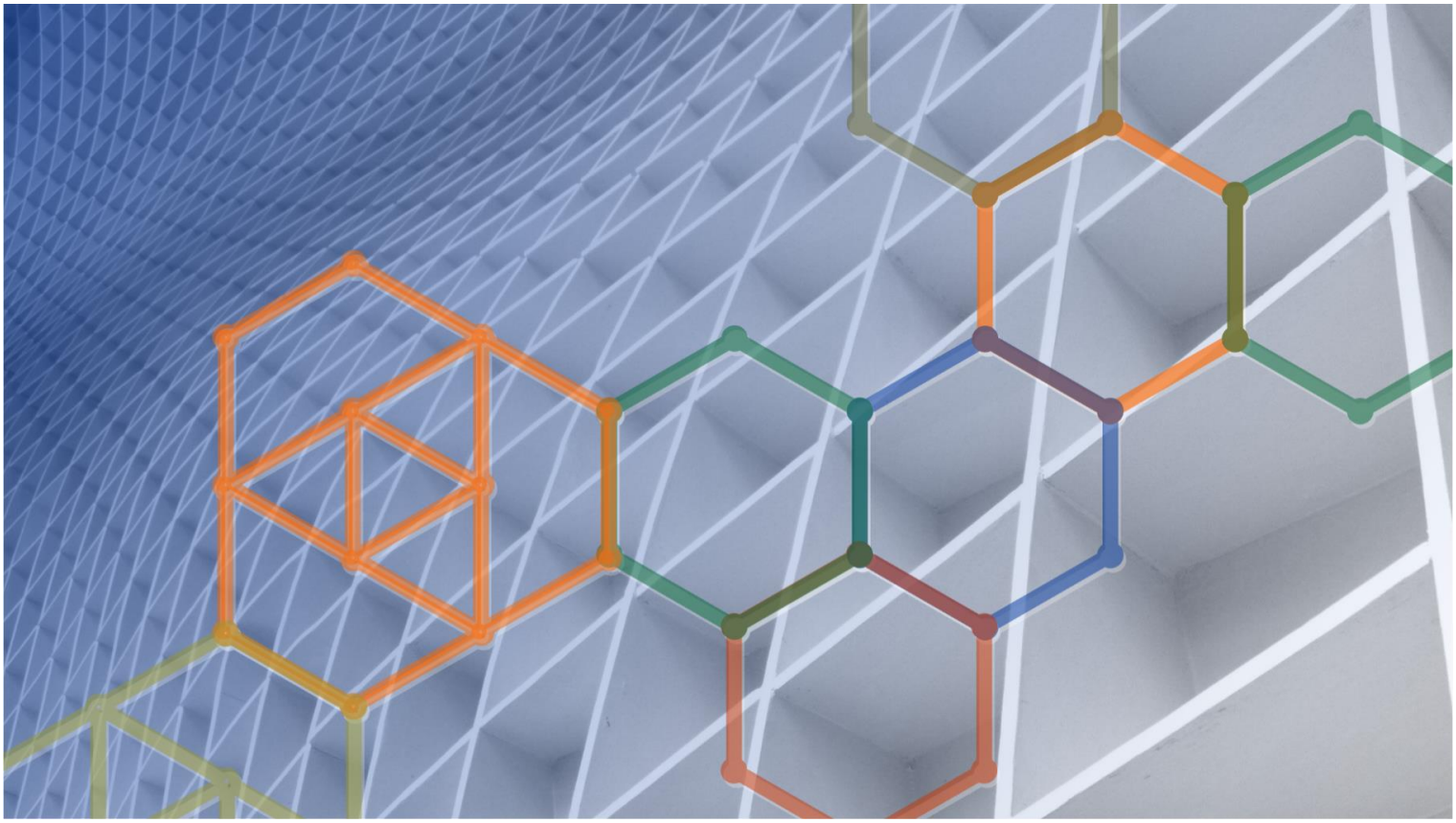

Digital Coach [2020-1-DE02-KA202-007683] – Intellectual Output 2

Challenges of Industry 4.0 for Young Entrepreneurs

Self-study module for Digital Coaches (Subtitle)

Mrs. Eszter Nagy – Ms. Kristina Pohli, Chamber of Commerce and Industry of Pécs-Baranya

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[University of Patras | School of Engineering | Systems and Automation | Department of Mechanical Engineering and Aeronautics, Patras – Greece]

Pécs-Baranyai Kereskedelmi és Iparkamara
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[Chamber of Industry & Commerce Gabrovo, Gabrovo – Bulgaria]

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[University of Technology and Economics Budapest | Center for University-Industry Cooperation | Industry 4.0 Technology Center, Budapest – Hungary]

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[Vocational Training Centre of the Heraklion Chamber of Commerce and Industry, Heraklion, Crete – Greece]

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Digital Coach [2020-1-DE02-KA202-007683]

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Table of Contents

0. Introduction

This module was created in the EU Erasmus+ project Digital Coach, and serves as a self-learn module (SLM) in the qualification program for future Digital Coaches, who are supporting SMEs in the digital transformation.

0.1. Objectives of the module

Strengthening the competitiveness, productivity and flexibility of small and medium-sized enterprises is part of the EU's industrial strategy. This also applies to the self-employed. One of the biggest problems is the lack of capital and cooperation partners. In addition, there is the challenge of extremely strong international competition and the fact that digitalization, which is different in each sector of an industry, has to be taken into account. As a result, there is no comprehensive solution in all areas. Rather, it is necessary to address the unique development opportunities in each sector. In doing so, the following points will be addressed:

1. Good practice presentations related to all emerging sectors.

2. Developing new digital skills and competences.

3. Create self-developing material

Today, every analyst agrees that the increasing penetration of digitization and the development of industrial robotics will lead to revolutionary changes in all areas of the economy over the next five to ten years. The so-called "Industrial Revolution 4.0" – some experts already introduced the term Industry5.0 - will change not only industry but all aspects of life - economy, social policy, technology - in no time. Thousands of jobs and occupations will disappear or change, new occupations will emerge that we may never have encountered before. To fill these, however, new competences, skills and, above all, different ways of thinking are needed for potential young entrepreneurs.

The so-called Industry 4.0 can be misunderstood, because transformation will not only occur in the industry, but also in the service sector and in most segments of everyday life: education, legal frameworks, capital markets, mobility, social benefits, etc. In the long run, it may even lead to transformations on the system level.

This self-learning material has been designed to show young entrepreneurs how to prepare for this situation.

This project helps to examine the effects of the digital revolution from another perspective. Industry 4.0 is also important from the individual point of view. In the case of self-employment, the individual has to be up to date to compete with contemporary challenges.

Learning Outcomes / Competences

The participants are able to explain the key developments linked to the Industry 4.0 concept.

The participants can discuss the impact of Industry 4.0 on the following levels: work place (micro level), organisations or enterprises (meso level) and economic system (macro level).

The participants are able to assess the consequences of the Industry 4.0 concept on the development of skills acquisition and on education and training.

0.2. Target groups

Digital coaches as drivers of the digital transformation

As a desired result of the EU Erasmus+ project Digital Coach, in future, digital coaches will support companies in the development and implementation of digital business models. In doing so, they will draw in particular on cross-customer and cross-sector approaches to unlock new potential for the companies and spread agile process thinking with the involvement of all process participants.

In order to successfully implement the relevant concept for digital transformation, digital coaches need to be qualified as either (1) internal innovation promoters, or (2) external innovation experts or promoters.

Internal innovation promoters are members of an organisation who have the task of analysing and further developing the innovative capacity of an organisation in relation to the digital transformation directly on site.

External innovation promoters are, for example, innovation or technology advisors from chambers of commerce and industry or chambers of crafts as well as organisational members of research institutions, universities, other (further) education institutions, consulting companies, or solution vendors.

The common goal of internal and external innovation promoters can be to uncover the state of a company in relation to the digital transformation (e.g. with the maturity model ADAPTION) and to initiate the necessary steps so that the digital transformation of a specific organisation succeeds.

Young entrepreneurs

Starting any kind of business these days takes courage. As did it in any period before. These days however young entrepreneurs need beside courage and a market validated idea also at least a basic level of digital skills. Just think about official administration matters. More and more administrative tasks are automated and available only online. Further, e.g. in Hungary, as an enterprise, no matter the size, or activity, you have to be able to issue an electric invoice, with a system, that is communicating with the tax authority. For being up to date about your own business you need to have a business management system. And how do you communicate with your suppliers and with your clients? Of course, mainly online.

0.3. Chapter structure and working instructions

Each chapter contains a description of the topics handling with. After the description, each chapter also contains practical examples. Finally, each chapter contains useful links, and reflecting questions for the future Digital Coaches and exercises for the young entrepreneurs.

The chapters are self-contained and build on each other.

- Each chapter begins with learning objectives
- and is based on didactic principles (e.g. from simple to complex, from concrete to abstract, etc.).
- There is at least one learning task per chapter.

A chapter ends with a summary, self-test tasks and literature tips.

The answers, solutions to the self-test tasks are collected in the annex.

The case studies are based on the following story line:

Christina Tailor is a graduate at the University of Pécs, at the Faculty of Business and Economics, with a specialization in management. She writes her thesis on change management in companies. Her consultant teacher advises her, to do research on the impact of Industry 4.0 and the challenges it gives young entrepreneurs. Christina first is not very enthusiastic about the suggestion. Due to her lack of knowledge about Industry 4.0, she has a preconception, that this is something only for IT companies. As she is discussing her doubts with her friends, one of them, Aisha is telling her to get in connection with the local chamber of commerce and industry, where she spent her internship last summer. She tells Christina about ongoing projects at the CCI, about awareness-raising events related to digitalization and industry 4.0, and about the developments of the regional companies. Christina contacts the chamber for support. She has now an appointment with and advisor on innovation and industry development.

0.4. Applicability and usability

Already in 2016, the European Commission has proposed 'A New Skills Agenda for Europe: Working together to strengthen human capital, employability and competitiveness' to address the skills challenges that Europe is currently facing. The aim was that everyone should have the key set of competences - including among others **digital competence and entrepreneurship competence** - for personal development, social inclusion, active citizenship and employment. Accordingly, the JCR issued a publication, 'EntreComp: The

Entrepreneurship Competence Framework', where the authors introduce the EntreComp framework, and provide a common definition of what entrepreneurship as a competence is. It is defined as follows: Entrepreneurship is when you act upon opportunities and ideas and transform them into value for others. The value that is created can be financial, cultural, or social (FFE-YE, 2012).

Definition of entrepreneurship

Entrepreneurship is a transversal competence. **Entrepreneurship is when you act upon opportunities and ideas and transform them into value for others. The value that is created can be financial, cultural, or social.**

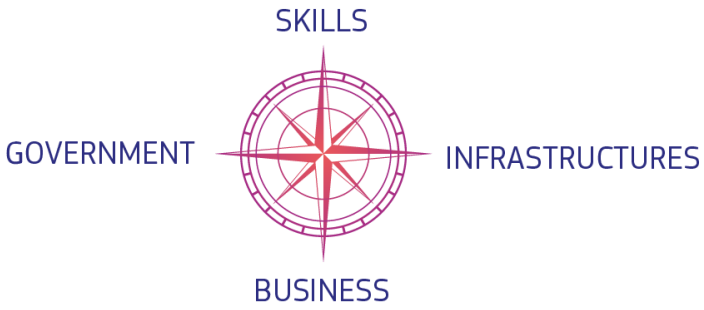
The necessity of digital skills and digitalization of SMEs is also a priority of the European Commission. The goals are described in the Europe's Digital Decade framework, and the Digital Europe Programme provides the financial support.

Initiatives of the European Union

The necessity of the learning modules in the project Digital Coach can be deducted also from the initiatives and programmes of the European Union and the European Commission regarding digitalization.

Europe's Digital Decade

On the 9th of March 2021, the European Commission presented a vision and avenues for Europe's digital transformation by 2030. The Commission proposes a Digital Compass for the EU's digital decade that evolves around four cardinal points:



Picture 1: Digital Compass (resource: https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en)

Digital Compass: the four points detailed	
Skills • ICT Specialists: 20 million + Gender convergence • Basic Digital Skills: min 80% of population	**Secure and sustainable digital infrastructures** • Connectivity: Gigabit for everyone, 5G everywhere • Cutting edge Semiconductors: double EU share in global production • Data - Edge & Cloud: 10,000 climate-neutral highly secure edge nodes • Computing: first computer with quantum acceleration
Digital transformation of businesses • Tech up-take: 75% of EU companies using Cloud/AI/Big Data • Innovators: grow scale-ups & finance to double EU Unicorns • Late adopters: more than 90% of SMEs reach at least a basic level of digital intensity	**Digitalisation of public services** • Key Public Services: 100% online • e-Health: 100% of citizens having access to medical records • Digital Identity: 80% of citizens using digital ID

Table 1 Digital Compass, detailed goals

As seen in the table above, the EU Commission urges the development of digital skills both for citizens, and for companies. This underlines the goals of the Digital Coach project and its learning modules.

Learning modules of the Digital Coach project are:

- Quality management as the basis for digitisation in enterprises (including process optimisation as the starting point for digitisation)
- Challenges of Industry 4.0 for Young Entrepreneurs
- Maturity Model in the Field of Industry 4.0
- Corporate strategy for digital transformation and agile project management
- Possibilities and Limits of Learning Transfer and learning location cooperation
- Value Creation Processes as Starting Points for Digitization
- Strategies to ensure the acceptance of digital solutions in companies
- Limits and Possibilities of Participation in the Implementation of Digital Solutions
- Development of New Business Models Against the Background of Digitization
- Corporate Cooperation for the Implementation of Digital Solutions

Further literature

Europe's Digital Decade: digital targets for 2030:

https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en

Visit the Digital Coach project website, to download the above learning materials: https://digitalcoaches.eu/

Digital Skills and Jobs Coalition

The Digital Skills and Jobs Coalition tackles the digital skills gap by bringing together Member States, companies and organisations. Having a digitally skilled labour force and population is crucial for European competitiveness and an inclusive digital society. To help address the skills gap in Europe, the European Digital Skills and Jobs Platform was launched under the Connecting Europe Facility Programme.

The Coalition tackles the need for digital skills of 4 broad groups:

Digital skills for all: developing digital skills to enable all citizens to be active in our digital society

Digital skills for the labour force: developing digital skills for the digital economy, e.g., upskilling and reskilling workers and jobseekers, and actions on career advice and guidance

Digital skills for ICT professionals: developing high level digital skills for ICT professionals in all industry sectors

Digital skills in education: transforming teaching and learning of digital skills in a lifelong learning perspective, including the training of teachers

Further literature

Digital Skills and Jobs Coalition - https://digital-strategy.ec.europa.eu/en/policies/digital-skills-coalition

Digital Skills and Jobs Platform - https://digital-skills-jobs.europa.eu/en/about/digital-skills-and-jobs-platform

The Digital Europe Programme (DIGITAL)

The Digital Europe Programme (DIGITAL) is a new EU funding programme focused on bringing digital technology to businesses, citizens and public administrations.

Digital technology and infrastructure have a critical role in our private lives and business environments. We rely on them to communicate, work, advance science and answer current environmental problems. At the same time, the COVID-19 pandemic highlighted not only how much we rely on our technology to be available to us, but also how important it is for Europe not to be dependent on systems and solutions coming from other regions of the world. Paving the way for achieving this goal is DIGITAL programme.

The Digital Europe Programme will provide strategic funding to answer these challenges, supporting projects in five key capacity areas: in supercomputing, artificial intelligence, cybersecurity, advanced digital skills, and ensuring a wide use of digital technologies across the economy and society, including through Digital Innovation Hubs. The programme aims to accelerate the economic recovery and shape the digital transformation of Europe's society and economy, bringing benefits to everyone, but in particular to small and medium-sized enterprises.

Further literature

Europe's Digital Decade: digital targets for 2030:

https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en

The Digital Europe Programme:

https://digital-strategy.ec.europa.eu/en/activities/digital-programme

Smart Specialization Strategies (S3) - SME integration to Industry 4.0

Smart Specialisation is a place-based approach characterised by the identification of strategic areas for intervention based both on the analysis of the strengths and potential of the economy and on an Entrepreneurial Discovery Process (EDP) with wide stakeholder involvement. The main objective of this partnership is to involve SMEs to the Industry 4.0 paradigm by increasing their absorption of specialised

digital services. There is an identified need to facilitate the transition of SMEs towards the Industry 4.0 paradigm, to boost their integration into digital (global) value chains by fostering the adoption of specialised digital services and to increase data collection in order to monitor the production. This means technological, behavioural and business model change for them.

