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Danube Transnational Programme
DanubePeerChains

Integrated capacity building and training programme for DANUBE area labour and business support organizations, local industry and entrepreneurs to enter innovative transnational value CHAINS as PEER-level collaboration partners
DTP3-497-SO1.2

Value-chain oriented training programme to qualify digitalization specialists and entrepreneurs

Deliverable D.T2.2.2

Lead Contractor of the Deliverable: LP Biz-Up

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Content

Introduction

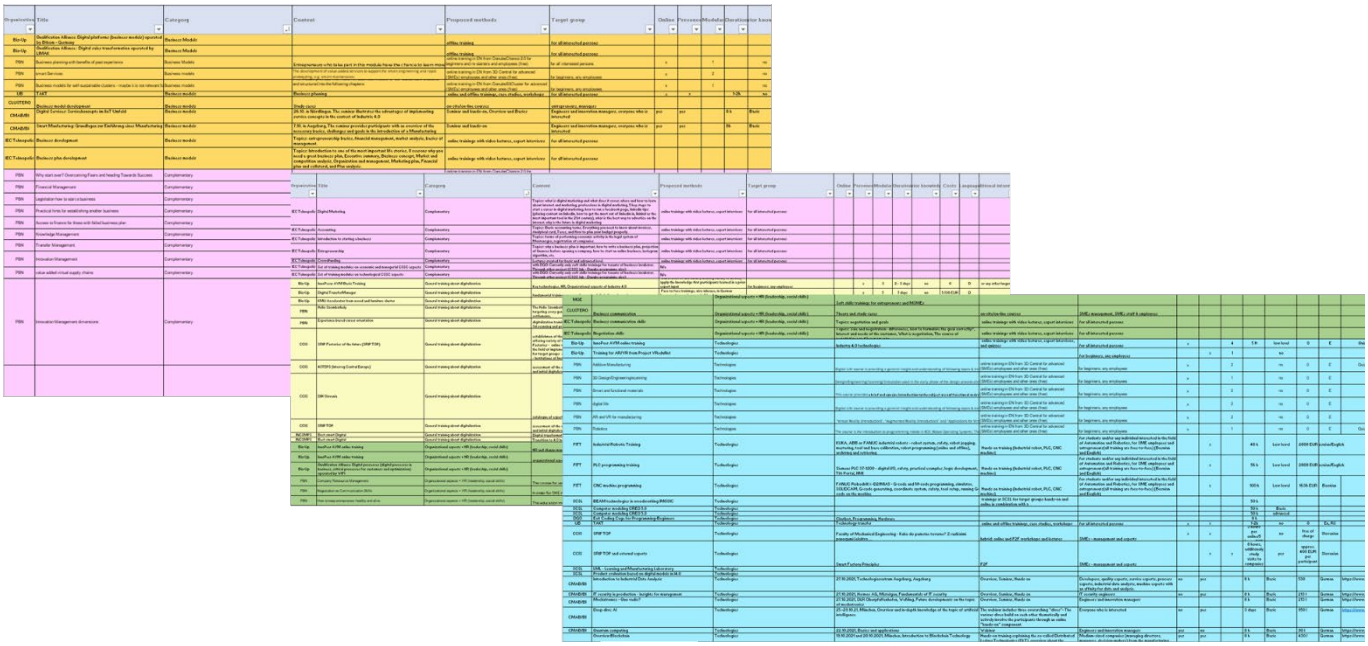
The main objective of D.T2.2.2 is the development of the training programme for entrepreneurs and SME employees with the aim to enhance their know-how in digitalization topics and to become digitalization specialists.

According to the AF: Activity leader Biz-Up will lead the development of the DanubePeerChains training programme to qualify digitalization specialists/entrepreneurs with clear focus on value chain perspective. Target participants, content and structure will be defined.

Based on the discussion held during the Meeting in Zagreb, in September 2021 the partnership decided to capitalize on the already existing training programme of the projects InnoPeer AVM, by taking into consideration the local capacities and upskilling needs, and complementary trainings. A specific focus will also be put on the value chain aspect, i.e. which are the pre-requisites for SME to become part of transnational value chains and how to exploit the widening of their business beyond their current customer / supplier territories.

