive credits from the events, nor do they pay for participation.
The teachers are multidisciplinary teams or pairs, either faculty and staff from different schools, or a combination of staff and alumni working in other organisations. Potential teachers need to submit a proposal for the D.School on what they would teach and how, and Pop-Outs are selected based on the applications by D.School staff. The selected Pop-Outs receive a small budget for e.g. prototyping materials and refreshments. A typical teaching team would be two to four people. A typical workshop would have 20-40 participants and at least half the participants are Stanford University students. The rest of the spots are open to Stanford staff, visitors and the general public.
The different types of learning outcomes are: 1) teachers and alumni get to explore new topics together, and to test drive interest in and working with new methods in a very light manner; 2) participants learn development and design process skills and multidisciplinary content knowledge; 3) both organizers and participants get exposure to diverse perspectives, thinking and networks.

Key Takeaways

Pop-ups were initially offering a light way to expand the reach of the D.School on campus, offering students the opportunity to test new topics before committing to full-time courses. Pop-Ups were turned into Pop-Outs as an experiment to expand the capacity beyond the limited facilities at the D.School itself. They have been continued to-date with good experiences as they lower boundaries between disciplines and between the university and the local community and industry. They leverage alumni connections for cases and update alumni understanding operating mainly on a volunteer basis for both content and participants, with just a few coordinating resources.

Programme

Bachelor of Creative Intelligence and Innovation (Australia)

INFO-BOX

Players involved: HEI, industry, student / alumni
Type: Workshop, event, industry – HEI collaboration, up-skilling, open education, free education
Why: The D.School Pop-Outs lower boundaries between different players
What is taught: Tech, business, design, soft-skills
Multidisciplinarity: Two or three disciplines
Integration: Different kinds of players
Relation to Industry 4.0: Directly addressing

The Bachelor of Creative Intelligence and Innovation (BCII) is a double degree programme at the University of Technology Sydney. After the students have completed their three years long core degree, they do a fourth year to earn the BCII degree, during which the students do courses and two internships. The final year is transdisciplinary, meaning that different practices connect, as opposed to multidisciplinary when different disciplines are applied in one project.
BCII teaches students to deal with newness and complexity using problem-solving approaches from different disciplines in multidisciplinary projects. The students are taught methods and practices that have been collected from and articulated by all of the different faculties of the university. The importance of reflection is emphasized, the students needing to get the aha moments for themselves rather than having faculty spell out the purpose straight away. The definition of creative intelligence is to be able to critically look at the practices one uses.
Different faculties lead during each winter and summer school. The fourth year is a combination of transdisciplinary education and confrontation with the outside world through internships. The internships and capstone project can be combined in start-up initiatives, and the internships can be international. The other courses are to organise a symposium and to find one's own position in the field through reflection. As the industry has been enthusiastic in collaborating with the bachelor's degree, a master's level programme is being developed utilizing microcredits for groups of employees to pursue jointly. Here one of the guiding principles is that everybody teaches, both faculty and the students of the programme.

Key Takeaways

Innovation happens between disciplines. Well-equipped students and industry collaboration can become a virtuous cycle which increases the demand for new types of teaching amongst faculty, students and industry alike. Collaboration can also become even more of a bidirectional learning experience with the help of microcredits, which have been established in Australia as a new way of achieving education through smaller increments of weekend courses or other small learning packages, allowing a more flexible combination of work and studies than traditional degrees. This model could help solve a part of the challenge to upskill employees.

SWitCH() (Portugal)

INFO-BOX

Players involved: HEI, industry, governmental
Type: Programme, course, re-skilling, industry - HEI collaboration
Why: An innovative approach to workforce reconversion/re-skilling, aimed at facing labour shortages in the IT sector and favouring the professional integration of qualified youngsters
What is taught: Tech, soft-skills
Multidisciplinarity: Two to three disciplines
Integration: Different kinds of players
Relation to Industry 4.0: Directly addressing

SWitCH() is a re-qualification programme for those who want to acquire competencies and skills for integration into the job market as IT professionals.

The programme applies agile practices and learning interactive processes to provide its students with a solid, yet fast, comprehension and application of software development skills. Students are graduates with or without a STEM background.

