Interreg
Danube Transnational Programme
DanubePeerChains

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

TRANSNATIONAL COMPETENCE MAP OF KNOWLEDGE RELATED TO DIGITAL VALUE-CHAIN CREATION

Deliverable D.T1.2.3

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Content

Introduction

The main objective of the D.T1.2.3 Transnational competence map of knowledge related to digital value-chain creation is to present an overview of input from all partner regions in following two aspects:

1) analysis of regional competences in key knowledge fields of digitalisation (D.T1.2.1), consisting of an overview of academic and R&D competences in key knowledge fields which are needed as a prerequisite in regional companies for their involvement in transnational value chains;

2) collection of practice cases (D.T1.2.2) – showcases of digitally transforming companies that have already enlarged their business to cross-regional collaboration level, investigated regarding still existing competence gaps and support demand.

Each partner country has implemented the analysis and collected practice cases with the focus on the following target industry sectors: metal industry, machine building, engineering, electro industry, electronics/robotics and ICT. Participating countries are as follows: Austria, Bosnia and Herzegovina, Germany, Croatia, Hungary, Montenegro, Romania, Serbia and Slovenia.

This document aims to outline the main thematic strengths and weaknesses which will serve as the evidence-base for the development of DanubePeerChains Toolbox for capacity building of LSO/BSO and specialists/entrepreneurs' trainings and further project activities.

Methodology for the analysis of regional competences in key knowledge fields of digitalisation and the collection of practice cases

As there are three key knowledge fields of digital transformation identified, namely technological knowledge, competences in human resource development and adaptation of business models for digital value chains, the methodology for the analysis of regional competences was developed as follows - based on the relevant sources, indicators have been identified and selected under each key knowledge field, focusing on capturing the essential elements needed for the digital value-chain creation (listed below) in both SMEs (R&D) and academia.

Current level of development of competences of SMEs and enterprises from the targeted sectors on one hand, and academia on the other, as well as the level of importance of these competences in the future, have been assessed. The method used was the self-assessment method (combined with the use of relevant primary and secondary resources). The results obtained within our analysis can be explained due to following methodological reasons connected to the self-assessment method (combined with the use of relevant primary and secondary resources):

- lack of professional knowledge in the respective field – assessment according to one's own knowledge and experience of the field;
- insufficient network – not having a sufficient pool of respondents or enough contact with the target group to know the real picture;
- lack of time – work overload, one of Europe's main diseases, doesn't allow time needed for the thorough analysis;
- predicting – prediction is often result of lack of knowledge or time, when our brain unconsciously begins to predict which increases the possibility of error.

For the digital value chain to be created, all the stakeholders involved must be digitally transformed, i.e. showcase high levels of technological knowledge, competences in HR development and adaptation of business models. According to research, there are four pillars of digital transformation, which are in line with the key knowledge fields as identified within the scope of this project: mindset, people (covered within this mapping under the field of Competences in HR development), processes (covered under the Adaptation of business models for digital value chains) and technology (Technological knowledge).

Regarding the technological knowledge, there are nine main technologies defining digital transformation, as illustrated in the image below, which were used as indicators in our analysis.

Image 1. Industry 4.0 – the digital transformation. Source: https://www.i-scoop.eu/industry-4-0/

Although technological knowledge presents an intrinsic part of the digital transformation, the results of our analysis will show that other two knowledge fields – competences in HR development and adaptation of business models – are equally important, if not a prerequisite for the successful digital transformation, which is in line with other research conducted on the topic.

As shown in the image below, the mindset represents the most significant part of the digital transformation, together with people and processes. Therefore, it is important to emphasize the role of HR development which has now shifted from an administrative role to the role of being a digital business partner.

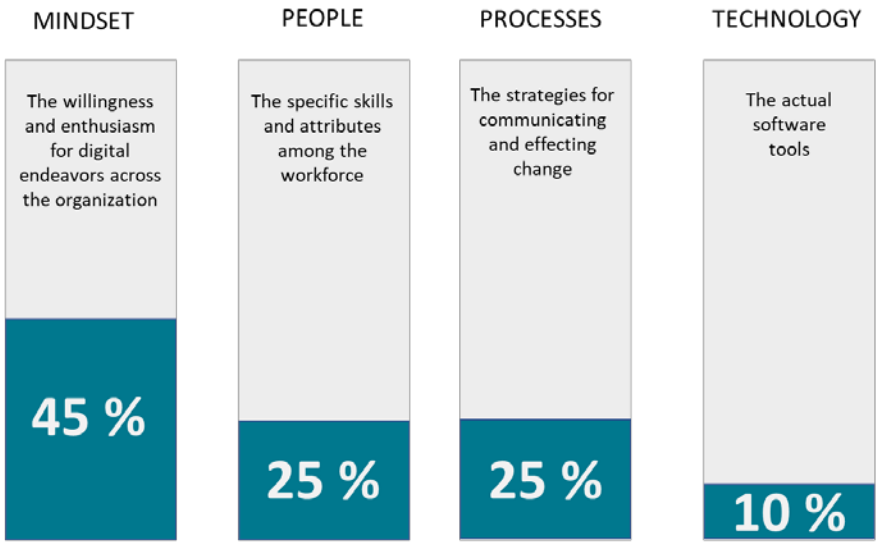

Image 2. Source: https://chapmancg.com/culture-business-transformation/the-role-of-hr-as-a-business-enabler-of-digital-transformation/

To further investigate the level of development in key knowledge fields needed for the digital value-chain creation in the Danube Region, a collection of practice cases showcasing the emergence of digital value-chains has been implemented. The template for this activity is available in the Annex section of this document.