Further literature

Smart Specialization Strategies (S3) - SME integration to Industry 4.0

https://s3platform.jrc.ec.europa.eu/sme-integration-to-industry-4.0

Network of European Digital Innovation Hubs (EDIH)

The Network of European Digital Innovation Hubs (EDIH) is a pan-European initiative that aims to accelerate digital transformation throughout the European Union and Associated Countries. EDIHs are one-stop shops supporting companies and public sector organisations to respond to digital challenges and become more competitive.

EDIHs support companies to improve business/production processes, products, or services using digital technologies by:

- providing access to technical expertise and testing, as well as the possibility to 'test before invest'
- providing innovation services, such as financing advice, training, and skills development that are central to successful digital transformation
- helping companies tackle environmental issues, in particular the use of digital technologies for sustainability and circularity.

Every EDIH–SME collaboration will be appraised using the Digital Maturity Assessment (DMA) Tool available on the official website of the EDIH Network. Before any substantial intervention by an EDIH, the digital maturity of the SME will be measured based on the criteria outlined in the DMA questionnaire. The main objectives of the DMA tool are to investigate the baseline level of digital maturity of every beneficiary organisation ahead of their cooperation with an EDIH, to observe its evolution over time and provide insight into their digital maturity's growth curve.

Further literature

EDIH Network official website:

https://european-digital-innovation-hubs.ec.europa.eu/home

Find your EDIH contact point:

https://european-digital-innovation-hubs.ec.europa.eu/edih-catalogue

1. What does it mean: Industry 4.0?

LEARNING OBJECTIVES IN THIS CHAPTER

The learner can…
… can explain the development, that indicated Industry 4.0
… can explain Industry 4.0 with her/his own words
… is able to list the topics of industry 4.0
… is able to name examples for the topics

Preparation for the meeting with the advisor of the chamber

After setting an appointment with the advisor of the local chamber, Christina has to prepare for the meeting. Tha advisor sent Christina a checklist, what to do research on, to be more familiar with the topic:

- Brief history of industrial development
- Definition of Industry 4.0
- Tools of Industry 4.0 – Technological pillars

Christina starts with the search – on the internet.

1.1. Brief history of industrial development

Industrial revolution

The term "industrial revolution" is nowadays understood to mean a transformation of the economy involving an explosion of development. In modern history it is the process of change from an agrarian and handicraft economy to one dominated by industry and machine manufacturing. These technological changes introduced novel ways of working

> and living and fundamentally transformed society.
> (https://www.britannica.com/event/Industrial-Revolution/The-first-Industrial-Revolution)

The term first appeared in history on 6 July 1799, when the Frenchman Louis-Guillaume Otto wrote in a letter that France was entering the industrial race with Britain.

Industrialisation has been accompanied by a steady increase in scientific and technical knowledge and the transformation of industrialising areas, such as the development of transport, the emergence of many large cities and an improved quality of life. This has radically transformed everyday life, society and the environment.

Manufacturing has changed substantially since its humble beginnings. There have been four major technological advances that align with each of the four Industrial Revolutions.

It is important to understand, that the 4 stages of industrial development are not considered as a straight line of development. The different stages can be observed in the world parallel.

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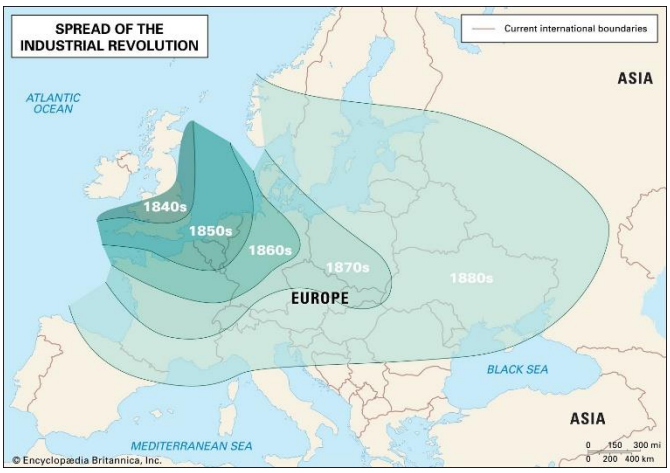
1st Industrial Revolution

The 1st Industrial Revolution began in the 18th century through the use of mechanisation of production and steam. The biggest changes came in the industries in the form of mechanization, which was the reason why agriculture started to be replaced by the industry as the backbone of the societal economy.

Water was used to power equipment such as the power loom, and this trend progressed to its high-powered counterpart, steam. The use of steam power for industrial purposes was the greatest breakthrough for increasing human productivity. Instead of weaving looms powered by muscle, steam-engines could be used for power. Instead of muscle-powered looms, steam engines were used for power transmission, and the mechanised version achieved eight times the volume in the same time.

With the advent of the steamship or (about 100 years later) the steam locomotive, further huge changes were brought about as people and goods could travel great distances in fewer hours.



https://www.britannica.com/event/Industrial-Revolution/The-first-Industrial-Revolution

2nd Industrial Revolution

The next Industrial Revolution began in the 19th century with massive technological advancements in industries that helped the emergence of a new source of energy—electricity, gas, and oil.

The rapid technological advancements that led to increased industrialization and standardization due to a need for interchangeable parts to support such growth. This is when the assembly line production as we know it came into existence. The idea came from meat processing: during the process each butcher only dealt with a part of the pig. This is where Hery Ford came up with the idea to assemble the vehicles on an assembly line, significantly faster and at lower costs.

This period resulted in the creation of the internal combustion engine that started to reach its full potential. Another important impact of this industrial revolution were the development of steel demand, chemical synthesis and methods of communication such as the telegraph and the telephone.

3rd Industrial Revolution

This period is sometimes called the Digital Revolution or the Information Age, which began in the ’70s in the 20th century through partial automation using memory-programmable controls and computers. Cell phones, microprocessors, PCs and the internet all were major technologies. The third revolution opened the door to biotechnology, robotics and space expeditions and brought forth the rise of electronics, telecommunications and computer technologies.

Since the introduction of these technologies (for example Programmable Logic Controllers (PLCs) and Robots), we are now able to automate an entire production process - without human assistance. Known examples of this are robots that perform programmed sequences without human intervention.

Further literature / literature tip

The industrial revolution - Encyclopædia Britannica, Inc. https://www.britannica.com/event/Industrial-Revolution/images-videos

https://ied.eu/project-updates/the-4-industrial-revolutions/

https://www.desouttertools.com/industry-4-0/news/503/industrial-revolution-from-industry-1-0-to-industry-4-0

https://www.machinemetrics.com/blog/what-is-industry-4-0

1.2. Definition of Industry 4.0

Industry 4.0

Industry 4.0 is a term for the digital revolution in industrial production emerging from the comprehensive networking and computerisation of all areas of production. Industry 4.0 is a term for the so-called »fourth industrial revolution « and in essence means the technological integration of cyber-physical systems (CPS) in the production process. CPS enables (internet-based) networking with all participants in the value creation process. (FES)

The term Industry 4.0 (Industrie 4.0) is a synonym for the fourth industrial revolution and originated with a future-oriented project that was part of the German government’s high-tech strategy in 2011.

We are currently implementing the Fourth Industrial Revolution which started at the dawn of the third millennium with the one thing everyone uses every day—the Internet. Automation is the big differentiator in this period. Smart and connection are the keywords: smart factories, smart sensors, predictive maintenance using machine data and machine learning, and additive manufacturing all have come from machine-to-machine communication and IoT technology.

Industry 4.0 builds on the developments of the Third Industrial Revolution: production systems that already have computer technology are expanded by a network connection and have a digital twin on the Internet so to speak, which allow communication with other facilities and the output of information about themselves. This is the next step in production automation. The networking of all systems leads to "cyber-physical production systems" and therefore smart factories, in which production systems, components and people communicate via a network and production is nearly autonomous.

When these opportunities come together, Industry 4.0 has the potential to bring incredible advances to the factory environment. Examples include machines that can predict breakdowns and start maintenance processes independently, or self-organizing logistics that react to unexpected changes in production.

It has the power to change the way people work, i.e. Industry 4.0 can engage individuals in smarter networks and this offers the potential to work more efficiently. The digitisation of the manufacturing environment allows for more flexible ways of getting the right information to the right person at the right time. The increasing use of digital tools within factories means that maintenance professionals can receive equipment documentation and service history in a timely manner and at the point of use.

In the words of former German Chancellor Angela Merkel, Industry 4.0 is 'the comprehensive transformation of the whole sphere of industrial production through the merging of digital technology and the internet with conventional industry'. In short, everything in and around a manufacturing operation (suppliers, the plant, distributors, even the product itself) is digitally connected, providing a highly integrated value chain. The term Industry 4.0 originated in Germany, but the concept largely overlaps developments that, in other European countries, may variously be labelled: Smart factories, the Industrial Internet of Things, Smart industry, or Advanced manufacturing. (Industry 4.0 Digitalisation for productivity and growth - https://www.europarl.europa.eu/RegData/etudes/BRIE/2015/568337/EPRS_BRI(2015)568337_EN.pdf

Industry 4.0 defined - by the European Parliament

Industry 4.0 describes the organisation of production processes based on technology and devices autonomously communicating with each other along the value chain: a model of the 'smart' factory of the future where computer-driven systems monitor physical processes, create a virtual copy of the physical world and make decentralised decisions based on self-organisation mechanisms. The concept takes account of the increased digitalisation of manufacturing industries where physical objects are seamlessly

> integrated into the information network, allowing for decentralised production and real-time adaptation in the future. (IPOL_STU(2016)570007_EN)

When we talk about the 4th industrial revolution, we have to recognize that it is underpinned by the digital transformation of industry, but that this can only be understood in conjunction with the social-economical-technological ecosystem. The revolution in the cyber-physical production systems (CPPS) take the whole value chain on a new level in the entire life cycle of the products. This cycle follows the increasingly individualized customer needs and covers all stages of the process from the conceptual design of the product, through ordering, product development, manufacturing, delivery to the end user and finally recycling, including product-related services.

All this is based on the real-time availability of all relevant information, which implies the interconnectedness of the objects in the value chain and the ability to determine the optimal value stream from this data at any given point in time. The interconnection of people, objects and systems creates dynamic, real-time optimized, self-organizing and cross-enterprise value-added networks that can be optimized according to different criteria such as cost, availability or resource utilization.

Some experts believe we are now on the other side of Industry 4.0 and are instead on the cusp of the Fifth Industrial Revolution (Industry 5.0). While disagreements remain, 5IR places great importance on human intelligence. It's during this Industrial Revolution that humans and machines must ultimately work together to achieve progress. An example of what could be considered budding 5IR technology is Elon Musk's Neuralink or MachineMetrics' Operator Dashboards, which overlay human context with machine data for better, more accurate ML analysis.

https://www.britannica.com/topic/Abundance-and-Unemployment-Our-Future-2119191

1.3. Tools of Industry 4.0 – Technological pillars

The concept of Industry 4.0 is not a simple one. It envelops many technologies and is used in a variety of different contexts. There are many pieces that define Industry 4.0 at its core. Each piece is similar in nature but, when integrated together, create capability that has never before been possible.

Additive manufacturing technology is a manufacturing process that produces objects by laying down thin layers. In conventional machining, excess material remained from a larger piece, becoming so the finished product. One of the best-known tools of additive manufacturing is the 3D printer. Its most significant advantages are the rapid production of samples and the acquisition of smaller parts and accessories by radically reducing lead time and extending customization.

Big data is a complex technological environment (software, hardware, network models) that allows the processing of data files that are huge and multifaceted. It would be unmanageable to process big data with

existing database management tools. Big data as a concept is all about processing extensive amounts of data that change at high speeds and are very diverse.

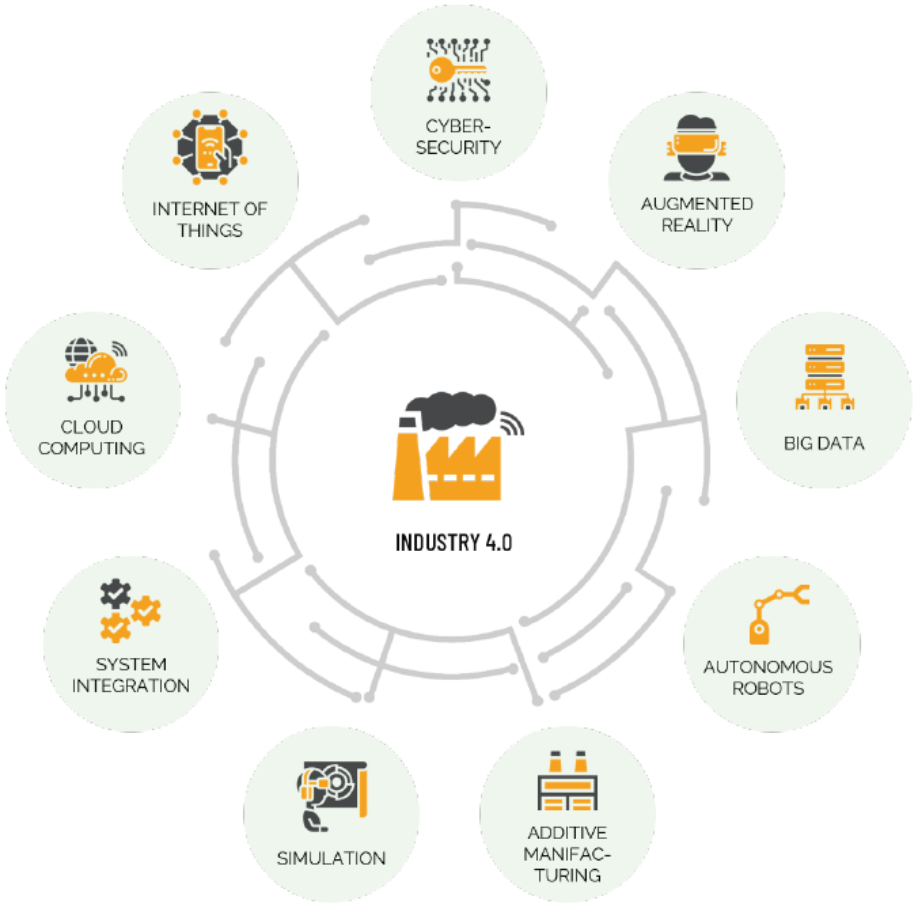
Internet of Things (IoT) is a variety of clearly identifiable electronic devices capable of recognizing some essential information and communicating it with another device on an Internet-based network. In other words, the term covers networked "smart" devices. This technology is evolving at an accelerating pace.

Cloud-based service: we can distinguish several types of cloud-based services, but the common thing is that the services are not operated on a dedicated hardware device, but distributed on the service provider's devices, hiding the operational details of the service from the user. These services are available to users over a network, the Internet for public cloud, a local network for the private cloud or the Internet.

By cyber-physical system, we mean „the integration of IT, software technology and mechanical and electronic components". It has a high degree of complexity in which the elements communicate via wired and increasingly wireless „data infrastructures", e.g., the Internet, and the components can adapt to current production conditions.

KPI (Key Performance Indicator) is an indicator, typically a ratio, by which we present the performance of the considerable activity by regular, preferably continuous measurement. For indicators, we set goals to mark the optimal state to be achieved. If our metrics deviate from this goal, we need to intervene. It is essential that there is no development without measurement and feedback.

M2M technology is the flow of data between devices without human intervention. Communication occurs between any machine equipped with the appropriate technology to connect to the system. Machine-to-machine interaction means not only simple data flow, but also independent decision-making and interference.



Source: Transit_Training-Guide_IO2_EN-2

MES (Manufacturing Execution System) is a computer system that controls production processes, which means real-time monitoring. MES provides information on the status of orders, material requirements during production, malfunctions, production losses, capacity utilization of production equipment, scheduled maintenance periods, operating hours. The most valuable service of MES is the arrangement of data collected on production activities running in parallel with each other, the provision of summary information to the workers and their managers, supporting and accelerating the making of necessary decisions and the implementation of measures.

OEE (Overall Equipment Effectiveness) is a fundamental production index, which gives the best overall performance characteristic of production processes. This complex indicator consists of the multiplication of three factors. The first factor, quality, shows the ratio of qualitatively appropriate pieces to the totals produced. The second factor is availability, which shows the proportion of the time spent on actual production to time planned. The third factor, performance, is the ratio of the prescribed cycle time to the actual one fulfilled.

Smart factory: The production environment in which manufacturing and controlling equipment coordinate and organize themselves without human intervention is called an „intelligent-" or „smart factory".