Results of the SCOM #2a in Zagreb, Sept. 2021

As preparation for the discussion of the training content during the SCOM the partners were encouraged to list already existing trainings, in order to capitalize on previous projects, initiatives and to also take into consideration the specific local situations. For example, in some countries the SME are facing strong challenges in financing new digital solutions and to overcome this knowledge gap, a training has been developed and provided for local SME. Another example is the challenge for SME to protect their intellectual property.



In total, the partners have collected more than 100 training offers, which have been categorized as follows:

- General training about digitalization
- Technologies
- Organizational aspects and HR incl. soft skills
- Business models and smart services
- Complementary

The training table is attached as annex to this document.

At the SCOM in Zagreb, the partnership decided to implement

- local training courses: 1 x training on a basic level, 1 x specific training
- online trainings: (new) value-chain related trainings, already existing trainings as capitalization of previous projects

Content of the training programme

This training programme comprises a collection of training topics which can be selected by the project partners according to their local needs. Starting with offline training on a basic level, and continued with specialized trainings the local SME should be training in native language. The online trainings that are developed within this project have a clear focus on the value chain aspect in different branches and economies. Further, the partnership will promote the already existing trainings from previous projects, which address digitalization specific topics, e.g. Industry 4.0 technologies, but also complementary topics, as e.g. innovation management or IPR.

General training/information about digitalization

The starting point for the DanubePeerChains training will be an offline training on a basic level, by capitalizing on the Basic Training from InnoPeer AVM.

The basic training will start with a general introduction to the term “Industry 4.0” (I4.0). One of the main aspects in the definition of I4.0 are the digitally networked systems needed to realize a world, where everything from machines to people are connected to each other. These intelligent connected devices can also be called cyber-physical Systems or CPS, since it consists of information technology / software and physical mechanical and electrical parts. These CPS are able to communicate with each other for example over the internet. Two of the main factors leading to the development of I4.0 are:

- Generally shorter product lifecycles, especially in electronic products
- Growing demand for individual products (mass customization)

Since these are only general trends in the context of I4.0, an example should be presented as storyline, in which a possible implementation in SMEs is shown. A concept, which can also be mentioned in the context of I4.0, is the Reference Architecture Model Industrie 4.0 (RAMI 4.0).

Technology topics in digitalization

This chapter describes the training topics, which can be covered in the trainings on technologies. Since all of the technology topics can be covered very detailed, the basic training has the goal to just give an overview with the most relevant information in addition to the technology-focused introduction in general.

General Technological Trends in I4.0

In the first part of a basic training, general technological trends have to be covered, which are the direct result of the reasons for the German Industrie 4.0. These topics are treated separately since they are not directly related to unified connectivity, which is typically one of the main aspects in I4.0.

Additive Manufacturing / 3D Printing

Due to the demand for individualized products, new manufacturing processes, which are able to produce a high variant diversity up to batch size one, are needed. As a result of this development, the technologies summarized with 3D printing or additive manufacturing have developed to the most promising manufacturing processes to produce batch size one. Generally, there are three processes that can be distinguished: Manufacturing out of a liquid state (e.g. stereolithography), manufacturing out of a plastic state (e.g. Fused Deposition Modeling) and manufacturing out of a powdered state (e.g. SLM, SLS, EBM).

For the basic training, these three manufacturing processes should be described briefly, with examples for their practical application.

Flexibility and Changeability

As a result of smaller batch sizes and shorter product life cycles, production systems have to be adapted to new products in a very short time to be cost efficient. In this context, the two terms “flexibility” and “changeability” are used very often to describe this kind of adaptability.

The concepts of flexibility and changeability should be covered in the InnoPeer basic training by explaining these two terms and their difference. They should be elaborated with suiting examples from existing production lines as well as research demonstrators that can show new concepts in this field.

Simulation, Digital Twins and Virtual Commissioning

To achieve shorter set up times in production lines, simulation can be used for creating or testing the configuration virtually before setting it up in reality. In this context, the terms “Digital Twin” and “Virtual Commissioning” are also used very often. Another term that has to be mentioned in direct correlation to virtual commissioning is Hardware in the Loop (HiL).