List of indicators assessed within the regional analysis of competences in key knowledge fields of digitalisation – R&D in companies

1) Technological knowledge:
    i. Internet of Things
    ii. Cloud computing
    iii. Cybersecurity
    iv. Big data and analytics
    v. Advanced manufacturing solutions
    vi. Additive manufacturing
    vii. Augmented/Virtual Reality
    viii. Digital Twin
    ix. Simulation tools
    x. AI
    xi. Connectivity

2) Competences in HR development
    i. Presence of R&D departments in SMEs
    ii. Presence of Innovation Managers in SMEs
    iii. Presence of R&D departments in enterprises, excluding SMEs
    iv. Innovation Orientation of SMEs
    v. Innovation Orientation of enterprises
    vi. Presence of Innovation Managers in enterprises, excluding SMEs
    vii. Readiness for change (e.g. infrastructure and employees' mindset)
    viii. Presence of Digital Transformation Managers in SMEs
    ix. Presence of Digital Transformation Managers in enterprises
    x. Agility of employees in SMEs
    xi. Agility of employees in enterprises
    xii. Openness for international engagement

3) Adaptation of business models for digital value chains
    i. Business Strategy
    ii. Business Model
    iii. Business Processes
    iv. ERP system
    v. Interconnection between the strategic level and the operational level of business processes
    vi. Resources
    vii. Internationalization
    viii. Involvement in (digital) international value chains
    ix. Traditional business model (product-oriented)
    x. Digital business model (service-oriented)

List of indicators assessed within the regional analysis of competences in key knowledge fields of digitalisation – Academia:

1) Technological knowledge
    i. Internet of Things
    ii. Cloud computing
    iii. Cybersecurity
    iv. Big data and analytics
    v. Advanced manufacturing solutions
    vi. Additive manufacturing
    vii. Augmented/virtual reality
    viii. Digital Twin
    ix. Simulation tools
    x. AI
    xi. Connectivity

2) Competences in HR development

   i. Presence of courses on the topic of the key technologies
   ii. Level of collaboration with industry
   iii. Level of financed projects on digital value chains related HR topics
   iv. Publications
   v. Conferences and events on the topic of digital value chains related HR topics
   vi. Transfer activities (flexible transition of experts between industry and institutions of knowledge)
   vii. Dedicated departments on the topic of digital value chains related HR topics

3) Adaptation of business models for digital value chains

   i. Presence of courses on the topic of digital value chains related business model strategy
   ii. Level of collaboration with industry
   iii. Level of financed projects on digital value chains related business models and process management
   iv. Publications
   v. Conferences, events
   vi. Transfer activities (flexible transition of experts between industry and institutions of knowledge)
   vii. Dedicated departments on the topic of digital value chains related business model strategy

Results

Technological knowledge in R&D in companies

According to the results, the level of development of key knowledge fields seems to be similar in all countries included. However, if we look a bit closer and take into consideration also the information extrapolated from the qualitative descriptions of the assessment, we can see that some regions are more developed and will serve as good practices examples and knowledge hubs for the knowledge transfer activities within the project.

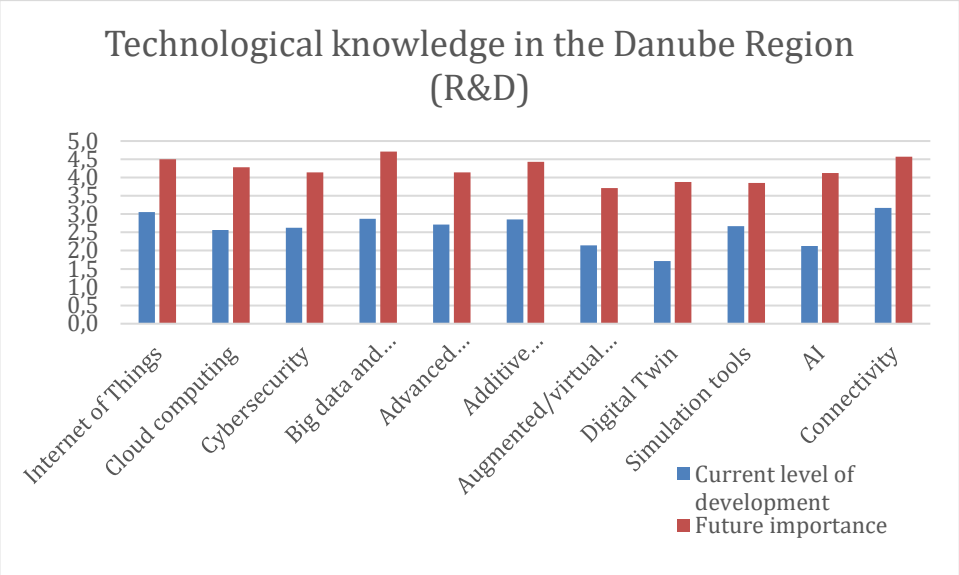

Chart 1. Assessment of the level of the development of technological knowledge and importance of technologies in the future in the Danube Region (R&D)

As shown in Chart 1, the current level of the development of the technological knowledge relevant for the digital value-chain creation in the Danube Region in the field of R&D varies from 1,6 to 3,3 (on a scale 1-5, where 1=not developed at all, and 5=very well developed), average score for this knowledge field being 2,52, meaning it is assessed as satisfactorily developed, but with the possibility of improvements.

The least developed are the technologies of Digital Twin, Augmented/Virtual Reality and Artificial Intelligence. As extrapolated from the qualitative part of the assessment, the low scores assessed are due mostly to the complexity and expensiveness of these technologies for SMEs. In the regions where these technologies are more developed, they are mostly used in enterprises and multinational companies, and very rarely in SMEs. Further on, the major barrier for

the implementation of Digital Twin, AR/VR and AI solutions lies in the lack of qualified experts. Another barrier can be seen in the investments needed for obtaining the relevant knowledge and for implementing the technology-based innovation. Especially with AI, the ongoing hype leading to wrong expectations is a problem as well.