Predictive (forward-looking) maintenance helps with the continuous use of diagnostic tools to predict expected failure and wear of the equipment without stopping the machine. Typical diagnostic methods are vibration diagnostics, ultrasound examination, compactness examination, endoscopic examination, etc. Its advantage over other maintenance methods is that it provides an assessment of the equipment as a function of parameters. It also estimates life expectancy and can predict the failure time of components, making the source and extent of the failure easily identifiable.

Preventive maintenance is rigid cycle maintenance, performing care and recovery measures on the equipment based on predetermined performance and time data without considering the actual condition. The goal is to avoid unexpected failures, so maintenance cycles are selected based on manual specifications and operational experience for a shorter period than required to use the full wear reserve with the intended use. The equipment is operational at the start of the measures, that is, the repairs are carried out independently of damage. Rigid cycle maintenance is very costly as the full wear reserve of the equipment is not well utilized. Parts are replaced with new ones at the end of the cycle, even though the original part still has some full wear reserve.

RFID (Radio Frequency Identification) is the communication of the radio frequency transceiver unit with the RFID tags placed on the observed objects. The process takes place automatically, without human intervention, so it is not necessary to read each package individually, the system reads the labels of all products passing through the reading gate and uploads them to the database at the same time. They can reuse tags, which makes the RFID identification system economical.

SCADA (Supervisory control and data acquisition): A control system architecture that includes computers, networked data communications, and graphical user interfaces (GUIs) to manage high-level process control. It also includes other peripherals, such as programmable logic controllers (PLCs) and discrete proportional integration/derivation (PID) controllers, which connect to a specific technology plant or machine.

Source: https://www.ipar4.hu/page/tudasbazis-ipar-4-0-fogalomtar

Mass customisation

In a demonstration of mass customisation at the Hanover Fair in April 2015, one German company allowed participants to add names and symbols to an electric light switch. Order data about customisation in the form of a DM/QR code was passed through the production chain (including an injection machine and a 3D printer). In addition, the code

was printed on the product box, where, by scanning it with a smartphone, the participant could access all the production data for their specific switch.

Online shoppers can also customise the design of their furniture when they buy from a Polish start-up which makes flatpack furniture. A 'parametric modelling' app on a smartphone allows them to change the dimensions, configuration, wood and colour of a shelving unit, and visualise the result before their order is transmitted to factory machines. The unit is delivered with a unit-specific assembly manual. The company won the 'best use of technology' prize at a startup festival in San Francisco in 2014.

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Summary or key Takeaways of/from the chapter are useful as reminder/recapitulation of the chapters' contents.

Summary / Key Takeaways

- … The industrial revolutions brought the industry forward with the emergence of new technologies.
- … The stages of industrial development are not considered as a straight line of development. The different stages can be observed in the world parallel.
- … Industry 4.0 builds on the developments of the Third Industrial Revolution.
- … Smart and connection are the keywords by Industry 4.0.
- … Industry 4.0 is based on the application of many smart technologies at the same time.

Self-test tasks/questions

1. How many industrial revolutions do we know?
2. What are the main characteristics of the 1'st, 2'nd, 3'd industrial revolution?
3. Mention some technologies from each period!
4. How can you present the industry 4.0?
5. Mention some technologies which are used in Industry 4.0!

For the answers, check the Annex sites 51-53.

2. Challenges of Industry 4.0

LEARNING OBJECTIVES IN THIS CHAPTER

The learner can…

- … name the challenges that occur with Industry 4.0
- … is able to differentiate the levels affected by the challenges
- … can realise the links among the challenges at the different levels

In the meeting

Christina did short research on the topics:

- Brief history of industrial development
- Definition of Industry 4.0
- Tools of Industry 4.0 – Technological pillars

She already learnt about the 1st and the 2nd industrial revolution at the university, in the class for economic history. By now she has a basic understanding of the term Industry 4.0, and can name the technological pillars of it. Christina briefly introduces her thesis to the advisor, and they start to have a conversation about the challenges of Industry 4.0. The advisor talks about the general challenges, and then they dig deeper, to talk about the challenges on different levels. Christina realises, that there are strong dependencies among the different levels.

The popularization of Industry 4.0 results in changes in many areas of society and economy. The scope of changes is very wide and it is impossible to list them all and even fully identify them. (Saniuk et.al) The scenarios of future developments are pretty ambitious. The conceptions of how Industry 4.0 is to affect companies and sectors, economies and societies differ greatly. They can be summarised, however, into three perspectives:

1 Disruption: Industry 4.0 enables completely new business and value creation models;

2 Progress: Industry 4.0 solves the problems of today with the technologies of tomorrow;

3 Destruction: Industry 4.0 is not new and lacks innovative approaches. (Buhr – FES)

In this chapter, we intend to provide an overview on the changes, Industry 4.0 initiates, with an emphasis on challenges on different levels (micro level: workspaces, meso level: organizations and enterprises, macro level: economic system, social level: human life) and some insight in some of the industrial sectors.

But first, the good news. Industry 4.0 bears a lot of possibilities on every level. Listed in a study of the Friedrich Ebert Stiftung (by Schröder), *positive microeconomic effects can be expected, production can become more flexible with falling production costs, while new value creation networks and new business models arise*.

According to Saniuk and his co-authors, we can group the changes, Industry 4.0 introduces, in different categories, depending on the point of view. They listed the changes, challenges and threats according to who is affected: the customer, the producer, or the employees. As we will see, these points of views can be integrated in the levels discussed in this chapter.

In general, we can group the challenges, as done in the EPRS Briefing of the European Parliament (EPRS Briefing):

Investment and change

The need for change and to partner with other companies (suppliers, distributors, as well as technology companies and infrastructure suppliers, and even with competitors) has to be accepted by business leaders. Large investments (at companies, and even on state level, in strategic infrastructure) are needed if enterprises, countries and societies are to make the move to Industry 4.0.

Data ownership and security

With the large quantities of data being collected and shared with partners in the value network, businesses, users, and governments need to be clear about who owns what data and to be confident that the data they produce will not be used in ways that they do not approve.

Legal issues

Advanced manufacturing also raises a variety of legal questions including employee supervision, product liability and intellectual property. For example, autonomous manufacturing systems raise the question of responsibility, and individualisation in mass production by clients raise the question on who owns the intellectual property (IP) rights to the design?

Standards

Standards are essential to ensure the exchange of data between machines, systems and software within a networked value chain, as a product moves into and through the 'smart factory' towards completion, as well as to allow robots to be integrated into a manufacturing process through simple 'plug-and-play' techniques.

If data and communication protocols are proprietary or only recognised nationally, only the equipment of one company or group of companies will be compatible; competition and trade can be expected to suffer and costs rise.

Employment and skills development

The nature of manufacturing work is shifting from largely manual labour to programming and control of high-performance machines. Employees with low skill levels risk becoming replaceable unless they are retrained. On the other hand, workers able to make the transition to Industry 4.0 may find greater autonomy and more interesting or less arduous work. Employers need personnel with creativity and decision-making skills as well as technical and ICT expertise, and face labour force shortage on local and EU level in ICT professionals; big data analysts and cybersecurity experts.

After this brief overview, lets dive deeper and see the challenges on the different levels.

2.1. Micro level: workspaces

This chapter gives an overview on what employers (in general, and with a focus on manufacturing) can expect at the workplaces, and from the employees.

With the knowledge about the fourth industrial revolution and the technological pillars of it, it is obvious, and in some sectors already on the way, that (Hecklau et.al.):

- simple and monotonous processes are automated, while other processes become more complex and intertwined, which leads to an increase of jobs with higher qualifications and a loss in jobs requiring lower qualifications.
- The storage of large amounts of data on external servers raises the additional problem of cyber security, as data must be protected from unauthorized access
- the social values of employees change, e.g. the importance of a good work-life balance grows, changes in work organizations raise the importance of flexibility (see home office solutions during COVID19 lockdowns)
- the society ages.
- less young people enter the labour market to replace those retiring.

Challenges for employers:

Strategies need to be developed to attract young people, whilst retaining the knowledge from older employees.

Facing the growing importance of flexibility, boundaries need to be set up to restrict the continuous availability of employees, so that their work life does not interfere with their private life.

Increasing virtual work and flexible work topics also require new forms of lifelong learning. While processes become more complex and intertwined, qualification strategies for the current workforce are required. Employees need to become enabled to take on more strategic, coordinating and creative activities. Companies need to qualify their employees for more strategic, coordinating and creative tasks with higher responsibilities. In order to have a successful transfer on this road, it is important, that companies (in best case an experienced professional, maybe from outside the organization, to minimize biases and to obtain consistent results) should conduct a competence gap analysis for required competencies in Industry 4.0. Ideally these are personalized for each employee, for each position.

Challenges for employees (Saniuk et.al):

The risk of losing a job rises (mainly in case of physical and/or simple operation work).

New jobs rise requiring new knowledge and qualifications. For instance, employees must further acquire the skills to be prepared for the increase in virtual work, e.g., with virtual glasses. The risk of inadequate

adjustment of employees' qualifications to new jobs appears, due to lack of access to new forms and directions of education.

Instead of permanent employment, temporary employment forms spread for the duration of projects. The security of existence becomes less calculable.

Intensification of employment in systems (e.g., virtual work, teleworking, etc.) becomes more spread. This can lead to loosening of the bonds in the employer–employee system, and in social bonds.

Workplaces are getting strongly polarized, meaning, that several positions, requiring medium level of competence (e.g., machine operators, maintenance) will be almost completely eliminated.

2.2. Meso level: organizations and enterprises

As already said and described in the above chapters, Industry 4.0 creates many new opportunities for companies. At the same time however, several challenges arise from the ongoing automation and digitalisation, that can be summarised as a transformational challenge. Several experts (Kiel et.al., Saniuk et.al., Schröder, etc.) on the topic listed these challenges, we try to provide an overview and summarise their findings.

As time has passed by since the introduction of the term Industry 4.0, it is clearly visible, that large companies have not only already attempted to anticipate the potential and risks of digitalisation, but have introduced them in their innovation and production processes. The answers of the SMEs on tackling the challenges vary on a broad spectrum.

The 101 of establishing any kind of business is to have a business plan. The founder might have a vision, but lot of SMEs do not have a strategy. This might lead to failure in a volatile, uncertain, and dynamically changing market environment. The general strategy can be then extended with innovation strategy, digitalisation strategy. This marks the rout of the company in this everchanging world. Also, having a strategy ensures the required resources and determination of the management, even if they lack the technical knowledge for digitalisation.

SMEs have to face the fact, that – even if they act only on a local, or domestic market – they compete on a global field, since customers – B2C or B2B – are able to access the global market. Therefore, innovation capacity (using the broad understanding of innovation) and short time-to-market cycles become essential.

Markets also become more and more volatile and heterogeneous for several reasons: problems in the supply chain (pandemic, logistic issues, war, rising energy and fuel costs, etc.), constantly changing customer expectations and needs, customisation on demand (variety of products and parts, IP issues, production capacity, etc.). Also, cost reduction has to be managed, to stay competitive.

Parallel to the trends of reduced time-to-market cycles and shorter product lifecycles (single use products, planned obsolescence, etc.), sustainability becomes a hot topic both on customer side (end users), and on legislative side (see EU Green Deal and connecting legislation on built-in obsolescence). This forces SMEs to increase the resources spent on product development.

Classical business models tend to become vulnerable; a higher level of service orientation conquers space.

Cloud solutions enable a lot of services, like software a service (SaaS), infrastructure as a service (IaaS), platform as a service (PaaS), desktop as a service (DaaS), managed software as a service (MSaaS), mobile backend as a service (MBaaS), data centre as a service (DCaaS), integration platform as a service (iPaaS), and information technology management as a service (ITMaaS). The biggest obstacle to the utilisation of cloud services are security concerns. Clearly, there is a major worry that sensitive company data are not really secure in the cloud and might be accessed by third parties. Further reasons for the neglect of cloud services include uncertainty about the geographical location where the company's data are stored and the applicable jurisdiction (Schröder 2015: 10) Further, data (business, financial, HR, production, etc. data) has to be protected from unauthorised access, and employees have to be trained also in this field.

Further, the business model of machine as a service (MaaS, also referred to as Equipment as a Service, or EaaS) becomes more and more popular.

Partly because of uncertainties in the supply chain, partly due to the growing global competition, companies have to enter strategic alliances with their suppliers (and sometimes even with their competitors). Large companies produce in high volumes, relatively capital intensively. Constant optimisation of highly automated production is a permanent element of process management. In SMEs the proportion of manual and hybrid activities is much higher. They produce rather for niche markets and often have a high degree of specialisation. In comparison with SMEs, large companies will realise much higher efficiency gains from the use of Industry 4.0 technologies. As the range of technological options increases small and medium-sized industrial enterprises will have to take advantage of developments towards networked production. That further leads to the correlation of entire value chains, and as a consequence, increases the complexity of processes. One point of these integrations is to bring data flow to adjacent internal and external areas in order to enable the exchange of production data horizontally with suppliers and customers and vertically for sales, planning, services or controlling.

It is an old rule of business, that, if you want to earn money, you have to spend money. This rule is also eligible in case of Industry 4.0. The software, the tools, the sensors, the robots. These cost a lot of money. On one hand, the return on investment might be low, and SMEs might not have the financial resources. On the other hand, a lack of standards and norms with regard to interface technologies is another reason why investments in the integration of IT systems are either not carried out or delayed. Small and medium-sized enterprises worry not only about opting for the wrong standard, but also about data security. At present, SMEs are adapting to the standard of the large company they supply. The lack of general standards makes it difficult for SMEs to join value creation networks with different standards and norms, by means of Open Platform Communications Unified Architecture an international standard has not yet been implemented. At the moment, small and medium-sized enterprises often adapt to the standard of the large company of which they are a supplier. (Schröder)

Changes in the world of work poses challenges on SMEs. They have to strive to create flexible organisational structures and to boost their employees' interdisciplinary thinking, since repetitive works are increasingly replaced, and employees have to reflect on latest technological solutions, new responsibilities and continuous improvement, as well as on data security. The lack of qualified workforce is visible also on the "other" side - both ICT partners supporting the transition, and trainers to train the staff on how to use the new technologies are short and can become too expensive.

The SME Envoy Network lists some further challenges. A cognitive obstacle might come up by SMEs, meaning the lack of awareness on digitalization and Industry 4.0. This can have different reasons: lack of knowledge about digitalization, generation problems meaning entrepreneurs not being digital natives, not being directly exposed to international competition hides the necessity of digitalisation, awareness about cyber security and adapting the business models, finding qualified staff, and even the lack knowledge and understanding of national/EU legislation in this field (online purchase, GDPR, etc.).

2.3. Macro level: economic system

To have a proper view on challenges on macro level, we have to step back some steps. Not only SMEs are competing on a global market, but countries as well. Just think about the latest investment decisions of global companies, on where they plant new factories. Competition is global on macro level too.

Digitalization can bring increase in effectiveness for global supply chains. The traditional productions systems, like lean and just in time are meant to be successful and can finally take their rightful place in production management. We have to be though aware, that these systems, ang globally widespread supply chains are not invincible. Just think about shortages and fallouts in production caused by the pandemic COVID19, or the accident of one ship (well, one of the largest container ships in the world, the name Ever Given says it all…) stuck in the Suez Canal.

Countries, societies and economies have to face several social challenges. One of the most influencing ones, a megatrend, that has been present for at least one decade now is the demographic change. Less young people are entering the labour market to replace those retiring. Therefore, not only companies need to work on solutions, but whole countries and supranational unions (e.g., the European Union) as well. Strategies need to be developed to attract young people. Younger generations express contrary social values, such as the growing importance of a good work-life balance. That goes in hand with the growing employee flexibility due to changes in work organizations. The legislation has to be aware, that boundaries need to be set up to restrict the continuous availability of employees. Increasing virtual work and flexible work topics also require new forms of lifelong learning. That means, the whole school system from kindergarten to university has to be upgraded.

One of the most evident political challenges is the increasing need for funding of research programs. Governments need to support organizations with the development of new technologies as well as the integration of those technologies in the existing environment. Moreover, governments need to establish legal parameters for the usage of big data.

Based on researches experts say, that due to automation 12 to 47 per cent of jobs will be lost. These calculations do however not count the cost-benefit aspect, and the fact, the that the uncodealbe practical knowledge of workers cannot be replaced by smart technologies. Further, the diffusion of new technologies partly depends on social, legal and ethical obstacles. The extent to which the number of jobs lost due to Industry 4.0 will be outweighed by new jobs cannot be reliably estimated at present. Nevertheless, a shift from manual to highly skilled jobs is inevitable. Once again, the school system has to be prepared and upgraded. Further, the consequences could also prove to be less dramatic due to ageing societies and to the already existing shortage of skilled workers. On the other hand, governments have to deal with structural unemployment, where labour supply and demand do not overlap. Further, completely new fields and positions are expected to arise, and the trend of outsourcing will further thrive, enabling the droves of "click workers" and "cloud labourers", who are poorly paid and less socially secure as freelancers will most likely grow.