The basic training should impart knowledge about general application of simulation models with focus on virtual commissioning/ HiL and show how these models can be created and integrated.

Human Machine Collaboration / COBOT

Human machine collaboration describes generally a coordinated, synchronous activity between a human and a machine that is the result of a continued attempt to achieve a common goal. This means that the machine and the human are directly working together on one task. The term “COBOT” is short for collaborative robot and a specialization of human machine collaboration. It refers to (industrial) robots working together with humans and supporting them in their tasks.

For the basic training, the different types of collaboration and cooperation between human and machines/robots should be explained by giving short examples out of practical application. It should also be mentioned that current research shows that a cooperation is a more realistic scenario in the near future than collaboration.

Connectivity

This chapter focuses on one main aspect of I4.0, which is connectivity. The topic connectivity is split up into the three aspects Connectivity Technologies, Data Models and Security.

Connectivity Technologies

In the introduction to I4.0 it was elaborated that the connectivity between all machines to form a digitally networked system can be considered as one of the main aspects. However, in today’s automation systems, there are many different interfaces and protocols present for connectivity, which are often also preferred or developed by certain manufacturers. To connect every machine to each other, a full interoperability and thus a unified communication needs to be established.

In the basic training the general problematics with proprietary interfaces in relation to the goals of I4.0 should be elaborated and also a brief description of the relevant I4.0 connectivity technologies provided. Detailed examples on the application of these standards can be given in more specific trainings for advanced participants.

Data Models

While unified interface standards are important to connect machines to each other, this does not necessary mean that a full interoperability is provided. It is still possible to transfer proprietary data by bits and bytes without any common understanding about its semantic meaning. It is therefore necessary to create common data semantics, which are known by all participants in an I4.0-Network. These data models can be based on existing standards, but have now to be adapted to the new communication technologies like OPC UA.

The basic understanding on why data models are as important as common network standards for I4.0 should be presented in the InnoPeer basic training by showing a few selected use cases, especially in terms of processing a lot of data from different types of machines for condition monitoring, predictive maintenance or online process optimization.

Security

While more and more machines will be connected over the Industrial Internet of Things (IIoT), the aspect of security becomes especially important. For security reasons, most production systems are currently heavily protected by firewalls or completely closed off from the outside world and are therefore not able to transmit any data to the IIoT.

The topic of security in IoT networks should be covered in the InnoPeer basic training by giving an overview on the topics' importance in a connected world and showing the biggest security risks that we are facing today. Since security is also directly connected to the communication technologies, brief but concrete examples should be given how these technologies tackle this topic (for example the build in security system of OPC UA especially designed for industrial application).

Data Collection and Analysis

This chapter focuses on how data can be collected effectively and how it can be analyzed to get a concrete benefit out of the connectivity.

Data Collection via Cloud and Big Data

While interfaces and data models are the basis for data collection, mechanism and technologies have to be found to collect and store this data efficiently. Since most of the IIoT-Standards are not capable of deterministic real time communication, they are currently used to collect data for use cases like condition monitoring or online process optimization. These use cases are elaborated in the following chapters. In the InnoPeer basic training, the most common examples on how to collect data from different devices to a cloud service should be elaborated shortly. Hereby, the different technologies and cloud platforms should be presented shortly as well as the possible architectures to get data from devices up to the cloud.

Condition Monitoring and Predictive Maintenance

As stated in previous chapters, the lack of real time capability in modern IIoT-Standards makes them prominent for use cases that are based on data collection. Very common examples are Condition Monitoring and Predictive Maintenance. These terms do also have a relation to each other, since Condition Monitoring is the basis for Predictive Maintenance.

In general, the following different types of maintenance can be distinguished:

- Preventive Maintenance: The date of maintenance is being determined by time or condition
- Corrective / Breakdown Maintenance: Maintenance is performed if a machine has already broken down
- Predictive Maintenance: Using data analysis from condition monitoring, breakdowns arising in the near future can be identified.
- Prescriptive Maintenance is an enhancement of predictive M. by using e.g. AI for deriving recommendations and corresponding outcomes to reduce operational risks
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In a basic training the different types of maintenance should be elaborated while stating why predictive/prescriptive maintenance are good strategies regarding costs and availability and thus justifying the higher investment costs.