However, the importance of these technologies for the future is recognized across the Danube Region, as they can reduce product quality problems and maintenance costs, improve employee training and increase efficiency of business processes and productivity, as well as the market competitiveness. At the moment quality improvement and optimisation tasks are the main motivation for implementing AI, AR/VR and Digital Twin applications, yet as more and more R&D institutions and departments are becoming involved in related activities, it has been assessed that in several countries in the Danube Region these organisations indicate relevant competences and projects, particularly in the field of machine learning, representation of knowledge, robotics and autonomous systems.

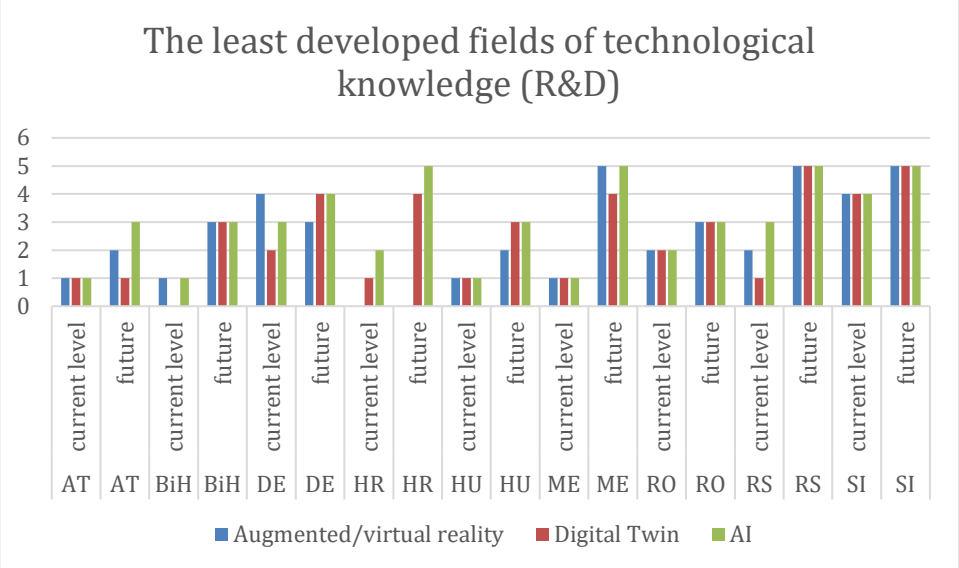

Chart 2. Country comparison of the assessment of the three technologies with the lowest score of technological knowledge (R&D)

There are two countries standing out with the assessment scores of Digital Twin, AR/VR and AI - Germany (namely Bavaria) and Slovenia.

There is an immense AR/VR ecosystem established in Bavaria , as it is recognized that this technology is a prime example of cross-industry innovation and it provides a variety of opportunities for the digital value-chain creation, the improvement of operational activities and learning methods. In Slovenia, AR/VR has been introduced in the field of education, R&D and other areas of application,

as it has been recognized that in the future AR/VR technologies will be very important for the construction of materials, semi-finished products and products, as well as in simulations, learning, creating and connecting. Furthermore, during COVID-19 situation, AR/VR has also provided an environment for enabling other processes, namely in the field of human resources, such as HR selection processes and onboarding.

Relative to the extent of "how new" is the Digital Twin technology, it has been assessed that Slovenia is very state-of-the-art and the technology is already widely used in industry – there is a demonstration centre "Pametna tovarna" operating within the GOSTOP programme, which is the largest S4 programme in Slovenia, and its infrastructure includes all important Industry 4.0 technologies, with the main aim of showing the innovative use and implementation of Industry 4.0 technologies and the concept of a smart factory in a real industrial environment. However, although Digital Twin has been recognized "as the next big thing", it is important to emphasize that it was assessed as only suitable for a fully digitalized company.

"The next, even bigger thing" is AI, which has been recognized as the key sector of the future. There are many policy and political initiatives in the Danube Region, especially in Germany, to research the full potential of the technology and transfer it to industry. In some countries participating in this mapping, although there are individual companies that are among global market-leaders in the field, such as Romanian start-up UiPath, they are still in the beginning phase, as they asses that a precondition for the implementation of the AI solutions should be increasing the number of qualified experts. In Slovenia, for example, although there are world-renowned experts in the field of AI, due to its size, international inaccessibility of academic environment and lack of recruitment strategy, there is a significant lack in the number of relevant staff. As AI is recognized as "the future", the other potential barrier can be found in the relation of AI specialists and domain engineers, as the latter will need to be able to assess whether AI technology is adequate for their activities, products/services and business models, i.e. competent enough to be able to work with the AI specialist.

There were four key knowledge fields assessed as both the most developed currently (scores ranging 2,9-3,3), and the most important for the future (scores ranging 4,4-4,6): Big Data and Analytics, Additive Manufacturing, Internet of Things and Connectivity.

Technological knowledge in Academia

As shown in Chart 3, the current level of the development of the technological knowledge relevant for the digital value-chain creation in the Danube Region in the field of Academia varies from 3,1 to 3,6 (on a scale 1-5, where 1=not developed at all, and 5=very well developed), average score for this knowledge field being 3,30, meaning it is also assessed as satisfactorily developed, but with the possibility of improvements. Although the average score is in the same range as the result assessed for the field of R&D, some technological fields are assessed as more developed within academia.