2.4. Social level: human life

Last, but not least let's have a look on the challenges, that we, as individuals and as a society have to face.

As mentioned already several times, the ageing of society as a megatrend forces governments to action. The social values are also altering, the importance of a good work-life balance grows, as grows the demand for flexibility in work organisations. Sharing economy gains on importance, which on the other hand changes our way of thinking and our relationship to property and owning things. Digitalisation and automation in the production lead to an increase of jobs with higher qualifications and a loss in jobs requiring lower qualifications. Therefore, not only companies and governments, but society as it is needs to face lifelong learning, and accommodate to this continuous flow. Otherwise, we have to face technological unemployment (that on the other hand implies decline in consumer demand), and negative changes in the social structure, due to the exclusion of people with low professional qualifications.

If we consider the society as the large group of customers, we have to be aware of the phrase: "If something is for free, then you are the product." That means among others, that the uncontrolled disclosure of preferences by customers may threaten their anonymity, without proper legislation, the risk of crossing the border between sales persuasion and surveillance might be very high. Further, even banal problems might rise, like customization may make it difficult for the customer to make a purchase decision, and customers may feel cornered by receiving continuous information about products. More worrying trends are the increased level of stress caused by the desire to purchase new, personalised products, that can even lead to addiction.

Sustainability is also challenged. If we consider the excessive increase in the level of consumption, especially for personalised products, we see, that this easily leads to increased demand for energy and environmental pollution. Further, the more often products are withdrawn from the market, the more ecological problems arise (raw materials, energy used for the production, packaging, transport, etc.).

Summary / Key Takeaways

- … Industry 4.0 bears a lot of challenges on one hand, and a lot of possibilities on the other hand.
- … both employers and employees face challenges, that can be solved together.
- … SMEs have to keep up, since digitalisation is not a competitive advantage any more, but it is a must.
- … there are a lot of opportunities and possibilities to keep up the pace of technological development, but it requires a decision towards lifelong learning.
- … governments of countries and supranational unions have to be able to ensure safety for citizens and the safe use of the technologies.

Self-test tasks/questions

1. How can we in general group the challenges?
2. Name the levels affected.
3. How do the challenges for employers and employees differ?
4. Name some of the challenges, organisations and SMEs have to face.
5. What challenges can you name for the economic system, and for the society?

For the answers, check the Annex sites 51-53.

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3. How can I develop myself/my company (digital skills)?

LEARNING OBJECTIVES IN THIS CHAPTER

The learner can…

- … name the possibilities on how individuals can develop their skills.
- … tell the definition of the learning factory, and can list its features.
- … is aware of the multitude of questions, an SME has to decide on, when considering digitalisation.
- … and is able to provide answers and suggestions for these questions.

The previous chapter was not meant to scare you away from digitalisation, or in worst case turn you to a luddite. You know, that movement turned out not as successful.

The Luddites

were a secret oath-based organisation of English textile workers in the 19th century who formed a radical faction which destroyed textile machinery. The group are believed to have taken their name from Ned Ludd, a legendary weaver supposedly from Anstey, near Leicester. They protested against manufacturers who used machines in what they called "a fraudulent and deceitful manner" to get around standard labour practices. Luddites feared that the time spent learning the skills of their craft would go to waste, as machines would replace their role in the industry. Over time, the term has come to mean one opposed to industrialisation, automation, computerisation, or new technologies in general.

You know the phrase by Charles de Gaulle: If you cannot beat it, lead it. In this case, obviously it does not mean, that you have to become the number one person/SME/organisation in digitalisation, but you have to accept, that is part of your life, and if you learn it, you can use it for your own benefit.

As already stated in the introduction chapter, the EU recognized the importance of digitization, digital skills and capabilities, therefore several initiatives were started, to enhance these on all possible levels. These initiatives, supported with the funding programmes of the EU provide a wide range of opportunities for member states, citizens and SMEs.

How to tackle these challenges

Christina and the advisor of the chamber set up a further meeting, to talk about the possible solutions. After the first conversation on the challenges, Christina now sees, that digitalisation projects in SMEs have a lot to do with change management. After the discussion she is also determined, to improve her own digital skills. At the second meeting, she talks with the advisor about possibilities. The advisor introduces the Digital Coach project, and the learning materials, that were created in the project.

3.1. Development of personal digital skills

Digital skills for work and for life are at the top of the European Policy Agenda. The EU digital skills strategy and related policy initiatives have the objective of enhancing digital skills and competences for the digital transformation.

Digital competence

involves the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking." (Council Recommendation on Key Competences for Lifelong Learning, 22 May 2018, ST 9009 2018 INIT; https://op.europa.eu/en/publication-detail/-/publication/297a33c8-a1f3-11e9-9d01-01aa75ed71a1/language-en).

Information and data literacy	Browsing, searching and filtering data, information and digital content Evaluating data, information and digital content Managing data, information and digital content

Communication and collaboration	Interacting trough digital technologies Sharing information and content trough digital technologies Engaging in citizenship trough digital technologies Collaborating trough digital technologies Netiquette Managing digital identity
Digital content creation	Developing digital content Integrating and re-elaborating digital content Copyright and licences Programming
Safety	Protecting devices Protecting personal data and privacy Protecting health and well-being Protecting the environment
Problem solving	Solving technical problems Identifying needs and technological responses Creatively using digital technologies Identifying digital competence gaps

Table X: The DigComp conceptual reference model

The reference model of DigComp is elaborated as follows: each competence is described for several proficiency levels, provides examples for knowledge, skills and attitudes, and for a better understanding, it also shares use cases.

For a better understanding and evaluation of the own digital competences, there are free online tools provided by the EU. (DigComp 2.2)

Whether you're looking to sharpen your digital skills or you're hoping to enter the workforce with a strong resume, you can benefit from further training. Fortunately, you don't need to attend a several years long training to improve your digital skills. The first step is to find out, where do you stand now.

There are free platforms and tools to find out. Following, some examples:

Self-assessment tool on Digital Skills and Jobs Platform

Using the Digital Skills and Jobs Platform, any EU citizen can access a self-assessment tool on digital competence. The tool is based on DigComp and it is available in all EU languages. By taking the test, one can learn more about their digital skills, and importantly, discover what the next step to improve them would be. For this purpose, the platform will give

matching suggestions of courses and learning opportunities, and suggest which digital skills one should focus on.

visit: https://digital-skills-jobs.europa.eu/digitalskills/screen/home

MyDigiSkills

MyDigiSkills is an online tool that allows citizens to self-reflect on their digital competence using the DigCompSat. The test is available in 11 languages: Dutch, English, French, German, Italian, Latvian, Lithuanian, Romanian, Russian, Spanish and Ukrainian. It takes 20 minutes to complete, and provides a report on levels of digital skills at the end. Further, the platform identifies the gaps and needs in digital skills, and last but not least it recommends opportunities to improve digital skills.

visit: https://mydigiskills.eu/

What are the opportunities to improve personal digital skills?

There are several tools, trainings, methods provided.

Self-Learning: technology is part of our lives, so we must acknowledge how critical it is in helping us learn. There is a vast amount of information on any topic you can think of online, making basic skills easier to acquire.

Free Online Courses: provide a more structured experience, and enable to learn at one's own pace at a slightly deeper level than self-learning.

Certificate Programs: Universities, adult education service companies and organisations offer dedicated certificate programs that deliver intense, in-depth instruction to ensure students are equipped with the digital skills and training to get them hired in today's workforce.

Grow with Google

> Grow with Google helps ensure that the opportunities created by technology are available to everyone. Through tools and training, we help people get the right skills to find jobs they want, advance their careers and grow their businesses. The services are available currently in 35 languages.
>
> visit: https://grow.google

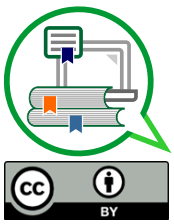
For a more detailed list of trainings see the table in the annex.

3.2. Development of digital skills for employees

You might wonder, but digital skills have been necessary for the workplace for decades. Since there have been computers, servers, and electronic communications, there has been a need for digitally inclined professionals. These days, the digital skills required in the workplace are a bit more advanced, and companies expect the vast majority of their employees to have them, not just a select few. An organization's performance and competitiveness greatly depend on how its employees are managed.

When speaking of digital skills of employees, the employers have to consider some of the following questions: What are general challenges the organisation will have to face? How do those challenges influence existing and future jobs and the related workflows? Which core competencies must employees possess in order to fulfil their current or future job?

Human resource (HR) management is a strategic approach towards the effective employment and development of a highly committed and qualified workforce to achieve the organisation's objectives. Essential functions of this concept were the deployment, recruitment, selection, staffing, retention and release of employees. However, another vital function is the development of employees: education, learning and training of individuals and teams. Competence development and qualification interact as a continuous improvement cycle. While competence development aims to identify required competencies and subsequently helps to reveal critical gaps, the purpose of qualification is to close those gaps. To identify the required competencies, a competence model can be used. In order to fill the identified gaps, qualification strategies can be developed. (Hecklaua et.al.)



Further literature / literature tip

Fabian Hecklaua, Mila Galeitzkea, Sebastian Flachsa, Holger Kohlb (2016): Holistic approach for human resource management in Industry 4.0

A good place for the development of employees is provided by learning factories. The learning and research factory is a "Learning environment in a real factory setting with real products and access to production processes that make problem-solving learning easier." Among other things, such a learning factory represents a "playground" for trying things out under practical conditions. Furthermore, this enables a higher acceptance among the employees due to realistic conditions and imparting new qualifications and competencies for Industry 4.0. The aim of the learning factory is to prepare specialists and young professionals for the demands of digitization. The realistic production environment allows for the testing of different technologies before their actual implementation in the organisation.

Characteristics of the Learning Factory

- special form of **job-related learning**
- use of **implicit experience** in addition to explicit knowledge
- **direct access** to the product development process
- possibility of **experimental and problem-based learning**
- active involvement of participants and **interactive** cooperation
- in addition to formal learning, **informal and action-oriented** learning is also made possible
- opportunity to **work out concrete measures** to master the challenges arising from the digital transformation

International Association of Learning Factories (IALF)

The mission of IALF is to design learning systems in such a way that stakeholders can grasp the complex technical and organisational interrelationships of today's industrial environment and obtain the competences to systematically improve it. The key to competitiveness is:

- the enhancement of competencies for technical students and
- efficient training and qualification “on the job in industry” with newest processes and developments

Find your nearest learning factory: https://ialf-online.net/

3.3. Development of digital skills for SMEs

As a response to the COVID19 pandemic and its economic effects, the European Commission launched the Recovery and Resilience Facility (RRF), a temporary instrument that is the centrepiece of NextGenerationEU -the EU's plan to emerge stronger and more resilient from the current crisis.

The COVID-19 pandemic accelerated the digitalisation of many European companies, which, forced by lockdown restrictions, had to resort to digital technologies and re-invent their business models. Nonetheless, the digital transformation of businesses still lags behind in many EU Member States. In order to make European companies more digitally competent and resilient to shocks such as these, the European Commission dedicated a cardinal point of its Digital Compass Communication to the Digital Transformation of Businesses, establishing three ambitious targets to be reached until 2030:

1. Tech up-take: 75% of EU companies using Cloud/AI/Big Data

2. Innovators: grow scale ups & finance to double EU Unicorns

3. Late adopters: More than 90% of small- and medium-sized enterprises (SMEs) reach at least a basic level of digital intensity

A fundamental contribution for a digital and resilient Europe comes from NextGenerationEU, and in particular the Recovery and Resilience Facility (RRF), which set the objective to dedicate at least 20% of funding to the digital transition.

One of the support pillars is the Network of European Digital Innovation Hubs (EDIH) is a pan-European initiative, as already described above, that aims to accelerate digital transformation throughout the European Union and Associated Countries. EDIHs are one-stop shops supporting companies and public sector organisations to respond to digital challenges and become more competitive.

When thinking of digitalisation of an SME, you face a lot of questions. What is the aim? What stage is my company at now? Where to start? How to convince and involve my colleagues? What do we have to digitise? Where do I get funding from? Do I have to do everything on my own? (A.k.a. Who can help me?) What do my competitors do?

These are tricky questions. Let's tackle them one by one.

What is the aim?

First, you need to define your goals you want to reach with digitalisation. Take care, a lot of questions are coming!

Do you wish to increase the income, or revenue of your company? Do you want to decrease costs? Do you want to speed up processes? Do you wish to enhance the adaptability of your enterprise? Do you plan to develop new assets? Are you keen to enhance brand recognition? Would you like your company to be more integrated in value chains? Do you consider sustainability goals?

As recent global developments, like the COVID 19 pandemic, and armed conflicts just at the border of the EU highlighted, digitalisation, using the tools and mechanisms as today is not a competitive advance any more. On contrary, the lack of digitalisation is a competitive disadvantage. We might even say with a little exaggeration, that the introduction of digitalisation is essential for the surviving of the company. With carefully selected and prioritised goals, you might ensure not only the survival of the enterprise, but the sustainable growth of it as well.

When defining aims, or goals, you might end up having a huge, long list, with several items, not weighing the same. Some might be small goals, some might be considered strategic ones, belonging into the corporate strategy. That is fine. Now, you need to prioritise your goals, strategic ones should be broken down into smaller steps.

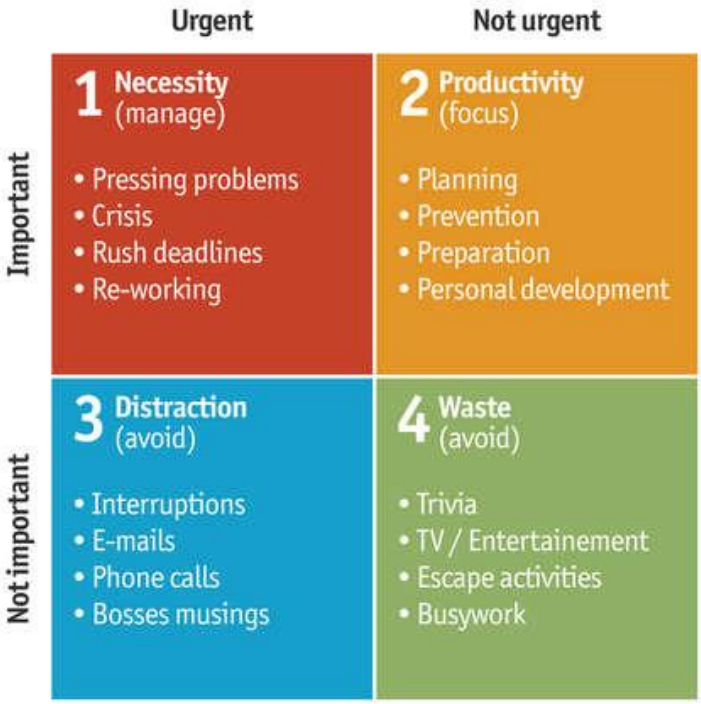
Priorisation can be done in several different ways. You can use the ABC-analysis or the Eisenhower matrix. Both methods are described in the learning material Self-organisation management in the age of digitalisation.

The ABC-analysis in a nutshell

The ABC method was developed by Alan Lakein, an American author, for time management. In this method, you break down tasks by prioritising them based on importance and urgency. You can use the method also for prioritizing your goals. The ABC method involves categorizing tasks, or goals into labels 'A,' 'B,' and 'C' — the letter A includes the highest priority and urgent tasks, while 'C' has the least important tasks. An A item or task has to be completed with the utmost urgency. The B item isn't necessarily associated with a deadline but needs to be completed when possible. Finally, the C item is the least important task, and should be completed when time is available.

The Eisenhower matrix in a nutshell

The Eisenhower Matrix is a time management system that divides tasks, or goals based on their importance. You divide your goals into four quadrants: Urgent; Not Urgent; Important; Not Important. Based on this template, you can decide which goals need your immediate attention and which can be postponed, delegated, or even eliminated.



https://us.123rf.com/450wm/saidtsbr/saidtsbr2010/saidtsbr201000039/157622370-.jpg?ver=6

Further literature / literature tip

Self-organisation management in the age of digitalisation – learning material for the project Career 4.0

What stage is my company at now?

In order to decide this question, you can request an evaluation. For this, there are countless online tools, provided either by companies, or by universities, or lately by the EU. These online assessment tools rely on the self-declaration of companies, company owners, and/or staff. Most of these tools can be used free of charge. However, since they are online, you don't have the opportunity to clarify questions. If you consider to have an accurate assessment, then you might ask for reliable support.