SWitCH(), which results from a partnership between an HEI (ISEP, Polytechnic of Porto's School of Engineering) and an association of IT companies (Porto Tech Hub), is a two-year training programme, with one school year and one year of paid internship in an IT company.

SWitCH() presents itself as an innovative programme. Each semester is structured around three simultaneous courses: a core software engineering and programming course; a technical course covering key supporting technologies and competencies; and a project course to develop a product for a client. Pedagogical principles include the careful application of selected active learning pedagogical patterns and PBL; learning by example and learning by doing; teamwork and peer-learning; continuous feedback; and a strong focus on the quality of the work being done.

By the end of this training programme, students should be able to understand and apply an iterative and incremental/agile development process, by analysing the requirements of a problem presented by a client and, as a team, specify a solution; designing the solution using appropriate architectural and design patterns; and implementing the solution in Java/JavaScript using Test Driven Development (TDD) and Continuous Integration (CI). Students should also be able to know and apply the essential technologies and best practices to be productive in an OO (Java) or web development team using CI.

Key Takeaways

SWitCH() points out the virtues of the interaction between HEIs and companies, both for the actual structuring and development of learning processes, the marketing of these type of initiatives, and the delivering of real career prospects to participants (through paid internships in solid, and growing, companies).

Waterloo Co-op Programme (Canada)

INFO-BOX

Players involved: HEI, industry
Type: Programme, industry - HEI collaboration, practical approach
Why: The Waterloo co-op programme ranks among the best in the world
What is taught: Tech, business, design, soft skills
Multidisciplinarity: One discipline
Integration: Different kinds of players
Relation to Industry 4.0: Addressing relevant skills

The University of Waterloo is well-known for its world-leading cooperative (co-op) programme. All the engineering programmes at the university are co-ops, and all the other five faculties offer a form of the co-op. Normally co-op students start with an academic term and then go to work in a job that is relevant for their studies. As students go through co-op they complete personal development programmes designed with employer input and delivered as accreditable online courses. After the students finish a co-op term, they write a reflection paper on what they learned. The differences between co-ops in different faculties relate to the sequencing of the terms and when the first co-op term is done. Common to all is that students must end with an academic term.

In a co-op programme, the aim is to do five co-op terms. Usually, the terms are 16 weeks long with a minimum of 12 weeks, and all of them are accredited.

Co-op requires the employer to give some form of remuneration, that can either be a salary or covering of travel, housing or meal expenses. The students graduate one year later than undergrad students normally, taking five years to complete their studies. However, at the time of graduation, they have up to two years of relevant work experience, from different industries and employers. This is positively reflected in their employability and earnings when they enter the workforce.

Co-op is a major part of the entrepreneurial ecosystem in the area. Founding a start-up and developing a business plan counts as a co-op term. If the student wants to move further, the university has an incubator, and if the business starts getting traction, the student can take their business even further to the university's accelerator.

Key Takeaways

The co-op model seems to be mutually beneficial to students and employers. Even as it increases the time before graduation, it accelerates the beginning of a career through supporting students in identifying their preferred jobs and giving them the skills needed in a workplace. The co-op programme also supports the students in applying their theoretical knowledge in practice already during their studies.

The University of Waterloo co-op programme is internationally recognised as one of the best. However, the model requires a large staff working on co-op and experiential learning, which in turn requires considerable financing. The co-op model is used at different universities across the globe, but to make it as good as it is at Waterloo might be extremely challenging in places where funding is hard to come by.

Platform

Learning Factory (Germany)

INFO-BOX

Players involved: HEI, industry
Type: Platform, workshop, course, training, industry - HEI collaboration, up-skilling, free education, practical approach
Why: The Learning Factory represents an established way of teaching factory production, and is preparing students and industry alike for Industry 4.0
What is taught: Tech
Multidisciplinarity: Two to three disciplines
Integration: Different kinds of players
Relation to Industry 4.0: Directly addressing

Learning factories are innovative institutions that develop a variety of skills using realistic factory environments for hands-on practical learning of manufacturing engineering competencies and knowledge acquisition. Students there can develop process improvements and see the results in real life.

The learning factory Centre for Industrial productivity (CIP) is oriented to teaching process optimisation and focuses on the application of lean methods, digitalisation and Industry 4.0. The research group carrying the same name, CIP, works mostly with the learning factory and manages it. The learning factory and the research group are educational and research initiatives within PTW Dosimetry at Technische Universität (TU) Darmstadt, which is one of Germany's leading technical universities.

