

# WPT4

## D.T4.1.7

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Transnational industrial innovation roadmap for the  
Advanced manufacturing sector

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## 1 INTRODUCTION

CHAIN REACTIONS project addresses the challenge for industrial regions not benefitting from innovation activities from large leading corporations to increase regional capacity to absorb new knowledge and turn it into competitiveness edge and business value.

New products and services, as well as new industrial sectors are not always the result of breakthrough innovation; they can be the result of value chain innovation, e.g. the transformation of 'traditional' value chains into new ones - emerging industries - through cross-border and cross-sectoral collaboration. The analysis of those emerging value chains shows that beyond their specificities, they have in common some key drivers: Key Enabling Technologies, Resource efficiency, Digital transformation and Service innovation. For many businesses, integrating durably the complexity of value chain innovation processes represents a challenge hampering sustained growth.

There is a strong need to help SMEs to overcome capacity shortages for innovation and integration into transnational value chains. The project aims at empowering regional ecosystems with the knowledge and tools to help businesses overcome those barriers and generate sustained growth through value chain innovation. CHAIN REACTIONS project builds thereby on modern approaches considering value chains and their complex developments rather than linear technology transfer approaches. The focus is on key sectors: advanced manufacturing, ICT and electronics, energy and environment, health and bioeconomy.

The objective of WPT4 is to create truly transnational open spaces for collaboration (e.g. value chain based) for RIS3 implementation. Ensure the sustainability of the project outputs beyond the project.

The following activities shall be performed:

1. Building on the regional IGAs (WPT2), the models and instruments (WPT1) tested in pilots (WPT3), the PPS will set-up transnational networks of relevant innovations stakeholders in each of the selected industrial sectors, which will perform jointly a foresight exercise (workshops) and develop the previous results into industrial innovation roadmaps, i.e. trends and expected innovations over time (5-10 years) for each of the selected industrial sectors. The roadmaps shall include necessary developments (in general) to make the expected innovation happen. Lead: STP, all PPs
2. Each industrial roadmap will be then further developed into transnational industrial innovation agendas, i.e. concrete innovation activities to be performed in the project regions and transnationally in order to realize the necessary development identified in the roadmaps and ensure industrial leadership in the selected industrial sectors. Those agendas shall be coherent with S3 in the project regions and provide the basis for potential future joint activities and transnational investments. Lead: STP, all PPs
3. Finally, PPs will define in parallel to the roadmaps transregional exploitation plans for the time beyond the project, aiming at providing guidance with respect to:
  - The use of the knowledge collected and developed during the project lifetime;
  - The implementation of innovation activities as identified by the members of the transnational networks; Establishment of durable transnational open spaces for collaboration in the selected industrial sectors.



## 2 A ROAD TO TRANSNATIONAL INDUSTRIAL INNOVATION ROADMAP

Following the regional IGAs' actions of the support and implementation of transnational pilots aiming at supporting value chain innovation (WPT3) and establishment of transnational networks of innovations stakeholders as the kick-off activity to develop transregional innovation networks and agendas (WPT4) in selected industrial sectors (WPT4), the main activity of the sectoral partner duo is to contribute to the project output O.T4.1 Thematic industrial innovation roadmaps (TIIR).

For the purposes of TIIR development of the Advanced manufacturing sector two (2) transnational industrial innovation roadmap workshops were implemented, with the main objective to collect relevant inputs for elaboration of TIIR and later on the transnational industrial innovation agenda for the target sector, in order to perform a foresight exercise and identify relevant sectoral trends and to present the possible evolution paths of the considered value chains and innovations within the target sector over a period of 5-10 years.

## 3 TRANSNATIONAL INDUSTRIAL INNOVATION ROADMAP

### 3.1 Trends

Among the external factors that affect or may affect the competitiveness of each country in the future are the so-called megatrends. Megatrends are the great forces in societal development that will very likely affect the future in all areas over the next 10-15 years. Megatrend is also defined as a large, social, economic, political, environmental or technological change that is slow to form. Once in place, megatrends influence a wide range of activities, processes and perceptions, both in government and in society, possibly for decades.