In the EU project Digital Coach, the ADAPTION maturity model was introduced, and tested in several countries – Bulgaria, Germany, Greece and Hungary.

You can deepen your knowledge on this model, and how to use it, in the self-learning module:

Maturity Model in the Field of Industry 4.0 (IO4)

After reading this module, the participants will be familiar with the key developments and impacts summarized under the Industry 4.0 concept. The participants know the different characteristics and application possibilities of maturity models in the Industry 4.0 context as well as migration paths in the context of digitization and can advise enterprises on the application. The participants know how Industry 4.0 content is communicated and how the application of a maturity model Industry 4.0 can be applied.

With the help of the maturity model, the participants can determine the current and desired digitization status of a company and derive the necessary actions. They will also know the starting points for change processes within companies. The participants can define the scope of the application of the maturity model within the company. The participants are able to find solutions which represent the optimum of the interaction of different factors for the respective enterprise. The participants can also help the companies to derive individual measures and to identify and design their own development path on the way to a cyber-physical production system. Furthermore, the participants can carry out an Industry 4.0 audit or accompany it under the aspects of technology, organization and personnel. Finally, the participants can plan and implement the measures to achieve a desired degree of maturity.

Where to start?

Once the goals are set, the current stage of the enterprise on digitalisation is defined, the next stap has to be the analysis of the processes in the company. You do not want to digitalise bad processes.

In the EU project Digital Coach, several self-learning modules process this topic:

Quality Management and Process Optimisation as the Basis of Digitisation in Companies (IO2)

After reading this module, the participants are able to design flexible production environments with regard to framework conditions related to the market and company and, for example, to identify and eliminate waste or material or information flow problems. Moreover, they can also analyse the variability in all production areas and how to deal with it, thus evaluating variability management and making it more efficient.

The participants can explain the connection between process optimization and the reference to quality management as the basis of digitization. In addition, they are able to analyse the general quality management of companies and to identify the needs that are necessary for the process of digitization in companies.

Participants should acquire the following practical knowledge and skills:

- Assess the implementation problems of TQM approaches or the EFQM model (Business Excellence Approach)

- Know quality management methods (e.g. self-assessment, Six Sigma, TQM scorecard) and critically reflect on their use
- Know and critically assess the approaches of ISO 9000 certification and EFQM self-assessment
- Select and assess recruitment and selection strategies against the background of the respective strategy and the objectives of the company in terms of the EFQM model
- Know instruments for labour employment from quality management (e.g. KVP, suggestions for improvement) and reflect on their possible applications on the basis of organisational change
- Know the multisource feedback procedure according to the TQM approach and critically examine its benefits in relation to the task area of leadership

Corporate Strategy for Digital Transformation and Agile Project Management (IO5)

Learning outcomes/competences, participants can acquire with the help of this module, by focus areas:

Corporate strategy

The participants can:

- understand strategic thinking and strategy development practices,
- contribute to the process of strategy development in companies, including the digitisation strategy
- understand the decision-making processes in companies,
- implement different approaches to implementing digital solutions in companies (especially SMEs and family businesses)
- understand the challenges posed by generational issues in companies,
- present different scenarios of corporate strategies to relevant target groups.

Project Management

The participants

- are familiar with programme management and the project portfolio,
- know the most important project management and development methods and can use them,
- know the differences between classic and agile project management,
- are able to explain the principles of agile project management,
- know different examples of agile project management,
- are e.g. familiar with the Scrum method and can define all Scrum roles (Scrum Master, Product Owner, member of the project/development team),
- can name the individual components of Scrum (Product Backlog, Sprint Backlog, Sprint, Story Cards etc.) and use them for the management of digital projects,
- know how to ensure the quality of projects on site.

Use of IT-Technologies

The participants

- have the core IT and technology skills necessary to understand digitisation (such as IT infrastructure, communication networks, cloud computing, sensors, etc.)
- become familiar with the main technologies used in the I4.0 solution, such as
    - Data Acquisition, Internet of Things, Intelligent Sensors
    - data analysis, machine learning, deep learning, AI, data visualisation
    - Digital twin
    - ERP, MES and PLM systems
    - Augmented / virtual reality, 3D technologies
- can assess which industry 4.0 solutions could be beneficial for a particular SME.

Value Creation Processes as Starting Points for Digitization (IO7)

After reading this module, the participants should know the central characteristics of a value creation process. Using concrete examples from different industries, the participants should be able to work out value-added processes and present them visually.

The participants will learn the basics so that they are able to reflect the principles of process optimization and apply them independently.

How to convince and involve my colleagues?

Involving employees in the digitalisation process, getting their support

Strategies for Securing the Acceptance of Digital Solutions in Companies (IO6)

The participants can analyse the acceptance of digital solutions in companies and have several methods which they can apply. They are able to interpret the results independently and derive measures from them. They are also able to meet the concrete needs of different employees in different positions by means of their own designed measures and thus advance the securing of acceptance. They can explain the different procedures based on individual, rank-specific and industry-specific characteristics of the employees and also apply them appropriately and are therefore able to motivate, calm and inspire employees of companies.

What do we have to digitise?

To answer this question, you might get familiar with the self-learning module Corporate Strategy for Digital Transformation and Agile Project Management (IO5). See in the “Where to start?” chapter above.

Do I have to do everything on my own?

Of course not. However, there are a lot a free, or freemium opportunities to learn, broaden your knowledge and experiences, so you have a better understanding of what you are looking for.

Several EU projects provide learning materials for SMEs, to support the digital transformation. In the Annex you can find a list of these projects and the related learning materials, with links (Table of EU projects on digitalisation).

Further, you can get a lot of support from your local Enterprise Europe Network (EEN) office. Your local EEN office is one of more than 600 in the EU and beyond. EEN offices have connections to the European Digital Innovation Hubs (EDIH), who also provide digitalisation services to SMEs. Services provided by EDIHs are free of charge, but are deducted from the de minimis frame of the company.

As for the first step, the EEN sector group for ICT and Digitalisation collected several tools, that can support the digitalisation endeavour of SMEs. In the Annex you can find a detailed table with tools a links (Table on tools and trainings for SMEs).

And last, but not least, one of the largest search engine operators, Google created also learning materials for SMEs, on how they can benefit most from Google services. Lot of free courses are offered, from introduction to digital marketing to payment methods. Some of these courses might be useful for employees as well.

By clicking on the following link: https://grow.google, your country specific site will open, and show you the opportunities, free trainings and tools, offered by the company.

And if you dare the journey, you can always count on the Digital Coaches, who support you and your company from the very beginning. Digital Coaches might be external (outside of the organisation) and/or internal (inside of the organisation) process promoters, who coordinate the work of the specialists, mediate between the levels, know resistances and use potentials, and are responsible for planning and controlling of the digital transformation project.

Summary / Key Takeaways

- … development of personal digitals skills requires dedication, but there are several opportunities.
- … learning and research factories are a good place for SMEs to test before invest, and to further train their employees.
- … SMEs have a strong support from digital coaches on their way in digitalisation, but dedication to take the advices and to involve the affected employees is essential.

Self-test tasks/questions

1. Who were the luddites?

2. What are the opportunities to improve personal digital skills?
3. How would you describe the learning factory?
4. What questions arise for an SME, when considering digitalisation?

For the answers, check the Annex sites 51-53.

4. Good practices

LEARNING OBJECTIVES IN THIS CHAPTER

The learner can…

… read about real life experiences of a food producer company

… read about real life experiences of a retail and service company

This chapter aims to collect and showcase some good examples and best practices from SMEs, that are already on their way in the digitalisation journey.

How does it look like in the real world

Last but not least the advisor of the chamber organises two company visits, to ensure Christina hands on experience in companies. This is also a good opportunity, to ask the CEOs of the companies, which challenges they faced and how they tackled them.

The stories below come from real companies, but we maintain their anonymity.

4.1. What digitalisation means to a syrup producer

Following you can read about the pilot implementation of the ADAPTION maturity model at syrup and soft drink producer in Hungary.

The company is located in the southwestern region of Hungary, was established in November 2004 as a family business and produces soft drinks and syrups. The production is carried out in a factory that meets all requirements and complies with European Union rules. Thanks to their continuous technological development, their market has been expanding since 2005, which they have achieved by extending their product range. One of their main objectives is to develop high quality and unique products in line with market demand. Their own label range is unique on the domestic and foreign syrup market, both in terms of packaging and flavour. Environmental awareness is a key factor in product development. The company has 28 employees.

The company had many problems with the digitalization of their processes. They used paper by the administration, and their files were not connected to an integrated database. By the time of the pilot implementation, the company was already working on the implementation of a new production management software, which would facilitate both day-to-day tasks and administration. By participating in the Digital Coach project, their aim was to get some useful information about the possible solutions.

Aims of the company:

- Continuous development, improvement
- Identifying cost-effective solutions
- Minimising defective and scrap production

The company selected ADAPTION criteria mainly from the technology and organisation dimensions. Further information was gathered partly through online research, and during personal meetings with the manager and the owner. We agreed that they will fill out the questionnaire at the personal meeting on paper. Further, trained digital coaches joined the implementation personal, or online.

In the morning of the first day, in a meeting room of the company, the participants and the company manager introduced themselves one after the other in order to get to know each other a bit. The aim of the first day was to familiarise the participants with the company's operations, processes and challenges, and fill out the questionnaire with the help of the Digital coaches.

The company manager presented the structure and the processes of the company. The participants used the interview question template which includes questions about the department to be analysed, current problems/needs in this department, the total number of employees in this department, the working hours of the employees in this department, the contact persons and persons with special responsibilities in this department as well as contact persons and persons with special responsibilities in the company, questions about the hierarchical structure, incl. the areas of responsibility/responsibilities and decision-makers in the company and finally about the company strategy.

The main issues of the business were the followings:

- The company embarked on the introduction of a new company management software, still in the planning phase.
- A lot of data is stored, but in separate databases.
- The digital skills of employees are at different levels.

The first step (the introduction to Industry 4.0) was skipped because it was assumed that the participants already had some knowledge in this area, because the CEO took part on the Digital coach training before.

The second step is the overview of the ADAPTION model including the dependencies between the criteria.

The third step is to identify the target and determine the area where ADAPTION should be applied.

The fourth step is the determination of the current state. For this purpose, we used the online questionnaire, which was filled out by the owner and the manager of the company after the meeting.

After that the participants created the process flow analysis (PFA), from the order to the delivery of the products.

The manager invited the participants to a tour of the company and explained the production process from order entry to order completion. They visited the office, the production and the storage area too. The participants asked questions about the different machines, and methods of the production and delivery, the tasks of the employees and work processes. Findings of the tour were, that the company has an unused machine that could deal with bottle caps, and that the digitisation of processes is not well advanced. Also, the company would like to introduce a new ERP system and have already started working with experts to develop a system that suits them.

The experts identified the following challenges for the company:

- Challenge 1: Strategy issues
- Challenge 2: Implementation of the new IVR
- Challenge 3: Manufacturing and product development
- Challenge 4: HR - motivation, attitude of employees

The third day was the core of the implementation. The participants went through each of the selected criteria. The created presentation (PPT) showed which level was selected by the company. During the preparation of this meeting the participants decided to suggest another, more realistic level if they didn't agree with the choice of the company. This has been marked with another symbol on the slides, and always discussed the final position with the company.

From the criteria chosen by the company, it is clear that they see both the technological and operational side as the main challenge, and this is where they would like to improve. The personal part of the operation remained in the background. However, in a future iteration, it may be useful to include such criteria among those selected. For most criteria, there was a wide variation in the responses. One reason for this was that everyone had a different view of the processes, not everyone had experience in everything. Following the discussion, however, it was easy to reach a consensus on the current state of play. With the help of the Eisenhower matrix method, the business owner sorted the seven goals. This prioritisation serves in particular for the follow-up phase.

The last step was the presentation and discussion of the identified challenges and possible solutions, and to make some general proposals.

The owner was very pleased with the meetings and the suggestions. According to him, the advice was very well timed, as they were in the middle of setting up the new company management software. They needed confirmation and guidance on what to pay attention to in order to end up with a really effective system.

4.2. What digitalisation means to an agricultural machine dealer

The following good practice comes from a company dealing with the sales and maintenance of agricultural machinery. The company is considered as a micro company, due to its number of employees. Only 5 people work in the company, among them the founder and CEO. See, it is a really small company. Yet, they managed introduce two innovative solutions. One is still in the garage, on TRL 5, but is improved continuously. The other product is already on TRL 9, and ready for the market. But how did they manage to achieve this with all the work they do?

The company was established in 2004, its main profile is the sale and development of precision machinery and technologies. The business model is to differentiate themselves from competitors, focusing on areas where they can leverage their strengths and limited resources and produce the value customers are looking for. The company is not a major player among agricultural machinery dealers and it would be difficult for them to try to implement all their ideas themselves, so they are working with partners to bring developments to fruition.

The company employs 5 people, of which 3 are service technicians with secondary education, 1 is a sales manager with higher education and 1 is a manager, an agricultural engineer with a PhD in crop production. The company has been involved in precision farming technology since 2006. They only represent a small number of manufacturers.

When selecting machinery and equipment, particular attention is paid to the after-sales service provided by the manufacturer, in particular the handling of breakdowns during and beyond the warranty period, service training and the quality of the spare parts supply. The commitment of the company is also demonstrated by their ISO 9001 certification. They only deal with original spare parts.

They believe that digital development can be truly successful in a multi-stakeholder model. Without industry knowledge and networking there is no foundation, and without IT and electronics there is no digitalisation. Co-development requires a functioning development ecosystem, which for them has been brought about by the Chamber network.

The company sees innovation and digitalisation as the primary drivers of sales.

Marketing, sales

In the agricultural machinery trade - at least in Hungary - personal selling is still the most effective sales method. However, having their own website, social media profile and, most unexpectedly, their own YouTube channel, helps them to do this. The latter has a surprisingly high number of hits, and it is here that many of their customers first see the machines they sell 'in action'.

In addition to the distribution of machines, the company also provides its partners with service. At present, orders are almost exclusively received by email, telephone orders are not accepted. Further digitalisation of the process could be achieved by creating a webshop. This would allow the partners to see the stock in real time. The feasibility of this is still questionable, as the staff typically assemble the parts ordered.

Administration

The business started with paper and pen. Only the price lists managed in Excel spreadsheets were digital. With so many problems (soggy invoice pads, blurred part numbers, lost delivery notes) and the administrative burden, the company had to realise that they needed a more reliable system.

The first milestone was the electronic invoicing system. This, as well as simplifying administration, gave the company a more serious image.

The second milestone was the digitalisation of stock records. They now had fully up-to-date stock information.

The third and most important milestone was the introduction of an integrated management system. The company learned the modules of the programme step by step. Each module saved a lot of time and simplified the work considerably. This has freed up much more time for sales and service tasks.

ISO quality management system

One of the main objectives of the implementation of the ISO quality management system was to regulate the administrative processes related to the sale of machinery and to consistently streamline the documentation required for financial accounting. This system was also based on the use of a word processor and spreadsheet. Staff saw the system documents as redundant administration until a long-standing and usually energy-consuming problem with a supplier was resolved.

The real milestone was when the company managed to integrate the ISO system into their integrated management system. This solved the problems of easy, in most cases automatic, document completion, numbering, electronic storage and quick retrieval.

Cloud-based services

The integrated management system first ran on a computer. The company then set up a server so that several people could use it simultaneously. On a not so nice day, the server went down. After struggling to recover, the company switched to a cloud service. It eliminated the horror and headache of missed backups and the problem of software updates. With mobile internet, the system can be used at any time, and the downtime problems of the past few years are immeasurably reduced.

As described above, the company is a micro-enterprise in terms of its number of employees. The tone among the staff is therefore direct and the motivation is mainly financial.

The new features of digitalisation, which have been described above, like most innovations, were initially received with reluctance by the staff. The new tools, the new, more cumbersome ways of administering the new tools, aroused resistance from staff, which over time "mellowed" into reticence. Solving a serious, long-standing and very labour-intensive problem showed why the new systems were useful. From then on, no extra motivation was needed.

Website and social media presence

The company has had a website since 2004, the novelty of which was that it was blog-like and filled with detailed professional content. Its success was best demonstrated by the fact that their competitors were also learning from it, so they stopped this blog-like activity. They switched to a much simpler solution with a fraction of the traffic of the previous one. Much can and will be done to improve this, but the saying "knowledge is power" should not be forgotten when it comes to website content.