The learning factory is essentially a fully functioning factory that assembles products, but instead of selling them they are disassembled back to parts so they can be used in future training. During workshops, the factory can be set in a "bad state", that the participants then improve. The learning factory forms a unique environment for learning, with educational offerings for students and companies. The methods are learned through active participation and applied directly to ensure a sustainable transfer of knowledge.

For university students, the learning factory offers bachelor's and master's thesis opportunities, student assistant positions and courses.

The industrial partners join for at least three years, during which they can send their employees to workshops on lean production. The trainers at workshops are research assistants working at CIP.

The CIP does research regarding learning factories themselves and uses learning factory as a validation environment for lean research.

Key Takeaways

Learning factories are an established way of teaching, that still need to improve and evolve constantly. During the past three years, CIP has been moving from the brownfield approach, meaning improvements to an existing factory, into implementing Industry 4.0. The task is still ongoing. Even though the learning factory CIP has good resources, it is taking considerable time and effort to create a factory of the future. This implies that in a world of fast technological advancements it is crucial to be able to forecast the future and to take decisive steps early on in order to keep up with technology. Doing this requires active collaboration with industry and often government funding.

In terms of learning, being able to implement theoretical knowledge in practice seems to work well for helping the learner to retain the information and to gain the self-confidence they need in order to take their learnings to the real world.

Design Factory Global Network

INFO-BOX

Players involved: HEI
Type: Platform, course, event, industry - HEI collaboration, practical approach
Why: *Network of interdisciplinary innovation platforms in universities and research institutions on a mission to drive educational change through passion-based learning.*
What is taught: Tech, business, design, social skills
Multidisciplinarity: Four or more disciplines
Integration: Several players of one kind
Relation to Industry 4.0: Addressing relevant skills

Design Factory Global Network (DFGN) is a network of interdisciplinary innovation platforms in universities and research institutions. Currently, there are 24 (as on Nov 2018) Design Factories on five continents. DFGN is on a mission to drive change in the world of learning and research through passion-based culture and design-driven problem-solving.

Design Factory as a concept is all about sparking and supporting collaborative creativity and innovation across borders, be they organisational, disciplinary, or cultural. Shared understanding and common ways of working enable Design Factories in the network to collaborate efficiently across cultures, time zones and organisational boundaries fostering creativity. Design Factories bring together research, students, business practitioners and other stakeholders not only to promote a new learning culture but also for opportunities for continuous experimentation. For students, they provide empowerment through hands-on learning experiences in real life challenges along with support for pursuing one's own ideas and passion projects. For the industry, NGOs and other stakeholders, Design Factories offer an environment for co-creation with leading scholars, top future talent and other operators in the ecosystem. Researchers have the opportunity to conduct interdisciplinary research together with industry partners.

Learning from and with other members of the network is a key reason for its existence. The International Design Factory Week (IDFW) is the annual opportunity for the members to meet, plan for collaboration, share and learn more about the best practices in the network. IDFW is also the main platform for decision-making for the network.

Key Takeaways

DFGN exists to support institutions in creating change. The main goal is in the community of practice of people who have a similar vision of how to support innovation. Most use a user-centred approach but also emphasize the value of the culture and environment that nurtures innovation. Shared ideology, passion and principles are a more important uniting force than certificates, formal structures or visual appearances.

Network

Finnish Institute Of Technology - FItech (Finland)

INFO-BOX

Players involved: Governmental, industry, HEI
Type: Network, HEIs collaborating, industry - HEI collaboration, re-skilling, up-skilling
Why: FITech has been able to quickly respond to a need, that is forecasted to grow in the future
What is taught: Tech
Multidisciplinarity: One discipline
Integration: Different kinds of players
Relation to Industry 4.0: Addressing relevant skills

FITech is a network university aiming to increase university-level technology talent in southwestern Finland. The educational offering is designed to match the need-forecasts of local industry, which is radically different from the traditional way of planning an educational offering at universities. FITech wants to serve the needs of industry, so TEK, the association for university students and graduates in technology, and Technology Industries in Finland were invited as founding partners as they can bring necessary insights.