Intelligent Sensors / Retrofit of existing machines

Often very old machines can be found in production systems, which have no connectivity options or even computer control. In these cases, sensors have to be added to utilize the use cases of condition monitoring and predictive maintenance. If a machine already has sensors but is missing connectivity, it is possible to fit adapters or gateways to get from proprietary data formats and connectivity options to standardized I4.0 protocols and data models. This process can also be called “retrofitting”.

In a basic training the addition of smart sensors and retrofitting of existing machines in terms of sensors and connectivity should be elaborated by giving different examples like the one stated above with the ABB Ability Smart Sensor. These examples should cover different types of devices and machines like Motors, Drives, CNC-Machines or injection moulding machines.

Organizational aspects and Human Resources Management

Implications of I4.0 for Human Resources and Org. Mgmt.

Companies are embedded in a wider context. This context has become more dynamic and competitive over the last years (“Hypercompetition”). Besides general changes in technology (e.g. digitalization), the introduction of Advanced Manufacturing technologies is determined by further factors of the context. The context can be distinguished in the industry and a wider societal context.

Regarding the wider societal context there exist six factors influencing changes towards digitalization – I4.0 are:

1. Technology: New technologies and the ongoing digitalization
2. Socio-cultural factors: Demographics, Digital Natives
3. Economic factors: Low interest rates, shortage on skills
4. Political factors: Digitalization agenda, innovation support programs, incubators
5. Law: Changes in data law, privacy, etc.
6. Environmental factors: Climate Change

Generally speaking, in Central European countries, demographics lead to a shortage of labour and states have been starting digital transformation agendas.

Regarding the industry further factors influencing adoption of Advanced Manufacturing can be distinguished:

1. Customers and their needs
2. Competitors
3. Suppliers
4. Potential entrants

In the last years industries have been disrupted by so called Internet giants (e.g. Amazon, Google, Tesla, etc.) threatening existing structures of value chains and businesses.

Against this background manufacturing firms start to work on their strategic goals (Positioning markets and resources in order to gain a competitive advantage), influencing their business models (combination of value proposition, value added model and revenue model) and finally their execution architecture (organizational design, work design and production system design). Central for the transformation of firms towards Advanced Manufacturing is a fit between strategic goals (based on resources and competencies), business model, and execution system with future demands resulting from the wider societal context and the industry context. Should there be a misfit, resources and competencies have to be aligned to the future demands.

Aims and Learning Goals for a Basic Training on HRM and Org. Mgmt.

A basic training on HRM and org. mgmt. has the overall goal to allow general managers and innovation managers to get a first introduction on the way these topics are affected by changes through Digitalization – I4.0. Specifically, the basic training aims at the following learning goals:

1. Describe and understand the interactions between environment, organizational structure and technology regarding I4.0
2. Describe and understand the changes for Human Resource Management and Org. Mgmt. design brought by I4.0
3. Describe and understand barriers and enablers of change towards Digitalization – I4.0 on the individual and organizational level

Based on these basic topics, practitioners should understand the importance of Org. Mgmt. and Human Resource Management for successful changes towards Digitalization – I4.0.

Content for a Basic Trainings on HRM and Org. Mgmt.

Based on the learning goals, a basic training should comprise the following topics and content:

1. Interactions of environment, structure and technology
    a. The law of requisite variety: Mechanistic vs. organic organizational forms, complexity and dynamic of context
    b. Technology, Size and Industry as context: Fit between organizational form, institutional and context factors
2. Changes for HRM and Org. Mgmt. design
    a. Allocating human resources according to future needs of the organization: Allocating will & skill according to the strategic needs
    b. Organizing work as a service and for flexibility: Innovative HRM, team-based work, virtual forms of collaboration
    c. Designing organizations for openness and continuous change
3. Barriers and Enablers of change towards Advanced Manufacturing
    a. Individual level: Competencies of employees, mindset of employees (technology acceptance, openness, empowerment & motivation), leadership
    b. Organizational level: Trade-off between flexibility (innovation) and efficiency (routine), culture & mindset as barrier, fit with strategy

Business models and smart services

Business Strategy and its relation to a Business Model

Starting a new business requires careful planning to maximize the chances of success. Many small businesses are unable to make profit and fail within the first few years of operation. The terms "business strategy" and "business model" describe related concepts that are key to the processes of planning and managing a business.