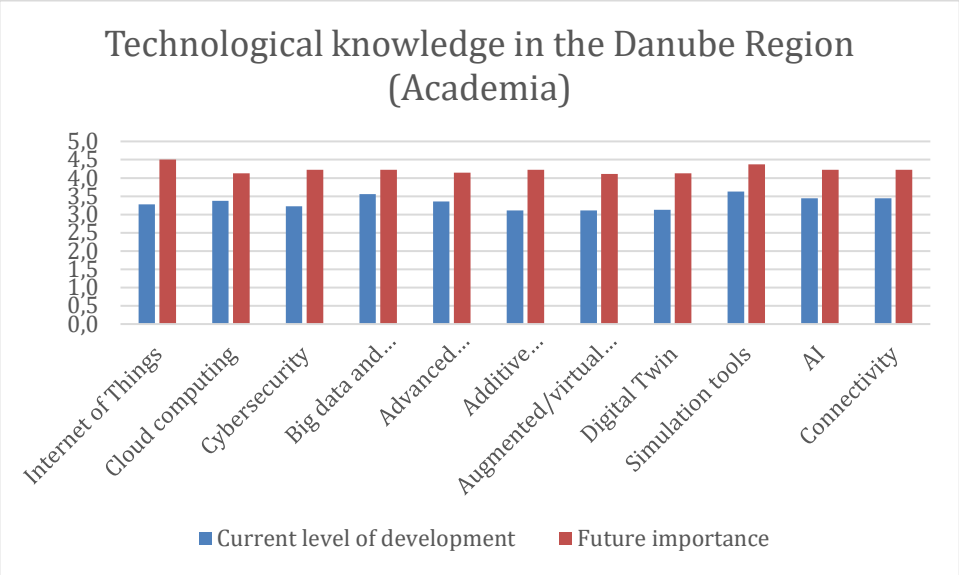

Chart 3. Assessment of the level of the development of technological knowledge and importance of technologies in the future in the Danube Region (Academia)

For example, whereas simulation tools had the average score of 2,7 within R&D, they have been assessed with the average score of 3,6 within Academia, which is also the highest score reached among specific technologies (together with Big Data and Analytics). In Austria, current level of the development of technological knowledge related to simulation tools has been assessed with the highest score of 5, supported with the example of the Bickel Group, operating within the Institute of Science and Technology, focusing on two closely related challenges: 1) developing novel modelling and simulation methods, and 2) investigating efficient representation and editing algorithms for materials and functional objects, noting that many institutes of the JKU (Johannes Kepler University Linz) apply simulation tools for various applications, from Semiconductors, Electronics, Polymers, etc. to Mechatronic Design and Production, several engineering

institutes, etc. Most of the participating country emphasized the importance of the simulation tools for academic and learning environment.

In general, all participating countries noted that the research related to Industry 4.0 and digital transformation has increased within Academia in recent years. Increasing number of faculties all over the region are introducing new departments and subjects dealing with the key technologies for digital transformation (such as the initiative “Digital Serbia”, for example, within which study programmes are being introduced focusing on technologies such as data analytics, bioinformatics, cloud computing, IoT, machine learning, AI, VR, as well as on business subjects such as management, finance, accounting, marketing, entrepreneurship, thus combining technological and business knowledge needed for digital transformation). Further on, Upper Austria intends to establish a new technical university in 2024 (at the earliest) with the main scope on digitalization - which clearly shows the immense importance of the topic.

The technological field of Big Data and Analytics within Academia has also been assessed as the most developed currently and as the most important for the future, especially in Austria, Germany, Romania, Serbia, Slovenia (where it was scored in both with either 4 or 5). In Austria, there are several institutes within JKU working in the field, namely Institute for Application-oriented Knowledge Processing, Institute for Formal Models; FH St. Pölten: Data Science and Business Analytics (bachelor degree programme); Institute of Science and Technology IST Austria - Mondelli Group - Data Science, Machine Learning and Information Theory. In particular, the Mondelli group focuses on wireless communications and machine learning. Research in the field of Data Science is closely interlinked with the research activities of the IT security department; and Verification, Institute for Computational Perception, Institute for Machine Learning FH OOE, Campus Hagenberg. UNIZG-FER is the coordinator of the Croatian Centre of Research Excellence for Data Science and Cooperative Systems, which gathers all key experts in big data analytics in Croatia. Department of applied computing at the University of Zagreb, Faculty of Electrical Engineering and Computing has founded the BigDataLab. BigDataLab is a software research laboratory used by teachers and students who attend courses related to Data storage and manipulation (Databases, Advanced databases, Database systems, Geospatial databases and Business intelligence), and students working on their seminars, projects or thesis in one of the related fields. In Germany, there are several professorships (e.g. at TH Ingolstadt) and study programmes (e.g. Universität Regensburg; TH Rosenheim). There are currently three categories of study programs in Serbia that cover the fields of computer science, informatics, and software engineering (RNI & SE) and which can serve as a basis for the education of Data Science experts: 1) dedicated programs in the given fields; 2) programs in

the field of (applied) mathematics; 3) programs in the field of economics, organizational sciences, and management. Some of the faculties where data science programs exist are, above all, the Faculty of Electrical Engineering-University of Belgrade, the Faculty of Mathematics-University of Belgrade, and the Faculty of Organizational Sciences-University of Belgrade. In Slovenia, the field of Big Data and Analytics is especially developed at the Faculty of Computer and Information Science, University of Ljubljana, with the second cycle master's study programme track of Data Science.

All the technological fields that were assessed as the least developed within R&D, namely AI, VR/AR, already mentioned simulation tools and Digital Twin technology, reached somewhat better scores within Academia. By extrapolating information from the qualitative descriptions, it is evident there are knowledge hubs present within the Academia in the region that can help in bridging the competence gaps between SMEs and institutions of knowledge and that the main objective should be collaboration and transfer activities.

It has been recognized among participating organisations, especially Academia, that the technology of Big Data and Analytics can greatly help SMEs in improving their operational efficiency, competitiveness on the market, customer service, and consequently open new revenue opportunities.

Further development and ease of bulk data collection methods will enable companies to leverage big data analytics methods to improve business and process efficiencies. In the future, it will be important that domain experts in companies are trained to analyze the data generated in business processes.

Competences in HR development in R&D in companies

As shown in Chart 4, the current level of the development of the competences in HR development relevant for the digital value-chain creation in the Danube Region in the field of R&D varies from 1,8 (Presence of Innovation and Digital Transformation Managers in SMEs) to 3,3 (Presence of R&D departments in enterprises, excluding SMEs; and Openness for international engagement) (on a scale 1-5, where 1=not developed at all, and 5=very well developed), average score for this knowledge field being 2,65, meaning it is assessed as satisfactorily developed, but with the possibility of improvements.