FITech has two ways of addressing the needs of industry in southwestern Finland, educating new talent and attracting existing talent to the region.

The majority of the operations of FITech are within universities, which produce different learning packages. They are either combinations of existing education or completely new courses.

The goal of FITech is to provide education that fits the needs of industry, and Technology Industries in Finland has a good understanding of the needs.

Industries are involved in several ways. In the executive board of FITech there is a representative from four local companies, including the chairman of the board. The partnership models between universities and industry are traditional, like course projects for industry and master's thesis positions. However, FITech aims to support the companies in building connections also to universities outside the region.

Key Takeaways

FITech is also proof that several universities can divide the work and collaborate. That collaboration could be taken even further. FITech was able to start its operations extremely fast. This has been possible due to the approach of doing and planning simultaneously, unlike the traditional model of planning first and then doing.

Industry

Learning platform

Futurice (Finland)

INFO-BOX

Players involved: Industry
Type: Platform, up-skilling, open education
Why: Futurice has an excellent reputation in educating their own employees. They also have an ambitious goal to become the ultimate learning platform.
What is taught: Tech, soft skills
Multidisciplinarity: Two to three disciplines
Integration: One player
Relation to Industry 4.0: Addressing relevant skills

Futurice is a software consultancy company that has expanded its scope to include consultation on digital services. The company wants to become the ultimate learning platform by 2023. In Futurice more of the learning happens in the informal settings, for example, employees who are experts on certain topics get together in teleconferences to share their learnings from their projects.

Futurice often uses new tools and programming languages for their projects, which supports employee learning. This does not necessarily mean that the newest tools are always chosen, but at least Futurice is not stuck with legacy coding, which means using the tools they have gotten excellent with.

The budget for teaching/training at Futurice is large. There are direct costs related to getting educated outside. In-house education is not shown in the company budget. The budget is divided into two, a top-down led budget is used to identify development areas and provide education within them, and almost half can be used freely by the employees. If an employee feels they need an education that the company does not offer, they are free to use the company education budget to get the training. Futurice has not limited it's teaching to own employees. They have a lean service framework, which they teach in-house and also organize free open events, for example to their clients and the general public. Futurice also organises paid project business teaching to their clients.

One concrete learning practice that Futurice has, which has also been copied in other companies, is their Spice Programme. The idea is that Futurice pays its' employees if they do open source contributions during their free time. There are no strings attached, meaning that Futurice does not have to be mentioned and gets no IPR. The Spice programme is a part of Futurice's social responsibility programme but also encourages learning experiences for employees.

Key Takeaways

Lifelong learning can be said to be a trend, and on fields that rely on the expertise of their employees, it is crucial to attracting the best people. As an opportunity to learn is becoming an important criterion for job seekers, it is important for companies to be able to provide that. Futurice's vision is further testament to the need for deeper collaboration between educational institutions and companies and the ever bigger role that companies play in educating their employees.

Company in the field of education

Founders And Coders (UK)

INFO-BOX

Players involved: Industry
Type: Company in the field of education, re-skilling, programme, free education
Why: There is a blooming scene of coding boot camps, and Founders and Coders represents them and peer-to-peer teaching
What is taught: Tech, soft skills
Multidisciplinarity: One discipline or several similar disciplines
Integration: One player
Relation to Industry 4.0: Addressing relevant skills

Founders and coders (FaC) is a non-profit coding boot camp and a community based on peer-to-peer learning. They have a strong emphasis on cooperation and are engaging students and alumni in running of the organisation. FaC teaches tech skills, mostly computer programming, but also broadly entrepreneurial skills.

The original motivation behind FaC was that the founder, Dan Sofer, wanted to study himself and make use of the online learning material that was emerging five or six years ago, like Coursera and EdX. He soon realised that learning alone was tiring, so he started organising meetups, but the space was not ideal, so Dan started to look for a space and was offered a classroom for the whole day permanently for a number of months. This sparked the idea to do a full-time coding boot camp based around using online learning materials. That was the first version of FaC.

FaC relies heavily on peer-to-peer teaching, there is no paid teaching staff. The staff gives the tasks and a starting point, but the rest is up to the students. They need to research on the internet and figure the tasks out by themselves. The tasks are done as pair coding, and best practices are taught. If the students get stuck, it is possible to get support from mentors, who are mostly previous students.