The presence on social media is critical, and must be constant and interactive. This type of marketing and constant interaction would require a full (at least half) person, and the company has not yet devoted resources to this. They are also very cautious about sharing digital content, usually saving really punchy recordings for in-person meetings.

Administration

The later CEO, by that time sole entrepreneur started the business without any knowledge of accounting systems, using manual invoice pads, manual delivery notes and price lists in excel sheets. For a start-up business, when you have plenty of time and energy, this is the most obvious and cheapest solution. This type of management has brought with it all the problems you can imagine as the business has grown. This includes illegible article numbers, wet pads of paper, lost delivery notes, etc. But the biggest problem was the time wasted – several hours every day – that the co-workers didn't even notice.

However, compulsory tasks such as invoicing and VAT return documents had to be completed on time, so the time taken up by primitive administration was a major obstacle to progress.

At the end of 2018, drastic changes were made to the organisation of the business. In a very short time, they had to learn how to manage and invoice. At that time, they had already been using a program for several years and they literally had to use the customer service to prepare the invoices they needed.

This series of events started a process that the company now calls digitalisation. Once the first invoices were created (or rather, born), they looked at the data in the system. As a first step, they updated the prices in it (by importing excel) and, to their surprise, this simple feat saved them at least 1-2 hours of work and hassle per day. The time savings were extraordinary for everyone and they got to grips with the software.

The next step was to eliminate the delivery note blocks. After the last batch was invoiced, they switched to using the delivery notes created by the software. They realised that with the push of a button, the delivery note would become an invoice and they had eliminated several opportunities for error.

They went even deeper into the management software and in 3-4 months the company found and started using customer quotes, purchase orders, vendor orders and a host of other things that are basically the day-to-day running of the business. It is worth mentioning that the online invoicing made compulsory by the NAV did not catch the company unprepared and did not represent any additional tasks, as the system met the expectations from the very first moment.

It is worth paying particular attention to the sales and quotation process. Batch quotations are a natural part of the company's life and part of their quality management system. Automatic numbering, categorisation, easy retrieval, quotation based on the previous one, sending in pdf with one click - all this is implemented in the case management system. Without it, the company would simply not have been able to carry out its tasks during the agricultural tender dumping of 2021.

ANNEX

Solutions to the self-test tasks

1. What does it mean: Industry 4.0?

Self-test tasks/questions

6. How many industrial revolutions do we know?
7. What are the main characteristics of the 1'st, 2'nd, 3'd industrial revolution?
8. Mention some technologies from each period!
9. How can you present industry 4.0?
10. Mention some technologies which are used in Industry 4.0!

1) We know 4 industrial revolutions.
2) 1st industrial revolution: The 1st Industrial Revolution began in the 18th century through the use of mechanisation of production and steam. 2nd industrial revolution: It began in the 19th century with massive technological advancements and new sources of energy—electricity, gas, and oil. These led to increased industrialization and standardization due to a need for interchangeable parts to support such growth. 3rd industrial revolution: this period is sometimes called the Digital Revolution or the Information Age, which began in the '70s in the 20th century through partial automation using memory-programmable controls and computers.
3) 1st industrial revolution: power loom, steam engine, steam ships. 2nd industrial revolution: assembly line production, internal combustion engine, telegraph, telephone. 3rd industrial revolution: cell phones, microprocessors, PCs and the internet.
4) Additive manufacturing technology; Big data; Internet of Things (IoT); Cloud-based service; cyber-physical system; KPI (Key Performance Indicator); M2M technology

2. Challenges of Industry 4.0

Self-test tasks/questions

1. How can we in general group the challenges?
2. Name the levels affected.
3. How do the challenges for employers and employees differ?

4. Name some of the challenges, organisations and SMEs have to face.
5. What challenges can you name for the economic system, and for the society?

1) Investment and change; Data ownership and security; Legal issues; Standards; Employment and skills development
2) Micro level: workspaces; Meso level: organizations and enterprises; Macro level: economic system; Social level: human life;
3) Simple and monotonous processes are automated, while other processes become more complex and intertwined, which leads to an increase of jobs with higher qualifications and a loss in jobs requiring lower qualifications. The storage of large amounts of data on external servers raises the additional problem of cyber security, as data must be protected from unauthorized access. the social values of employees change, e.g. the importance of a good work-life balance grows, changes in work organizations raise the importance of flexibility. The society ages. Less young people enter the labour market to replace those retiring.
4) New business models. Widening technological difference between large companies and SMEs. More volatile and heterogeneous markets. Lack of funding for continuous development.
5) Countries competing on global market; global supply chains become more fragile; demographic changes affect the labour market, and the social security system; legislation (on work, AI, etc.) lags behind the development; due to the fast development cycles, the whole school system has to be upgraded; governments have to deal with structural unemployment. Social values are also altering; sharing economy alters the way we think about property; "If something is for free, then you are the product."; sustainability is challenged by the excessive increase in the level of consumption.

3. How can I develop myself/my company (digital skills)?

Self-test tasks/questions

1. Who were the luddites?
2. What are the opportunities to improve personal digital skills?
3. How would you describe the learning factory?
4. What questions arise for an SME, when considering digitalisation?

1) The luddites were a secret oath-based organisation of English textile workers in the 19th century who formed a radical faction which destroyed textile machinery.
2) There are several tools, trainings, methods provided: self-learning, free online courses, and certificate programs.

3) The learning and research factory is a "Learning environment in a real factory setting with real products and access to production processes that make problem-solving learning easier."
4) What is the aim? What stage is my company at now? Where to start? How to convince and involve my colleagues? What do we have to digitise? Do I have to do everything on my own?

Tables

Table of EU projects on digitalisation, with learning materials

Name of the project	EU	Brief description	Further information
"Digitalisation – Strategy Development Tool for the Digitalisation of SME"	Eramsus+	The aim of the **two-year EU project *Digitalisation*** is the development of a freely accessible self-learning tool for the CEOs, managers and employees of European SMEs in the business services sector. With the help of this **self-learning tool which can be accessed online**, European SMEs will be able to implement step by step of an accurate digitalisation strategy.	https://businessschool.luiss.it/en/news-en/digitalisation-strategy-development-tool-for-the-digitalisation-of-smes/
EDucation for DIgitalisation of Energy	Eramsus+	EDDIE is a four-year Erasmus+ EU funded collaborative project creating a Sector Skill Alliance (SSA) to develop a long-driven Blueprint for the digitalization of the European Energy sector. The Consortium is coordinated by COMILLAS and brings together 16 partners from 10 EU Countries.	https://www.eddie-erasmus.eu/
Supporting skills audits in adult education through digital tools	Eramsus+	Cooperation for innovation and the exchange of good practices	http://www.assess-plus.eu/
Digital Adult Educators: Preparing Adult Educators for a Digital World	Eramsus+	The main aims of the DigitALAD project were the following: Build the capacity of adult educators to become digitally literate in their teaching practices; Build the competencies of adults to use digital tools for employability; Develop innovative quality resources for adult educators/ trainers and adults; Promote awareness on the importance of digital skills for adults in Europe.	https://erasmus-plus.ec.europa.eu/projects/search/details/2019-1-LV01-KA204-060398

Curriculum guide of media and information literacy for adults	Eramsus+	The goal of this project is to develop a media and information literacy training curriculum for adults and especially for parents. The curriculum will define the requisite knowledge and competences to reach digital maturity. Adults should learn how to use the digital world in a self-determined and self dependent way.	https://erasmus-plus.ec.europa.eu/projects/search/details/2019-1-DE02-KA204-006183
Teaching and Learning for Life in Europe	Eramsus+	The project's main objective was to update and develop adult educator's international skills and professional competences especially in new information and communication technologies. All partners aimed to find new methods to tackle socio-economic challenges, internationalization and digitalization.	https://erasmus-plus.ec.europa.eu/projects/search/details/2015-1-FI01-KA204-009071
Practices for Increasing Export-oriented Entrepreneurial Skills of VET Learners	Eramsus+	The overall objective of this project was to develop export-oriented entrepreneurship skills of VET learners via open-access training modules.	https://erasmus-plus.ec.europa.eu/projects/search/details/2019-1-TR01-KA202-076388
Creative Minds - Service Designed Sustainable Startups	Eramsus+	As VET schools we should be able to offer motivating and meaningful learning paths for all students with totally different backgrounds, experiences, know-how and dreams. At the same time society is digitalizing and we should find our unique ways of using eLearning in VET and learn to use it as there are big differences between schools. All this has to be done with less money than before due to VET budget cuts in many countries. In this project we will find solutions to these and some other challenges.	https://www.cminds.pro/
INSYSTED - Integrated System for European Digital Learning	Eramsus+	The idea of the INSYSTED project is to experiment a new, integrated model that sees the blend among serious games, MOOCs and Learning Communities with the objective to offer a tool with a high	http://www.alliance4tech.eu/insysted/

		grade of modularity and integration in pre-existing ecosystems.	
Educational package for SMEs to increase their innovation capabilities and productivity	Eramsus+	EPIC aims to improve the capacity of European SME's to implement effective innovation initiatives. To do this, we must adopt a user-centric approach so that the intellectual outputs we develop aligns well with the needs of the end user. To ensure this, we will conduct research to assess the needs of innovative SMEs regarding the competences, skills and knowledge their employees are lacking or should improve in terms of innovation management to be able to carry out successful innovation projects; methods and parameters (length, depths, design) of a training that would be suitable and motivating for employees to do.	https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-HU01-KA202-078669
Digitalization in construction, Computer-based design for structural elements - Analyses and Validation of compliance to EuroCodes	Eramsus+	The construction sector is crucial for the European economy, representing approximately 10% of the GDP and providing 20 million jobs. The education of qualified, competent engineers for this important market lies in the responsibility of the universities. The educational process has to be constantly adapted to the state-of-the-art and new technologies. This leads to attractive course programs fitting the needs from industry. The future of the construction sector is strongly affected by the upcoming digitalization process and industry 4.0.	https://erasmus-plus.ec.europa.eu/projects/search/details/2018-1-LU01-KA203-037313
21st century skills	Eramsus+	With this project we wanted to foster the skills every student needs for being well prepared for the time at and after school. With the help of new media and ICT we focussed on critical thinking-, communicating-, collaborating-, creative thinking- and career and	https://erasmus-plus.ec.europa.eu/projects/search/details/2018-1-DE03-KA229-047203

		life skill. If students leave school being unaware of their skills and unaware of the competences that our century looks for, they will be unprepared for the challenges of society and workforce.	
AI REGIO	I4MS	The AI REGIO project aims at filling three major gaps currently preventing AI-driven DIHs from implementing fully effective digital transformation pathways for their Manufacturing SMEs: at policy level the Regional vs. EU gap; at technological level the Digital Manufacturing vs. Innovation Collaboration Platform gap; at business level the Innovative AI (Industry 5.0) vs Industry 4.0 gap.	https://www.airegio-project.eu/
KITT4SME	I4MS	KITT4SME delivers a modularly customisable digital platform that can seamlessly introduce artificial intelligence in their production systems. The project will ensure that the kits are widely distributed to a wide audience of SMEs and midcaps in Europe. What is more, the seamless adoption of the kits will be facilitated with the use of factory systems like ERP, as well as IoT sensors and wearable devices, robots, and other factory data sources.	https://kitt4sme.eu/
Exploiting Ubiquitous Computing, Mobile Computing and the Internet of Things to promote Science Education	Horizon 2020	In this project we aim to develop an integrated yet open training framework for upper high school students.	https://cordis.europa.eu/project/id/710583
RETHINK	Horizon 2020	Open and productive interactions between science and society are vital for a healthy democracy. The relationship between science and the rest of society is a crucial aspect of how our society develops and addresses societal challenges.	https://cordis.europa.eu/project/id/824573

Table on tools and trainings for SMEs

	training (basic)	training (advanced)
Business Organisation Management	**1. Co-working tools:** a) Google Docs - https://www.google.com/docs/about/ b) MS 365 - https://microsoft.com **2. Safe data sharing tools:** a) DROPBOX - https://www.dropbox.com/business/tour b) Google Drive - https://www.google.com/drive/ c) WASP - http://www.waspbarcode.com/training d) SHAREiT - http://www.ushareit.com/help **3) Project management tools:** a) Asana - https://academy.asana.com/ b) Monday - https://monday.com c) Basecamp - https://basecamp.com/learn d) MS Project - https://www.microsoft.com/pl-pl/microsoft-365/project/project-management-software e) Trello - https://trello.com/tour **4. ERP:** webpages of particular software developers, You Tube, Linked In (SlideShare) etc.	
Staff digital competences and skills	**How is the digital world impacting careers?** https://openclassrooms.com/en/courses/5651686-how-is-the-digital-world-impacting-careers **Digital Skills for SMEs:** https://www.digitalsme.eu/digital-skills-resources/	
Finance	https://www.udemy.com/topic/payments/ https://www.mooc-list.com/tags/payment-systems https://www.youtube.com/watch?v=KltZZ9js99w	
Business environment and Strategy		

Planning (business model...)	**STRATEGYZER** 1. https://www.strategyzer.com/training#virtual-masterclass 2. https://www.strategyzer.com/training#online 3. https://www.strategyzer.com/training#live 4. https://www.strategyzer.com/training#enterprise **LEANSTACK** 1. https://leanstack.com/educators 2. new business model for manufacturing companies: https://i4ms.eu/trainings/new-business-models-for-manufacturing-companies/ 3. Introduction to Connected Strategy: https://www.edx.org/course/connected-strategy-2 4. Drive Digital Transformation Programs or Projects: https://openclassrooms.com/en/courses/6356111-drive-digital-transformation-programs-or-projects	Business model: digital transformation https://www.researchgate.net/publication/326808621_Digital_Transformation
Business Intelligence	Digital Transformation in Business https://www.edx.org/course/strategic-and-transformational-it-2	Business Intelligence Concepts, Tools, and Applications: https://www.my-mooc.com/en/mooc/business-intelligence-concepts-tools-and-applications/
Innovation management	https://www.imp3rove.de/services/training_courses/	
Investment /funding	crowdfunding: https://www.youtube.com/watch?v=8b5-iEnW70k	
Marketing	**digital marketing:** https://openclassrooms.com/en/courses/6910726-discover-digital-marketing **social media strategy:** https://openclassrooms.com/en/courses/6910706-develop-a-social-media-strategy **digital marketing tools:** https://www.youtube.com/watch?v=zBD-wxaUm1Q	Digital Marketing Analytics Tools and Techniques: https://www.edx.org/course/digital-marketing-analytics-tools-and-techniques
Sales	digital sales tools for SME https://www.youtube.com/watch?v=k9dH-33pGx0	
Client management and services	Manage Your Customer Relationships With CRM https://openclassrooms.com/en/courses/5961521-manage-your-customer-relationships-with-crm	
Customer experience		
Product Design & Prototyping		The Design Sprint: https://www.thesprintbook.com/the-design-sprint

Production process	**Destination AI: Introduction to Artificial Intelligence:** https://openclassrooms.com/en/courses/7078811-destination-ai-introduction-to-artificial-intelligence **AI Opportunities for SMEs** https://i4ms.eu/trainings/ai-opportunities-for-smes/ https://i4ms.eu/trainings/ https://www.elementsofai.com/	Additive manufacturing/ AI/VR-AR/ Big data/ IoT https://i4ms.eu/trainings
	https://crosser.io/blog/ https://blog.arduino.cc/ https://projects.raspberrypi.org/en	Additive manufacturing/ AI/VR-AR/ Big data/ IoT/robotics https://azure.microsoft.com/en-us/support/options/ https://i4ms.eu/trainings https://iot.eclipse.org/community/resources/ http://oscada.org/wiki/Home
IT system / infrastructure		
Connectivity	https://www.slideshare.net/search/slideshow?searchfrom=header&q=connectivity	
IT security/cybersecurity	**Secure Your Web Application with Spring Security:** https://openclassrooms.com/en/courses/5683681-secure-your-web-application-with-spring-security **SlideShare:** https://www.slideshare.net/search/slideshow?searchfrom=header&q=cybersecurity **Cybersecurity self-assessment:** https://cyberwatching.eu/cybersecurity-best-practices-smes-assessment **Cyberwatching.eu** is regularly organizing a series of webinars and in-depth analysis on the cybersecurity and privacy landscape https://cyberwatching.eu/webinar	European union agency for cybersecurity: https://www.enisa.europa.eu/topics Cybersecurity: https://scholarship-positions.com/open-university-free-online-course-on-cyber-security/2015/08/05/
Data collection & storage/account management	**IT management system** https://www.slideshare.net/search/slideshow?searchfrom=header&q=it+system+management **Perform an Initial Data Analysis** https://openclassrooms.com/en/courses/6037301-perform-an-initial-data-analysis **Intro to Data Analysis** https://www.udacity.com/course/intro-to-data-analysis--ud170	https://i4ms.eu/trainings **Knowledge Management and Big Data in Business** https://www.edx.org/course/knowledge-management-and-big-data-in-business
Advanced technologies for all business areas		