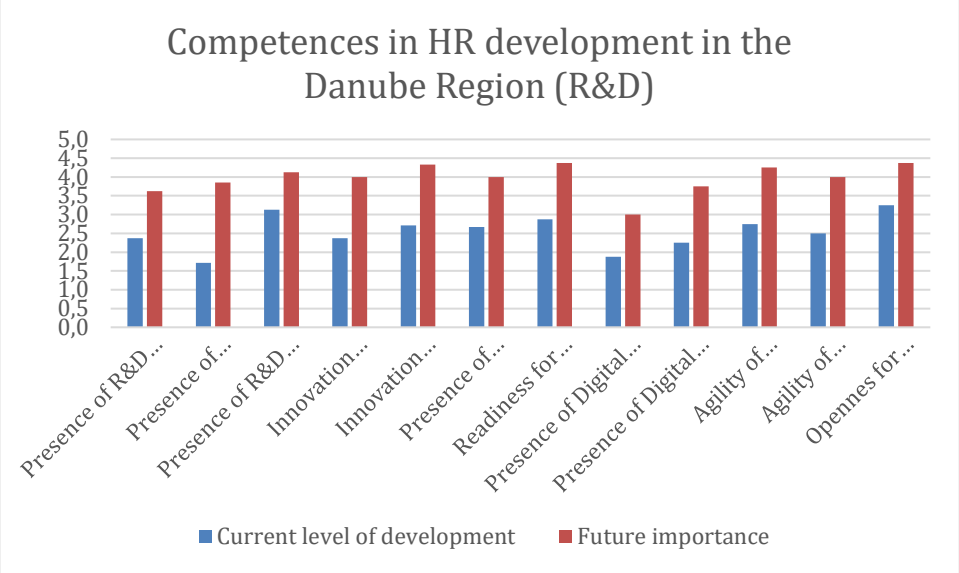

Chart 4. Assessment of the level of the development of competences in HR Development and importance of these competences in the future in the Danube Region (R&D)

The importance of the competences in HR development for the future, in the next 3-5 years, (on a scale 1-5, where 1=will be negligible; 2=will be less important; 3=will be important; 4=will be very important; 5=will be essential) has been assessed as follows - 2,9 the lowest (Presence of Digital Transformation Managers in SMEs), 4,3 the highest (Readiness for change, Agility of employees in SMEs and Innovation Orientation of enterprises), average score for this field being 3,98, meaning the competences in the HR development in the next 3-5 years will be very important in the context of the digital transformation and digital value-chain creation.

Competences in HR development in Academia

As shown in Chart 5, the current level of the development of the competences in HR development relevant for the digital value-chain creation in the Danube Region in the field of Academia varies from 1,9 (Dedicated departments on the topic of digital value chains related HR topics) to 3,4 (Presence of courses on the topic of the key technologies) (on a scale 1-5, where 1=not developed at all, and 5=very well developed), average score for this knowledge field being 2,72, meaning it is assessed as satisfactorily developed, but with the possibility of improvements.

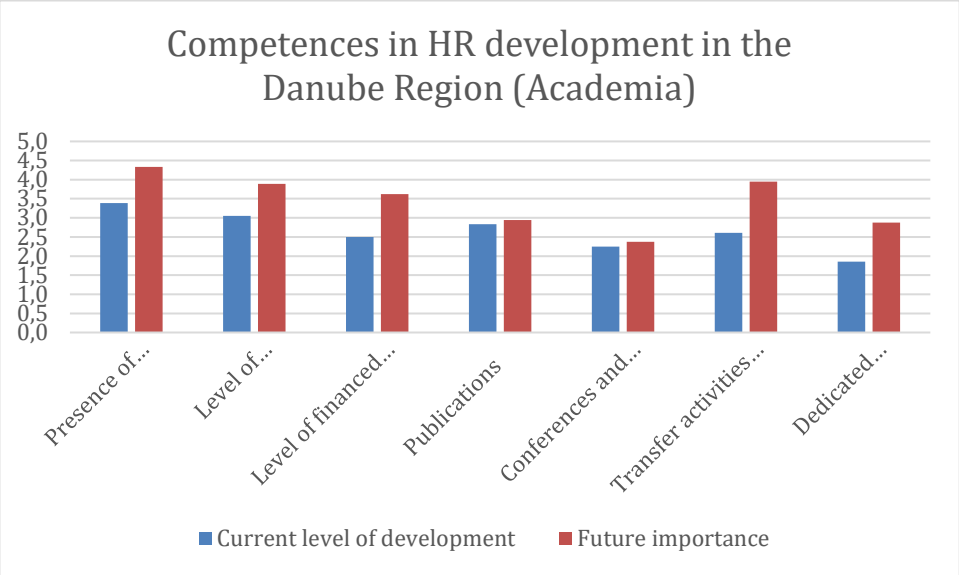

Chart 5. Assessment of the level of the development of competences in HR Development and importance of these competences in the future in the Danube Region (Academia)

The importance of the competences in HR development for the future, in the next 3-5 years, (on a scale 1-5, where 1=will be negligible; 2=will be less important; 3=will be important; 4=will be very important; 5=will be essential) has been assessed as follows - 2,4 the lowest (Conferences and events on the topic of digital value chains related HR topics), 4,3 the highest (Presence of courses on the topic of the key technologies), average score for this field being 3,48, meaning the competences in the HR development in the next 3-5 years will be important in the context of the digital transformation and digital value-chain creation. It is necessary to emphasize here also the importance of the transfer activities, i.e. flexible transition of experts between industry and institutions of knowledge, which has been assesses as the second most important factor for the digital transformation i.e. digital value-chain creation (score of 3,9).