FaC also offers a programme for graduates, in which they work for charities or other social impact causes for a small recompensation. The social impact work is not limited to software, but FaC does training as well to support understanding the role of a product owner, user research, and user testing.

FaC is similar to other coding boot camps. The main differences are, that instead of lectures there are workshops and that it is a free programme at the point of access. They have a student agreement in which students are asked to support the programme by donating their time or money, but there is no contractual obligation to do so. FaC also gets a recruitment fee if one of their students is hired in a partnering company. The model is based on the low cost of delivery, peer-to-peer learning only with no paid staff, as mentors are volunteers.

Key Takeaways

Founders and Coders is about individual empowerment within the context of a community. More than anything, they are offering choices to students to do the right thing and to make a positive contribution to the world, without having to compromise their own economic choices. Today's students seem to prefer hands-on and fun ways to learn, which FaC provides through projects and peer-to-peer learning. Being able to make a contribution to society is also an important factor in making education attractive.

Singularity University (USA)

INFO-BOX

Players involved: Industry
Type: Company in the field of education, platform, up-skilling
Why: Singularity University is an established and respected private player in the field of education, that has proven the value of a degree that is achieved outside traditional institutions. In a sense, they are largely crowdsourcing academics through their extensive network
What is taught: Tech, business, design, soft skills
Multidisciplinarity: Four or more disciplines
Integration: One player
Relation to Industry 4.0: Addressing relevant skills

Singularity University (SU) is best described as a think tank, rather than a university. SU brings together people from different disciplines including tech and social sciences, to teach them about the future. They organize events, academic programmes, and seminars, and have become a major player in the futures discussion globally. The speakers come from a wide range of backgrounds and represent different opinions, but generally, the place is "a mind-blowing, rattling place".

The global solutions programme (GSP) is the flagship programme of SU. In GSP the lecturers and participants look into how to tackle the world's biggest problems over the course of ten weeks. Each cohort has roughly 80 participants, and over 100 staff members and visiting lecturers. There are no exams, but the students receive an official certificate for participation.

During the GSP students go through global challenges and what needs to happen in order for the global society to move forward, for example on food equality, learning, or electricity. These global challenges have been identified by the United Nations. When learning about new technologies a guru from the field presents what has been done and what will be happening in the field. Personal development and growth are learned through workshops in small groups, for example, a diver teaching on using your full potential. There are also guest lectures given by for example authors, who want to share their own learnings. During the course feedback is gathered after every lesson, in which the students can have their say on the contents of the rest of the programme. The staff also includes two psychologists who support the students in their learning journey and on any personal issues that might emerge.

Other programmes include the Launchpad, a programme for graduates from GSP, that lasts for 8 weeks. During it students start their own companies. SU also organises different kinds of programmes for executives, that run with a pay to participate model, but are open only to executives of large corporations. In addition to programmes and courses SU offers summits and events, for example the yearly Global Summit in San Francisco that gathers together thousands of people.

The teachers at SU are members of a strong and wide network, who are accomplished in their respective fields. The lecturers have been handpicked from companies like Google, and the permanent teachers have done a career in their field and decided to move on to teach at SU.

Key Takeaways

The core of SU is in the excellence of people it brings together. Those people form lasting bonds and create new companies, that help solve some major issues globally.

Student/Alumni

Course

BEST – Board Of European Students Of Technology – Courses (Europe)

INFO-BOX

Players involved: Student/alumni, HEI, Industry
Type: Course, event, HEIs collaborating, industry - HEI collaboration, up-skilling
Why: The concept of BEST courses is an example of industry/HEI/student collaboration directly related to Industry 4.0 technologies
What is taught: Tech, soft skills
Multidisciplinarity: One discipline
Integration: Different kinds of players
Relation to Industry 4.0: Addressing relevant skills

BEST Courses are short courses, organized by students for students in collaboration with their local universities and local companies. Their purpose is to complement student knowledge in different fields of study, visit companies, industrial plants and research centres, and take part in case studies. The courses are designed to be multidisciplinary, and classes can cover material of the chosen topic from many different viewpoints: Different technology fields, economical viewpoints, marketing and management. Students often receive ECTS credits from the courses as the academic content is covered by the local university's teaching staff or by experts from companies. At the end of the course, students take an exam, which is designed to evaluate the participant's success.