AI	Destination AI: Introduction to Artificial Intelligence: https://openclassrooms.com/en/courses/7078811-destination-ai-introduction-to-artificial-intelligence AI Opportunities for SMEs https://i4ms.eu/trainings/ai-opportunities-for-smes/ https://www.elementsofai.com/ Introduction to AI – EDUREKA https://www.youtube.com/watch?v=4jmsHaJ7xEA&list=PL9ooVrP1hQOGHNaCT7_fwe9AabjZI1RjI	https://i4ms.eu/trainings/
IoT	IoT Tutorial for Beginners – EDUREKA https://www.youtube.com/watch?v=h0gWfVCSGQQ	https://i4ms.eu/trainings/
Blockchain	BlockChain Technology Expert https://www.youtube.com/watch?v=qOVAbKKSH10 BlockChain Technology Explain – EDUREKA https://www.youtube.com/watch?v=QCvL-DWcojc	https://i4ms.eu/trainings/
VR / AR / XR	Exploring VR - https://www.youtube.com/watch?v=YicQh4d5488	https://i4ms.eu/trainings/
Big Data		https://i4ms.eu/trainings/
High Performance Computing (HPC)		https://i4ms.eu/trainings/

Category	Tool Description	Tool Name	Tool Website
Business Organisation, Management	Co-working	Miro	https://miro.com/
		MS Teams	**https://www.microsoft.com/en-ww/microsoft-teams/group-chat-software**
		Stormboard	https://stormboard.com/
		DropBox Paper	https://www.dropbox.com/paper
		Mural	https://www.mural.co/
		Google Workspace	https://workspace.google.com/
		Klaxoon	https://klaxoon.com/
		Monday.com	https://monday.com/
	Safe data sharing	Dropbox	https://www.dropbox.com/
		Google Drive	https://www.google.com/drive/
		Sharepoint	https://www.microsoft.com/en-us/microsoft-365/sharepoint/collaboration
	Project Management	Trello	https://trello.com/en
		Jira	https://www.atlassian.com/
		Asana	https://asana.com/guide

		Zapier	https://go.zapier.com/webinars-on-demand/
		Agiloft	agiloft.com
		Product Board	https://www.productboard.com/
		MS Planner	https://www.microsoft.com/en-us?ql=6
		BaseCamp	https://basecamp.com/
		PRIVMX	https://privmx.com/pl
	Document Management	Sharepoint	https://www.microsoft.com/pl-pl/microsoft-365/sharepoint/collaboration
		Google Drive	https://www.google.pl/intl/pl/docs/about/
		Evenote	www.evernote.com
Staff digital competences and skills	HR4.0	Monday.com	www.monday.com
	Employees Mental Health	Teems	**https://www.teem.com/**
		Wellics	https://www.wellics.com/
		Welltok	https://welltok.com/
		Headspace	https://www.headspace.com/
Finance	Payment tools	Six	six-payment-services.com/en/home.html
		Paypal	https://www.paypal.com/
		Stripe	https://stripe.com/
		Expensify	https://www.expensify.com/
		Square	https://squareup.com/us/en
		Quick Books	https://quickbooks.intuit.com/eu/
Planning	Business model	Strategyzer	https://www.strategyzer.com/
		Pimento Map	https://www.pimentomap.com/fr/
Business Intelligence	business intelligence-analytics	SAP BusinessObjects	https://www.sap.com/products/bi-platform.html
		Dundas BI	https://www.dundas.com/dundas-bi/platform
		SAS Viya	https://www.sas.com/en_ie/software/viya.html
		Geckoboard	https://www.geckoboard.com/
		Sisense	https://www.sisense.com/
		Oracle BI	https://www.oracle.com/business-analytics/business-intelligence/
Quality Management		AppQual	https://www.viotconsulting.fr/en/
		Mastercontrol	https://www.mastercontrol.com/uk/
		Intelex Quality Management Software	https://www.intelex.com/landing/quality-management-software/
		Scilife	https://www.scilife.io/
		Euroquity	https://www.euroquity.com/fr/home

Investment - funding	investment platform / Crowdfunding	Ulule	https://fr.ulule.com/
		Spreds	https://www.spreds.com/
		Kiss Kiss Bank Bank	https://www.kisskissbankbank.com/
		Fundedbyme	https://www.fundedbyme.com/en/
		Symbid	https://www.symbid.com/
		Companisto	https://www.companisto.com/en/version-b
		Invesdor	https://www.invesdor.com/en-gb/
		Seedmatch	https://www.seedmatch.de/
		Look&Fin	https://www.lookandfin.com/fr/
		Lita co	Lita.co
		Miimosa	https://www.miimosa.com/
Marketing	Marketing tools	Presenter Media	https://www.presentermedia.com/
		MS Dynamics	https://dynamics.microsoft.com/en-us/
		Google Adwords	https://ads.google.com/home/
		Monday.com	Monday.com
		Grammarly	https://app.grammarly.com/
		Canva Pro	https://www.canva.com/pro/
		Adobe Premiere	https://www.adobe.com/gr_en/products/premiere.html
	Website building tools	Wordpress	https://pl.wordpress.org/
		Squarespace	https://www.squarespace.com/
		Medndix	https://www.mendix.com/
		Hubspot	https://www.hubspot.com/
		Sendinblue	https://www.sendinblue.com/
		Wix	https://www.wix.com/mystunningwebsites/domain-solutions
	Social Media	HootSuite	https://signuptoday.hootsuite.com/
		Sendinblue	https://www.sendinblue.com/
		Google Adwords	https://ads.google.com/home/
		LinkedIn	https://business.linkedin.com/
		Facebook	https://www.facebook.com/business/small-business
		Twitter	https://business.twitter.com/en/basics/create-a-twitter-business-profile.html
		Sales Navigator	
		Clubhouse	
	Communi-cation tools	Zoom	https://zoom.us/
		MS Teams	https://www.microsoft.com/
		Cisco Webex	https://www.webex.com/#
		GotoWebinar	https://www.goto.com/webinar
		Slack	https://slack.com/intl/en-pl/
		Join me	https://www.join.me/

		Click Meeting	https://clickmeeting.com/
		Livestorm	https://livestorm.co/
Sales	Sales Tools	Monday.com	https://monday.com/
		Showell	showell.com/product
		Salesscreen	https://www.salesscreen.com/
	Online Surves	Google Forms	https://workspace.google.com/intl/en_ie/products/forms/
		MS Forms	microsoft.com/en-us/microsoft-365/online-surveys-polls-quizzes
		Survey Monkey	https://www.surveymonkey.co.uk/
		Qualtrics	https://www.qualtrics.com/uk/
		Doodle polls	https://doodle.com/make-a-poll
	Emailing tools	Mail chimp	https://mailchimp.com/
		Flexmail	https://flexmail.be/
		GetResponse	https://www.getresponse.pl/
		FreshMail	https://freshmail.com/
		Sendinblue	https://www.sendinblue.com/
Client Management, Client Satisfaction & Other Services	CRM	Hubspot	https://www.hubspot.com/
		MS Dynamics	https://dynamics.microsoft.com/en-us/
		Monday	Monday.com
		Salesforce	https://www.salesforce.com/
		Apptivo	https://www.apptivo.com/
		WRS Health	
		Keap	
Customer enagagement & experience	**Chatbots**	Boost AI	boost.ai/chatbot-vs-conversational-ai-solutions
		Netomi	https://demo.netomi.com/learn
		BonsAI	https://bonsai.tech/technologies/enterprise-chatbots
		Atspoke	https://www.atspoke.com/
	Customer Experience (CX) softwares	Zendesk	https://www.zendesk.com/
		Zephyrtel	https://www.zephyrtel.com/solutions/customer-engagement/
		Satmetrix	https://www.satmetrix.com/
		SAS	https://www.sas.com/en_lu/home.html
		Survey Monkey	https://www.surveymonkey.com/cx/
		Qualtrics	https://www.qualtrics.com/uk/customer-experience/
Product Design & Prototyping	Prototyping	Adobe XD	https://www.adobe.com/pl/products/xd.html
		Sketch	https://www.sketch.com/
		Origami	https://origami.design/
		Lean Startup	https://leanstack.com/leancanvas

		Mendix	https://www.mendix.com/
		AutoCAD/AUTODESK	https://www.autodesk.com/products/autocad/overview?term=1-YEAR
PP:IoT	IoT	Arduino	https://www.arduino.cc/
		Eclipse IoT	https://iot.eclipse.org/
		Azzure IoT	https://azure.microsoft.com/en-us/features/iot-accelerators/
		Crosser	https://crosser.io/use-cases/edge-analytics-use-cases/on-premise-iot/
		Rasbpian	https://www.raspberrypi.org/downloads/raspbian/
		Open Scada	oscada.org
		IoTiFY	https://iotify.io/
		EVO-On	https://www.sidel.com/en/go-digital/evo-on-software-suite-sv1-82
		aPriori	https://www.apriori.com/
PP:AI	AI	Watson	https://www.ibm.com/watson
		dataiku	https://www.dataiku.com/stories/transforming-predictive-maintenance-with-ai/
		Rstudio	https://www.rstudio.com/
PP:Big Data	BD	Rstudio	https://www.rstudio.com/
		Tableau Public	https://public.tableau.com/en-us/s/
		Microsoft Power BI	https://powerbi.microsoft.com/en-us/what-is-power-bi/
		Funnel	https://funnel.io/business-intelligence
		Anodot	https://www.anodot.com/
PP: Additive Manufacturing		OpenSCAD	https://openscad.org/
		Tinkercad	https://www.tinkercad.com/
		Fusion 360	https://www.autodesk.in/products/fusion-360/overview
		CATI	https://www.cati.com/blog/2016/03/3d-printing-manufacturing-floor-tools/
PP: XR, AR, VR, 3D,	XR	Makerbot	https://www.makerbot.com/
		RepRap	https://www.germanreprap.com/home-en.aspx
		Unity	https://unity.com/
		Adobe Illustrator	https://www.adobe.com/gr_en/products/illustrator.html
PP: Robotics/ Robotics Automation		blueprism	https://www.blueprism.com
		Inflectra Rapism	https://www.inflectra.com/Rapise/
		MAGOS	https://www.themagos.com/
PP:Logistics		Logisuite	https://www.logisuite.com/
		SoloPlan	https://www.soloplan.com/
PP: Maintenance		Atlantis engineering	https://atlantis-engineering.com/aimms/

		Ranesas Electronics	https://info.renesas.com/en-predictive-maintenance-motor-ctrl-ra6t1-webinar
PP: Other	Other	ArcMap GIS	https://desktop.arcgis.com/en/arcmap/
Connectivity		PRTG Network Monitor Reviews	https://www.paessler.com
		NetApp OnCommand Insight	https://www.netapp.com/data-management/oncommand-insight/
		OpenRoaming	https://www.cisco.com/c/en/us/solutions/enterprise-networks/802-11ax-solution/openroaming.html
		Datadog	https://www.datadoghq.com/
		SolarWinds NPM Reviews	https://www.solarwinds.com/fr/network-performance-monitor/reviews
		LogicMonitor	https://www.logicmonitor.com/
Cloud	cloud services	NetApp	https://www.netapp.com/
		Microsoft Azure	https://azure.microsoft.com/en-us/overview/
		AWS	https://aws.amazon.com/?nc1=h_ls
		Google cloud	https://cloud.google.com/
		IBM cloud	https://www.ibm.com/uk-en/cloud
		GAIA-X	https://www.data-infrastructure.eu/GAIAX/Navigation/EN/Home/home.html
		Pcloud	https://www.pcloud.com
		FUGA cloud	https://go.fuga.cloud/european-cloud
		Oracle	https://developer.oracle.com/
CyberSecurity	Penetration Testing	Kali linux	https://www.kali.org/
		Metasploit	https://www.metasploit.com/
	Tools for scanning web vulnerabilities	Nexpose	https://www.rapid7.com/products/nexpose/
		Paros Proxy	https://www.sophos.com
		Burp Suite	https://portswigger.net/burp/enterprise
		Nessus Professional	https://www.tenable.com
	Password auditing and packet sniffers	Solarwinds	https://www.solarwinds.com

	cybersecurity tools	ManageEngine NetFlow Analyzer	https://www.manageengine.com/products/netflow/
		Paessler Packet Capture Tool A packet sniffer,	https://www.paessler.com/packet_sniffing
	Cybersecurity tools for network defense	syxsense	https://www.syxsense.com/secure
	Encryption cybersecurity tools	IBM Security Guardium Data Encryption	https://www.ibm.com/security/services/cryptography
		AxCrypt Premium	https://axcrypt.net/premium
		NordLocker	https://nordlocker.com/
	Tools for monitoring network security	Splunk	https://www.splunk.com/
		Nagios	https://www.nagios.org/
		Acunetix	https://www.acunetix.com/web-vulnerability-scanner/
	Cybersecurity tools for detecting network intrusions	Forcepoint	https://www.forcepoint.com/
		GFI LanGuard	https://www.gfiguard.com/GFi-LANguard-NSS.asp
Accounts management / Storage other	Password managers	Keeper	https://www.keepersecurity.com/
		1password	https://1password.com/
		Dashlane	https://www.dashlane.com/
		Nordpass	https://nordpass.com/
		rememberbear	https://www.remembear.com/
AI	AI	Microsoft Azure AI Platform	https://azure.microsoft.com/en-us/
		Google Cloud AI Platform	https://cloud.google.com/
		IBM Watson	https://www.ibm.com/watson
		Infosys Nia	https://www.edgeverve.com/artificial-intelligence/nia/
		Dialogflow	https://dialogflow.cloud.google.com/#/getStarted
		BigML	https://bigml.com/
		Chatbot	https://www.chatbot.com/
IoT	IoT	Comarch	https://www.comarch.com/iot-ecosystem/iot-platform/
		Arduino	https://www.arduino.cc/
		Eclipse IoT	https://iot.eclipse.org/
		IBM Watson	https://www.ibm.com/watson

		Open Scada	http://www.scadasoftware.net/scada/openscada.html
		Microsoft Azure IoT	https://azure.microsoft.com/fr-fr/overview/iot/
		Crosser	https://crosser.io
		Paessler	https://www.paessler.com/
		IoTiFY	https://iotify.io/
Blockchain	Blockchain	Solidity	https://docs.soliditylang.org/en/v0.8.5/
		Truffle	https://www.trufflesuite.com/
		Metamask	https://metamask.io/
VR / AR / XR	VR AR XR	Unity	https://unity.com/
		Amazon Sumerian	https://aws.amazon.com/fr/sumerian/
		Google VR for everyone	https://developers.google.com/vr/
		Unreal Engine 4 (UE4)	https://www.unrealengine.com/en-US/
Big Data	Big data	R Studio	https://www.rstudio.com/
High Performance Computing (HPC)	HPC	Anodot	https://www.anodot.com/
		Microsoft Power BI	https://powerbi.microsoft.com/en-us/
		Tableau public	https://public.tableau.com/
		PRACE	https://prace-ri.eu/prace-for-industry/shape-access-for-smes/

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Digital Coach [2020-1-DE02-KA202-007683]

Title of the respective Self-Study-Module

Self-study module for Digital Coaches (Subtitle)

Editor:
Prof. Dr. Martin Kröll, Institute for Work Science (IAW), Ruhr-University Bochum. All rights reserved.