Based on the information retrieved from the qualitative part of the assessment, it is evident that R&D departments in companies (both SMEs and enterprises) are relatively weak, that there is insufficient or too weak cooperation between knowledge institutions and industry, among companies themselves and among knowledge institutions themselves.

Adaptation of business models for digital value chains – R&D in companies

As shown in Chart 6, the current level of the development within the field of adaptation of business models for digital value chains in the Danube Region in the field of R&D varies from 2,1 (Digital business model (service-oriented)) to 3,8 (Traditional business model (product-oriented)) (on a scale 1-5, where 1=not developed at all, and 5=very well developed), average score for this knowledge field being 2,68, meaning it is assessed as satisfactorily developed, but with the possibility of improvements.

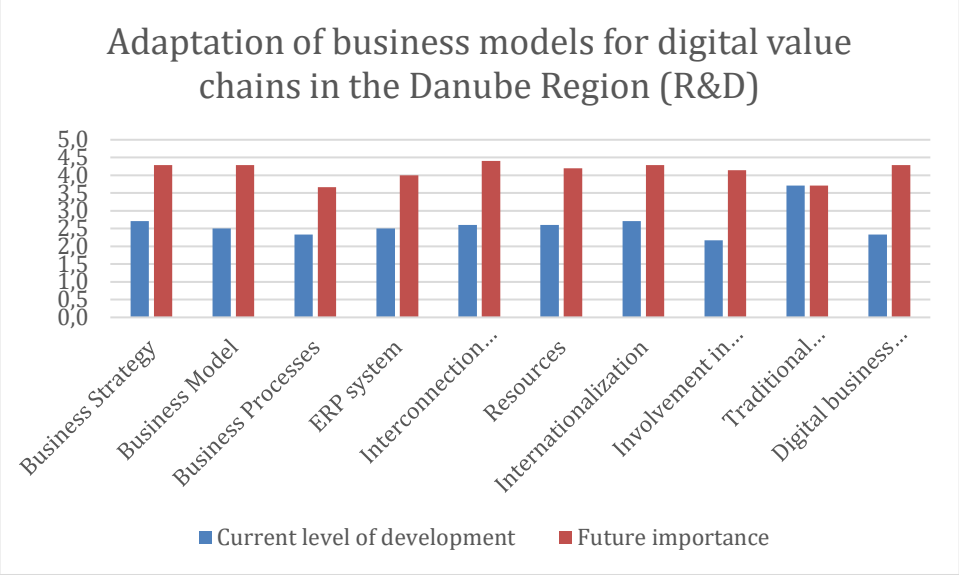

Chart 6. Assessment of the level of adaptation of business models for digital value chains and importance of these competences in the future in the Danube Region (R&D)

The importance of the adaptation of business models for digital value chains for the future, in the next 3-5 years, (on a scale 1-5, where 1=will be negligible; 2=will be less important; 3=will be important; 4=will be very important; 5=will be essential) has been assessed as follows - 3,7 the lowest (Business processes), 4,3 the highest (Business Strategy, Business Model, Interconnection between the strategic level and the operational level of business processes, Internationalization), average score for this field being 4,04, meaning the adaptation of business models in the

next 3-5 years will be very important in the context of the digital transformation and digital value-chain creation within the field of R&D.

Besides the fact that it is evident that the orientation is still towards the development of products on the basis of technology development (push factor), with too little emphasis on development of services/experience (pull factor) and that this shift is assessed as very important in the following 3-5 years, it seems significant also the importance recognized of the interconnection between the strategic level and the operational level of business processes (4,3), internationalization (4,3) and involvement in (digital) international value chains (4,1).

Adaptation of business models for digital value chains – Academia

As shown in Chart 7, the current level of the development within the field of adaptation of business models for digital value chains in the Danube Region in the field of Academia varies from 1,9 (Level of financed projects on digital value chains related business models and process management) to 3,2 (Publications) (on a scale 1-5, where 1=not developed at all, and 5=very well developed), average score for this knowledge field being 2,68, meaning it is assessed as satisfactorily developed, but with the possibility of improvements.

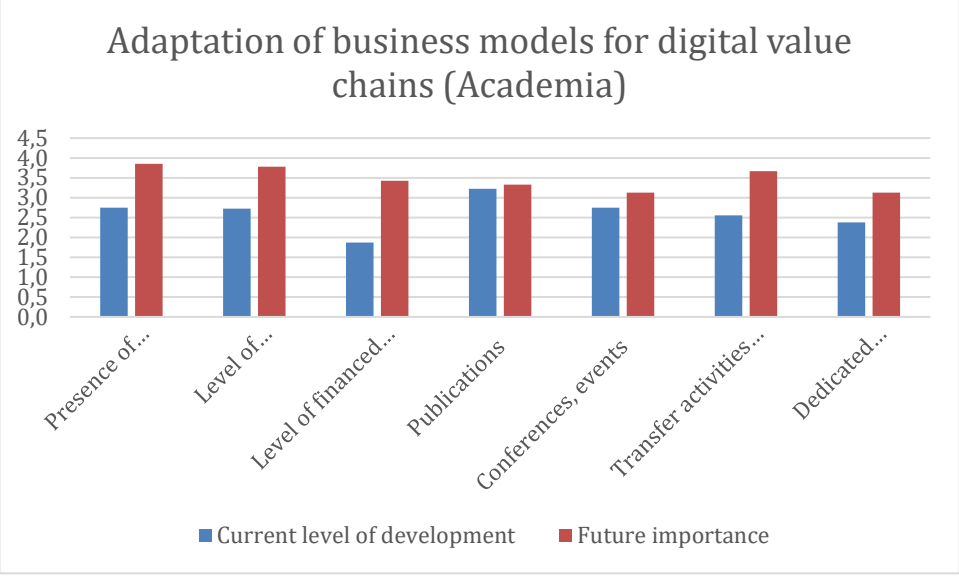

Chart 7. Assessment of the level of adaptation of business models for digital value chains and importance of these competences in the future in the Danube Region (Academia)

The importance of the adaptation of business models for digital value chains for the future, in the next 3-5 years, (on a scale 1-5, where 1=will be negligible; 2=will be less important; 3=will be important; 4=will be very important; 5=will be essential) has been assessed as follows - 3,1 the lowest (Dedicated departments on the topic of digital value chains related business model strategy; Conferences, events), 3,9 the highest (Presence of courses on the topic of digital value chains related business model strategy), average score for this field being 3,49, meaning the adaptation of business models in the next 3-5 years will be important in the context of the digital transformation and digital value-chain creation within Academia. It seems also of significance importance to point out the other two indicators assessed very important in the next 3-5 years – level of collaboration with industry and transfer activities (flexible transition of experts between industry and institutions of knowledge).