Each year around 100 courses are organized by different student groups all around Europe and the rising number of new local BEST groups is a marker for the growing demand for the services of BEST. Subtypes are BEST Courses on Technology, BEST Courses on Career-Related Skills and BEST Courses on Applied Engineering.

Key Takeaways

What makes BEST courses an interesting approach is that the courses are organized on the initiative of the students: The students can decide the topic that they find relevant and collect academic professionals and companies together to form the academic content. The courses work outside normal university curriculums and are thus not limited by the academic restrictions of the local universities. The courses also compete against each other in the number of applicants: This "property" creates a self-fixing system of education. In order to gain applicants, the courses must be attractive, relevant and the local groups must have a good image on the international level.

In addition to the hard skills learned, the courses create international mobility, exchange of knowledge and international career opportunities for the students. It also creates collaboration with all of the relevant stakeholders: Students, companies and higher education institutions.

Event

Dare to Learn (Finland)

INFO-BOX

Players involved: Student/alumni, HEI, Industry
Type: Event, platform
Why: Dare to Learn represents an ambitious effort to spark discussions across the globe and to incorporate lifelong learning in a culture
What is taught: Soft skills
Multidisciplinarity: Four or more disciplines
Integration: Different kinds of players
Relation to Industry 4.0: Addressing relevant skills

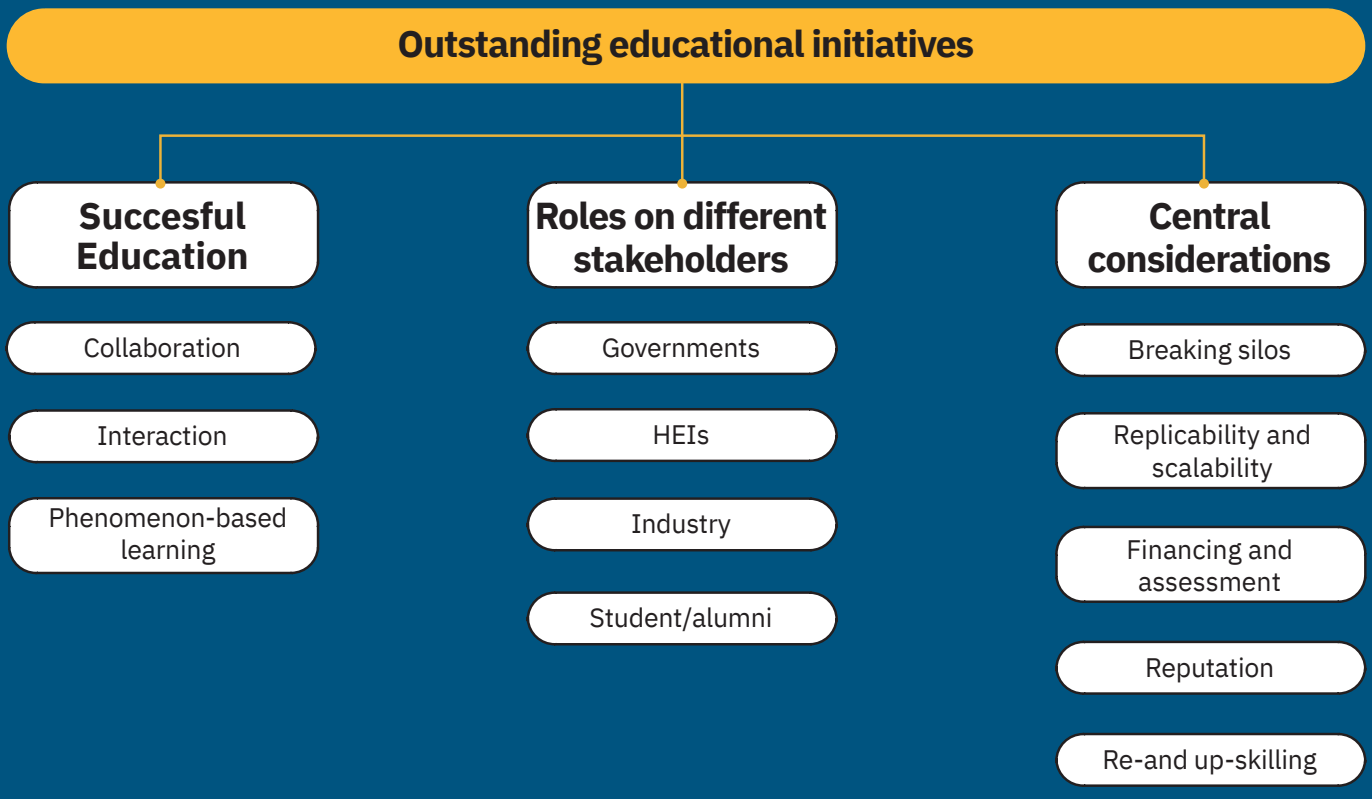
Dare to Learn is an international non-profit event organised in Finland. It is also a platform for organising events and people together to let new ideas formalize. Their sole focus is on learning and letting different viewpoints meet. The event brings together different actors of the learning sector, to engage them and let them learn from each other.
The organisers themselves act as facilitators, giving the opportunity for people in the field to network, meet and discuss important matters. Most of the organising at the event itself is done by volunteers, which is a good way to learn soft skills. The Dare to Learn team consists of young people and students who are given responsibilities that increase their personal development and empowers them to become young professionals wanting to change the world. The event consists of keynote speeches and activating workshops, that gives an even better opportunity to solve problems and discuss issues deeper. Edtech start-ups can buy booths to present themselves and there are side events supporting, like the Higher education hackathon coordinated by LINKO.
Anyone interested in learning can come to Dare to Learn. The event welcomes learning enthusiasts from all industries and walks of life, the whole point is to mix people usually working in their silos.