The business strategy for a company defines the path that the business will take to achieve its goals. These goals include the elements of the business model, along with any additional mission or goals. It explains the steps, processes and changes that the business will follow and it identifies the strategies the business will use to counteract potential upsets and hurdles. Achieving the business strategy requires the efforts of every employee. The business strategy should be

contemporary, if not advanced, to meet the current industry demands, as well as the forecasted demands.

In general, a business model makes no statements about the competitive situation. In contrast, a strategy describes how a company can differentiate itself from the competition and develop a sustainable competitive advantage.

Business Models in general

A business model is a plan for how a company is going to make money. This can be simple or very complicated. The business model should include details on all operations, as well as short- and long-term visions for the business' growth. Without a business model, investors and owners will not have a clear idea of how to best grow the business, and it will be much harder to create a stable and sustainable concern. The following terms should be described: Value Proposition and Market Segment, Value Chain Structure, Revenue Generation, Market Position and Strategy.

Impact of I4.0 on the Business Model

The fourth industrial revolution brings with it a wealth of possibilities; things can be done now that were never possible before. This gives organizations in the manufacturing industry the freedom to make the leap from supplying a product to delivering a service. An interesting example of this is the German company Kaeser Compressors. It transformed from being a supplier of compressors and being quite active both inside and outside manufacturing into being a supplier of compressed air.

This transformation was realized after Kaeser started up a large-scale project to integrate business processes. To do this, the Internet of Things (IoT) – the motor that runs I4.0 – was put into place to connect processes and devices via sensors. As a consequence, Kaeser got great insight into the entire production chain, a starting point from where service levels could be raised. Service is therefore central in the revamped business model.

Benefits of Business Models

The best business idea is usually not sufficient if it is not based on a well thought-out and functioning business model, which covers the key pillars of future success.

Making a business model serves several purposes, firstly the people involved in authoring the model engage very intensively with all the important aspects of the business, which can help to better understand it. On the other hand, the unique selling point can be worked out even more clearly and thus a better positioning in the market can be made possible. In addition, a mature business model provides a better estimate of the scalability of a business idea.

Description of Business Model with Canvas

The "Business Model Canvas" method is based on a specific, process-oriented approach to the content development of the various business model components. The method supports the analysis of the market potential of business ideas and business models in order to make the relationships and influences on a business model tangible and comprehensible. Using special visualization and creativity techniques and templates, nine essential building blocks of potential business models (customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships and cost structure) are developed in several workshop settings. Future developments can be structured and played through with different variants.

Describing new I4.0-Business Models

Existing Models that can be developed in direction of I4.0

In this chapter, the development of existing models in direction of I4.0 is outlined. Especially three models should be named and described: “Principal of E-Business in B2B market”, “Extreme Integration of Suppliers and Customers (value chain gets more connected)” and “Mass Customization is getting easier with I4.0”.

All this requires an IT system with the capacity to compute an enormous amount of data. All mutations must be recorded and accessible, day and night. That necessitates a powerful database. But then, all the information you need is available in real time, and you can respond even better to your customers’ requests.

Newly developed and models possible only with I4.0 - Service-based Business Models

The digitalization of plants and mechanical engineering enables many new business areas. Most of these digital business models affect service providers in the IT industry (such as software developers, software providers, data processors, service providers, web and app designers), and there are many new value-added opportunities for plant and machine builders, as providing Infrastructure as a Service with pay-per-use / pay-per-hour models. These new business models shift the classic services of the plant and machine manufacturer to IT-based services.