Country overview

R&D in companies in the partner countries:

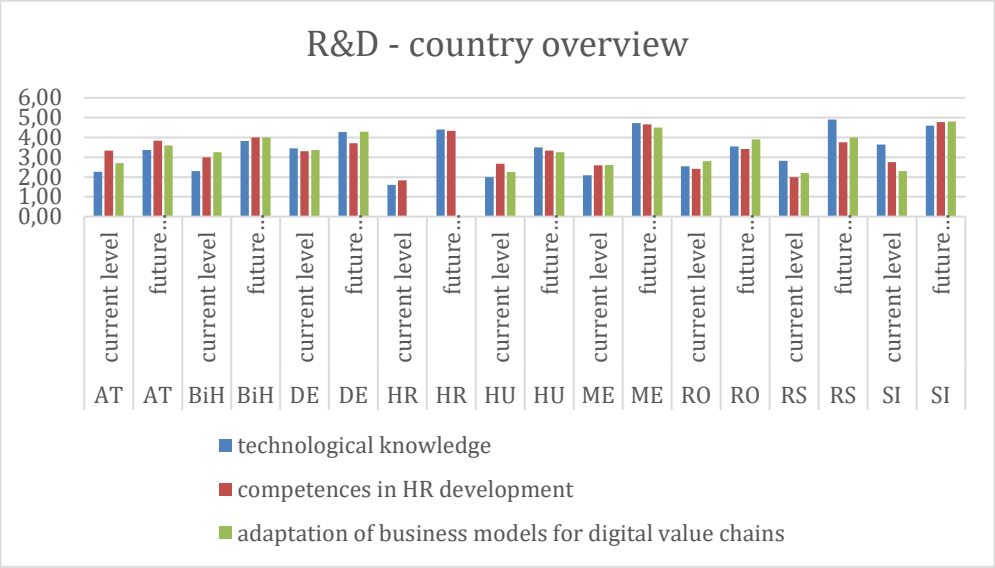

Chart 8. Assessment of current level of development and future importance of competences in key knowledge fields for digital transformation and digital value chain creation in R&D – country overview

Academia in the partner countries:

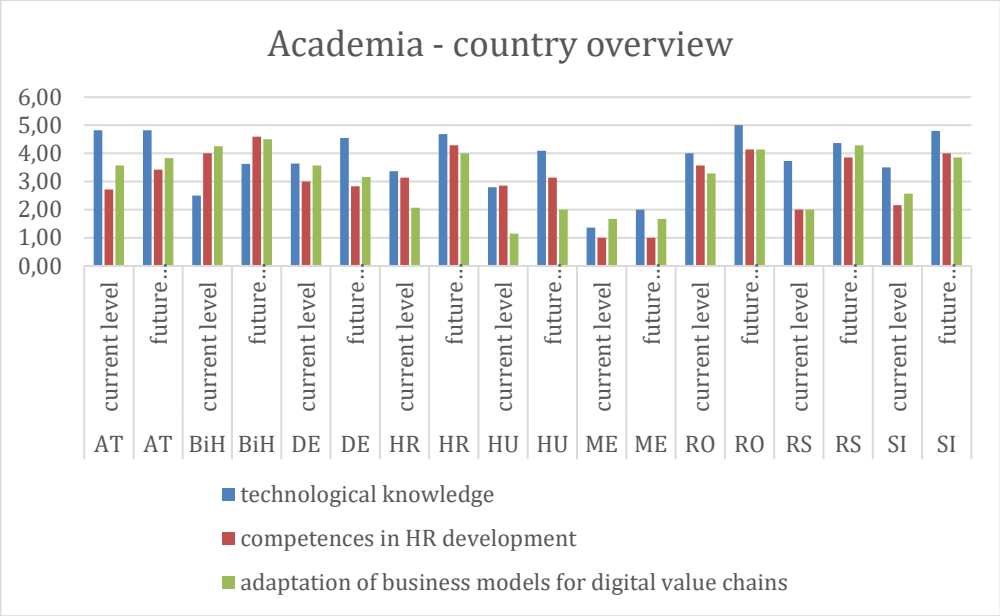

Chart 9. Assessment of current level of development and future importance of competences in key knowledge fields for digital transformation and digital value chain creation in academia – country overview

As shown in Chart 8 and 9, the current level od the development of the key knowledge fields within both R&D and Academia in the participating countries is on a similar level, with highest scores assessed in Austria, Germany and Slovenia.

Digital value-chain knowledge hubs: the map

The table below is based on the organisations participating in the DanubePeerChains project, organisations retrieved from the qualitative country-specific assessment and the collection of the practise cases, showcasing the evidence of emerging value-chain collaboration.