Key Takeaways

Much is happening in education around the globe, from Edtech start-ups to MOOCs to traditional HEIs re-inventing themselves. There is great potential in bringing together people with different expertise, experiences and backgrounds.

4 Lessons Learned From The Benchmarks

Benchmarking of the 35 outstanding educational and Industry 4.0 related initiatives across the globe indicates that education is increasingly taking place outside the traditional systems, with more peer-to-peer initiatives, private companies focusing on education, and new types of educational models emerging. In the coming years, high-quality education can be provided with a wide array of different approaches that deviate from the traditional classroom setting. Consequently, the use of interactive approaches, such as peer-to-peer learning, is likely to increase. Governmental, industry and higher education representatives interviewed for the benchmarks widely agreed on the need to add more flexibility to the current educational offering and to increase the degree of student-centeredness in teaching.



Shared elements of the benchmarks included collaboration across disciplinary, cultural, and institutional borders. In addition, an increased need for interaction was an overarching theme; Almost all cases highlighted people as the key ingredient and peer-to-peer learning was common. Majority of the benchmarks also identified people-related skills, like multidisciplinary teamwork, as a central learning outcome. Further, applying elements of phenomenon-based learning was highlighted as a way to support deep learning for Industry 4.0.

Different stakeholders seem to occupy different roles in facilitating learning around the emergence of Industry 4.0. Governments were reported to create strategies and support initiatives for adopting Industry 4.0. Governments support local companies in their transformation towards Industry 4.0 and act as initiators for multi-stakeholder collaboration. The industry is putting effort into up-skilling their personnel and creates open access course material both on their own and in collaboration with higher education institutions. Higher education institutions were seen as "hosts for learning", well positioned to act as bridge-builders between different stakeholders. One of the growing stakeholder groups is private educational players. Also student and alumni organisations create new initiatives to accelerate learning in areas where the formal educational system is lacking behind.

Some challenges were pervasive in the benchmarks. While collaboration was identified as one of the key success factors, breaking the silos was also highlighted as a challenge. High quality education was often difficult to replicate or scale. When creating new types of educational initiatives, the reputation and familiarity of the education provider was a key issue. As the transformation of work will modify the requirements for professional and working life skills, the main challenge is to identify new and more effective ways for re-and up-skilling the future workforce.

There are four key issues that need to be addressed in order to develop education for Industry 4.0:

1. Flexibility and fast reaction to changes
2. Effective delivery of education
3. Inclusiveness of the educational system
4. Opportunities for lifelong and life-wide learning

Find more in the full Benchmark Report available on the project website.

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Inspiring Practices *in* Education

from Industry 4.0 Perspective

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