Editorially responsible organization:
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Project Website:
www.digitalcoaches.eu

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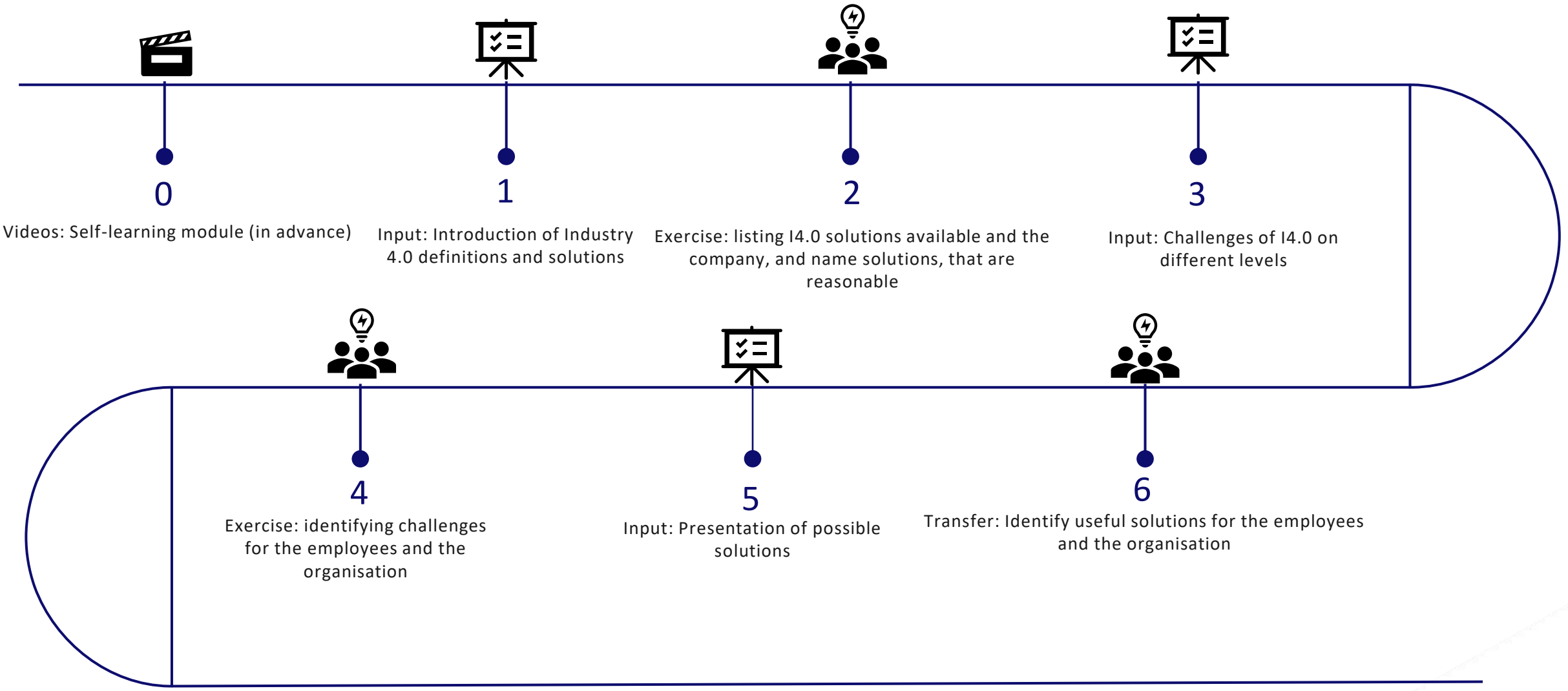
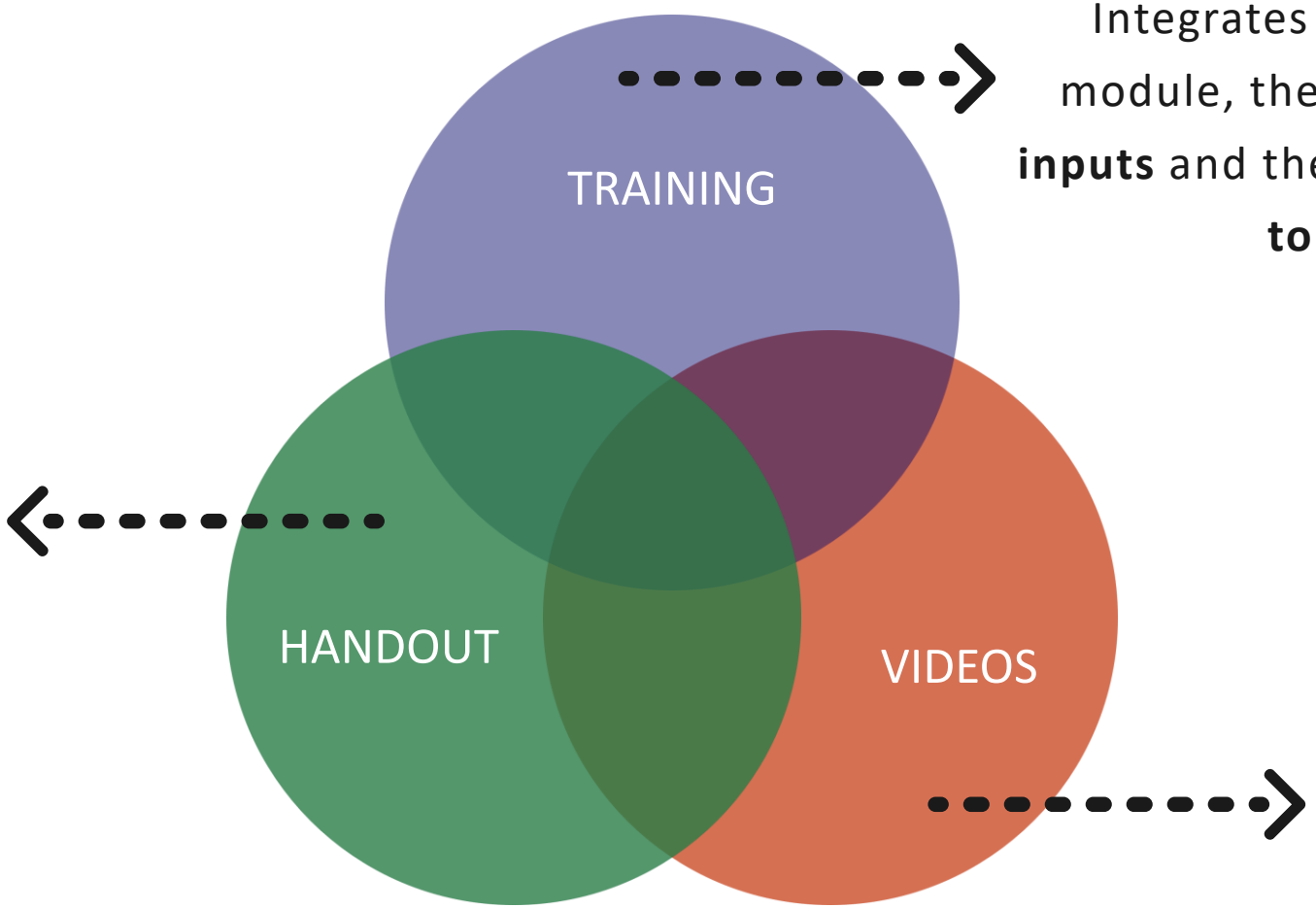
Training concept for the module Challenges of Industry 4.0 for Young Entrepreneurs

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

Training structure



How is the knowledge about the module communicated to the participants ?

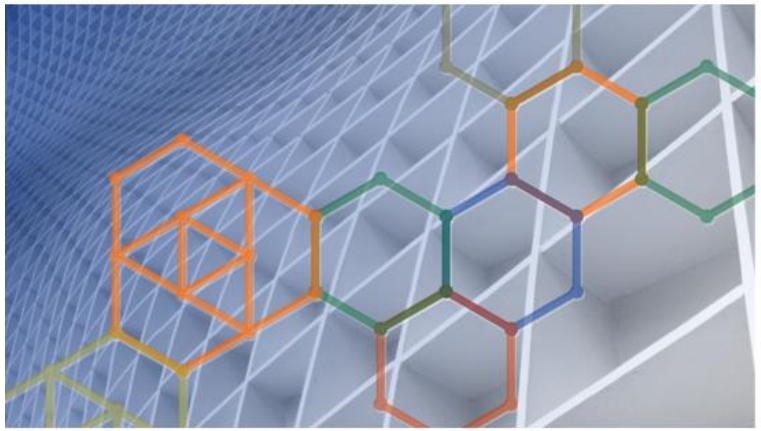


Integrates the self-learning module, the video, the **theory inputs** and the **individual transfer to practice**

Self-study module serves as support during the seminar and for effective follow-up work

Gives a **quick overview** of the topic as an easy introduction to the training content

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



Digital Coach [2020-1-DE02-KA202-007683] – Intellectual Output 2

Challenges of Industry 4.0 for Young Entrepreneurs

Self-study module for Digital Coaches (Subtitle)

Mrs. Eszter Nagy – Ms. Kristina Pohli, Chamber of Commerce and Industry of Pécs-Baranya

Published by: Institute for Work Science - Ruhr University Bochum | BOCHUM, 31st AUGUST 2023

Video of the self-learning module

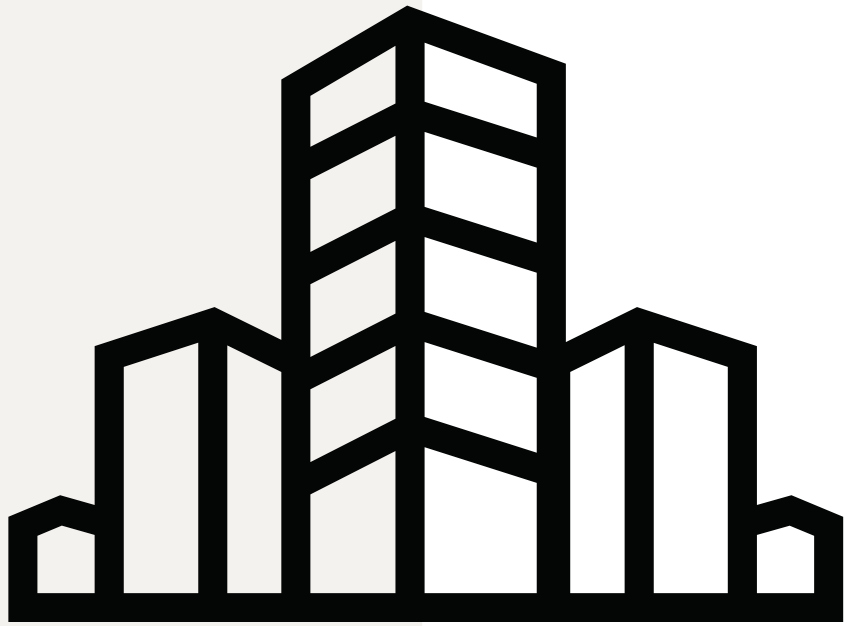
- Presentation of the self-study module:
  - What are the objectives of the self-study module?
  - How is the self-study module structured?
  - What to expect as a reader/learner?

THEORETICAL INPUT

Training Part 1: Introduction of Industry 4.0 definitions and solutions

- Brief history of industrial development
- Definition(s) of Industry 4.0
- Tools of Industry 4.0 – Technological pillars

THEORETICAL INPUT



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Training Part 2: listing I4.0 solutions available and the company, and name solutions, that are reasonable

- What technologies are already used in the organisation?
- What further technologies would be reasonable technologically and financially for the organisation?
- What other aspects must be considered, when deciding on developments in the organisation?

GROUP WORK +
SUBSEQUENT PRESENTATION OF THE RESULTS

SOLUTIONS AVAILABLE?

WHAT DEVELOPMENTS WOULD BE REASONABLE?

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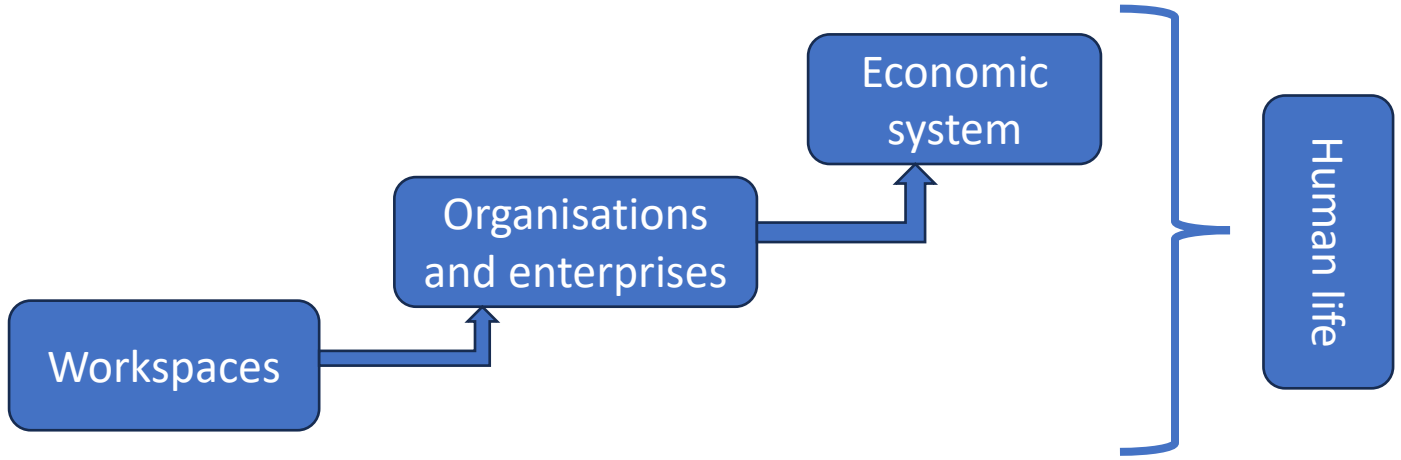
Training Part 3: Challenges of I4.0 on different levels

LEVELS

- Micro level: workspaces
- Meso level: organizations and enterprises
- Macro level: economic system
- Social level: human life

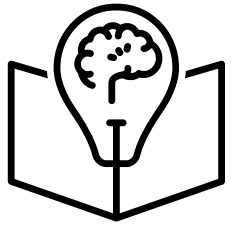


GROUP MEETING

- Which levels can be handled individually?
- Which levels can be handled in an organisation, or enterprise?
- How do these levels affect each other?

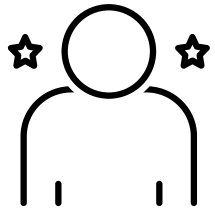
Reflection in large group

Training Part 4: identifying challenges for the employees and the organisation



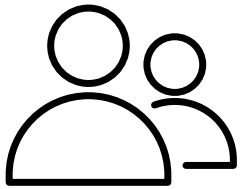
Theoretical input

- What are the challenges for the organisation/enterprise, and it's members?



Individual work

- Identify the challenges in the different departments of the organisation
- Who can support the participants to face these challenges?



Exchange in teams (sparring partners)

- Compare the results
- Reflect together/ feedback from the sparring partner

COMBINATION OF INDIVIDUAL AND TEAMWORK

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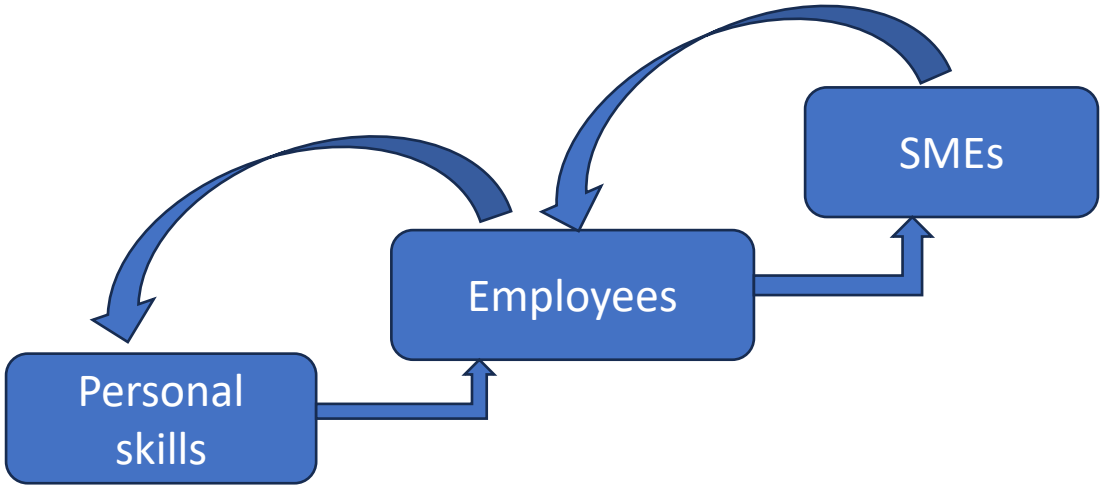
Training Part 5: Presentation of possible solutions

LEVELS

- Development of personal digital skills
- Development of digital skills for employees
- Development of digital skills for SMEs

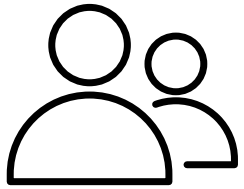


GROUP MEETING

- Which levels can be handled individually?
- Which levels can be handled in an organisation, or enterprise?
- How do these levels affect each other?

→ Reflection in large group

Training Part 6: Identify useful solutions for the employees and the organisation



Decide together on:

- What is the aim?
- What stage is my company at now?
- Where to start?
- How to convince and involve my colleagues?
- What do we have to digitise?

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