Country	Organisation (institutions of knowledge, LSOs, BSOs, SMEs and enterprises
Austria	• Business Upper Austria and its associated companies • ConPlusUltra GmbH • Johannes Kepler University Linz • Institute for Work, Research and Work Policy at Johannes JKU

	• VESCON • RUBBLE MASTER
Bosnia and Herzegovina	• Foundation for Innovation, Technology and Knowledge Transfer • BNT Travnik • Kalim Profil • MST BH • Mikron-Metalno • Profine BH • Semblie • Starnet
Germany	• Cluster Mechatronics & Automation • R-Tech GmbHProfine BH • Gefasoft
Croatia	• Zagreb Innovation Centre Ltd. • Croatian Employment Service – Regional Office Zagreb • University of Zagreb, Faculty of Electrical Engineering and Computing • Robotq.ai • AgilosIT
Hungary	• Pannon Business Network Association • METALCONSTRUCT • KEVEFÉM KFT.
Montenegro	• Innovation and Enterpreneurship Center Tehnopolis • Montenegro Ministry of Economy • Chamber of Economy of Montenegro • Faculty of Metalurgy and Technology • Science technology park Montenegro • Institute for ferrous mettalurgy • 3D Room • Bild studio

Romania	• National Scientific Research Institute for Labour and Social Protection • Romanian Cluster Association • POLITEHNICA University Bucharest • Transilvania University in Brasov • Politehnica University Timișoara • Technical University Cluj-Napoca • University Alexandru Ioan Cuza of Iaşi • Romsoft • Beia Consult International • National Administration of Romanian Waters
Serbia	• University of Belgrade • Bel Medic • Blist d.o.o. • Link travel • NO Solutions
Slovenia	• Chamber of Commerce and Industry of Slovenia • School Centre Škofja Loka • Digital Innovation Hub Slovenia • University of Ljubljana • The Jožef Stefan Institute (IJS) • Polycom • IMPOL

Conclusions

This document aimed to outline the transnational map of existing knowledge hubs in academia and R&D in the Danube Region, with emphasis on the nine participating countries (AT, BiH, DE, HR, HU, ME, RO, RS, SI), focusing on relevant technologies for digital transformation and expertise hubs in the field of organisational and HR management, development of labour and business conditions. It showed the thematic strengths and weaknesses of the participating regions and the corresponding demands for transnational know-how transfer through capacity building and qualification of SME/industry employees and entrepreneurs, further backed up with the collection of practice cases showcasing the evidence of emerging digital value-chain collaboration.

As shown throughout the analysis, currently the biggest problem for a quicker and easier implementation of digital transformation and digital value-chain creation is the lack of financial resources and a lack of knowledge of employees in terms of digitalization.

As seen in the assessment, many of the technological solutions are interconnected. Despite the lack of resources, especially from HR perspective, digital transformation is now gaining momentum also in SMEs, whereas company size becomes less significant and there is not enough evidence of less proactivity related to innovative approaches towards digitalisation in SMEs. However, due to the limited financial and human resources, SMEs experience more difficulties in catching up with large enterprises in terms of digital transformation. “Digital awareness” of SMEs has increased in recent years in all regions involved, with main drivers being the use of digital communication tools, quality improvement and task optimisation.

Another significant difference among SMEs and large enterprises, again resulting from the limited resources of SMEs, is the presence of digital transformation and innovation managers, wherein in larger enterprises the digital transformation managers work in close cooperation with innovation managers or perform both functions at the same time, while in SMEs they are rarely nominated.

As in the past digital transformation primarily impacted the operational level of business processes, it is now impacting also the strategic level. Not only agile management methods are becoming more commonly applied also in SMEs, digital transformation has had an impact on the establishment of new networks and cooperation, including the level of openness for international engagement. Furthermore, readiness for change, agility of employees, transfer activities (flexible transition of experts between industry and institutions of knowledge) and level of collaboration with the industry have been assessed as the most important for the

future (next 3-5 years). The willingness and enthusiasm of the employees, meaning the presence of the culture within the company that is enabling employees to learn, un-learn and re-learn, to enable agility and adaptation, is of crucial importance, as people are the ones implementing new practice, using new tools, and therefore should be suitably skilled for it. Changes, new strategies and protocols should be communicated transparently, often and in time.

Even though the majority of business models are still traditional ones (selling a product and/or oriented towards development of product based on technology development (push factor) with little emphasis on the development of services/experiences (pull factor)), the high importance of the adaptation of business models in the next 3-5 years has been identified. Increasing number of faculties all over the region is introducing new subjects and departments dealing with not only key technologies for digital transformation, but also for the adaptation of business models.

Based on the information retrieved from the qualitative part of the assessment and on the collection of practice cases, some evidence of emerging value-chain collaboration has been identified. However, it is evident that R&D departments in companies are relatively weak, that there is an insufficient or too weak cooperation between knowledge institutions and industry, among companies themselves and among knowledge institutions themselves. Another issue emerging is lack of systemic incentives in the framework of knowledge institutions (such as career systems, mobility, habilitation procedures...). Although the role of HR development has been shifting towards becoming a digital business partner, to achieve readiness for change and agility of employees, as well as to ensure the appropriately skilled experts needed for the successful digital transformation and digital value-chain creation, collaboration between SMEs, enterprises and knowledge institutions is a prerequisite, as well as investing in and awareness raising about the importance of HR development. Developing competencies is crucial for every company introducing digital transformation and HR should predict and enable gaining new knowledge or developing competencies, all achieved in a timely manner so that the strategies could be implemented successfully. Some level of collaboration has been reached in all regions, however, as shown above in the analysis, some have gone further and can provide knowledge and know-how in the upcoming project activities.

At the end of the day, digital transformation is much like any other business transformation and should be viewed as such. An organisation needs to understand first and foremost, based on their business and transformation objectives, what outcomes they are looking to achieve, whether the workforce has the right mindset and skill sets to deliver these objectives and whether they can

support the processes for delivering the business and transformation objectives. It's only then they should decide on which platforms and technologies they need in order to make that happen. If HR can work with the business to support on the three crucial aspects – people, mindset and processes - the actual technology piece has a far higher chance of success.

Annexes

I. Analyses of regional competences in key knowledge fields of digitalisation (AT, BiH, DE, HR, HU, ME, RO, RS, SI)

II. Collection of practice cases (AT, BiH, DE, HR, HU, ME, RO, RS, SI)