As part of the pay-per-use business model, the manufacturer waives the sale of a component or a machine. Instead, it provides the plant infrastructure or the machine as a service for a service charge. Thus, for example, the manufacturer of a power plant turbine could receive a fee only per completed operating hours of the turbine. This life-cycle-based approach shifts the maintenance and operational risk within the agreed availability to the plant and machine builders.

However, a pay-per-use model could offer some advantages, especially for plant and machine builders. On the one hand, he could incorporate his entire production know-how into the operation of the plant and make efficient use of synergies. On the other hand, he could gain information from the operation of a larger number of systems. By analyzing the data (big data) from the fleet control, predictive maintenance, that is the optimal timing of the maintenance based on pathological machine data, could be established.

Development of a Business Model

A business model typically contains a description of the customers, how customers use the product, how the company distributes the product and details about how to promote that business. The model also describes key operational tasks, staffing and other resource requirements as well as details about how business is conducted.

There are 3 approaches for business development.

The first one aims to optimize an existing business model. The technical possibilities outlined above for the automation of processes make it possible to reduce costs, and most of all, to react faster to changes in the market and of course specific customer inquiries.

The second approach is to conquer neighboring business models. The "Outcome Economy" forms blueprints for this, among other things with its "as-a-service" models, but even in the traditional industry, products are no longer thought of. Why not sell truck tires per trouble-free kilometer instead of one piece? Or jet engines per flight hour? And that's not science fiction, it's already reality.

The third approach aims to build entirely new (disruptive) business models - and here, in particular, digitalization has drastically lowered entry barriers.

Value-chain aspect of trainings

As most companies are searching for emerging markets for their products, they are forced to go beyond the borders of their country. On the other hand, this offers the opportunity to create higher value for their own business.

The typical value chain includes activities such as research and design, production, marketing, distribution, and support to the final consumer. Research and development, production, distribution, sales and service are all business processes which most companies consider to be integral aspects of their business strategy, which shall also be part of this practical training.

By managing the value chain's activities strategically, a company can create a competitive advantage for itself. This means ensuring that supply meets projected demand effectively and efficiently, with maximum consumer satisfaction. Productivity, innovation, flexibility and responsiveness to the consumer become critical attributes of the value chain and SME must choose the most effective solution for each link in the chain. This requires expanding SME’s vision outside the walls of their country, morphing their previously domestic/internal value chain into a transnational, or even global one.

With developing a global value chain business model the participating SME shall be enabled to organize operations in innovative ways which deliver greater value to their customers through reduced costs and increased product and service quality. By focusing on what they do best, and using strategic relationships with other partner companies to fill in the gaps, these companies are able to strengthen their competitive advantage in ways which would not have otherwise been possible.

Complementary Trainings

Apart from the above described common topics of trainings in the field of digital transformation, the partners have the opportunity to provide complementary trainings that aim at supporting the companies in their digital transformation process in a comprehensive way. These training topics can be chosen on request of the local companies in the respective partner regions.

The complementary trainings can be grouped as follows:

- Innovation / Transfer / Knowledge management
- Market analysis and (digital) marketing
- IPR: in general, patent database search, patent commercialization
- Funding for / financing of digital transformation, crowdfunding
- Start-up support
- Soft skills

Conclusion

The DanubePeerChains partnership has developed a training programme for their local SME and entrepreneurs to enable them to participate in transnational value chains. This training programme contains an introduction part about digitalization in general, the most relevant digitalization technologies, organizational aspects and human resource topics, business implications of digitalization. These four aspects will be tackled by a basic training, to be implemented in all partner regions. Further, the project partners will select an in-depth training module out of the collected list of already existing trainings, which is demanded by their local companies. These trainings can cover one or more of the above mentioned thematic areas or complementary topics, e.g. legal aspects.

Based on the workshops and discussions that were held at the steering committee meeting in Zagreb in September 2021 and together with the deliverable D.T2.2.1 – Training methodology, this current document forms the basis for the definition of offline trainings (D.T2.2.3) and value-chain oriented online trainings (D.T2.2.4).

Within the work package T3 the partners will pilot the defined trainings in local face-to-face seminars/workshops or hand-on trainings (in native language) as well as in online seminars (live and recorded, in EN language), adapted to the needs of the local companies in the respective partner regions.