Megatrends cannot be clearly identified as opportunities or threats, as most trends carry a hidden opportunity to discover new economic models of operation, to accelerate technological progress or the demand for more effective solutions to current problems. At the same time, however, no or insufficient response to change can be a major threat to competitiveness, either in terms of the direct effects of trends or relative lags behind neighboring countries, which will be more successful in new sectors and markets. Given the nature and objectives of RIS3, the predominant view is to identify the opportunities that megatrends present, although the main threats are not completely overlooked. The approach to the definition of megatrends, their number and degree of impact varies considerably across the literature, however, in general we can identify 5 megatrends illustrated in the figure below. All of those magatrends have significant effect on advanced manufacturing sector.

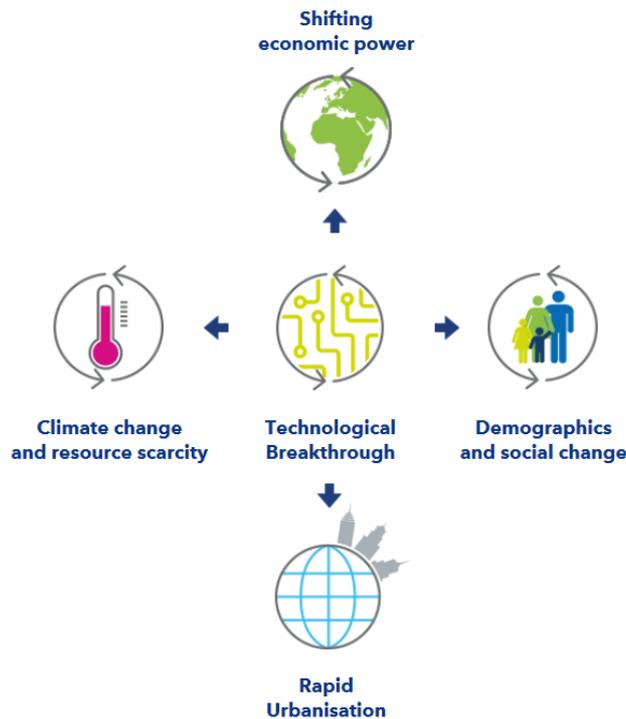


Figure 1 - Five main megatrends [blackrock.com]

### Technological breakthrough

Technological development in recent years has been characterized by exponential development. The ongoing industrial (digital) revolution and the rapid development of technologies, especially artificial intelligence and machine learning, are probably at the center of all ongoing changes. The scale and pace of technological change is likely to have far-reaching consequences in almost all industries and areas of human performance, that why it stands in the middle of all megatrends. Artificial intelligence already successfully automates routine processes, causing some professions to disappear but others to be created. Data is the key to success.

### Climate change

On one hand, the climate change is a major threat to a large part of the world's population, however on the other hand it is an opportunity for improvement of our environment. The EU response is formed within the Green Deal strategy. This emphasis is reflected in a radical increase in spending on climate change prevention and mitigation, the achievement of climate neutrality and the promotion of the environment in general.

In the context of continuing ecosystem degradation, biodiversity loss and soil degradation issues, another key area is agriculture, where there will be huge scope for developing and implementing innovative, environmentally friendly practices. We will have to continue to innovate in order to be able to increase production and, conversely, reduce resources. Technology will play a key role here, especially in the area of so-called precision agriculture. We already know how to use drones to monitor, for example, the level of weeds or pests in the fields and thus apply sprays and other interventions. Sustainable energy sources and the reduction of fossil fuels will continue to be



developed. EU pressure to move towards full electromobility is relentless. Reducing energy intensity will affect every citizen and every area of human activity.

### **Demographic change**

Not only European population but also many countries in the world are being influenced by the population aging. Regarding to those changes the actions have to be taken in areas like pension system or health care. The paper focuses on other very important area which is working environment and conditions. Adaptations of current schemes and limits valid for production planning in these days have to be done accordingly to the needs and capacities of older workers. Older workers may experience various age-related changes i.e. increased weight, reduced flexibility, mobility and strength, deteriorating vision and hearing, possible reduction in cognitive abilities and, in some cases, health complaints. If those facts aren't taken in consideration and companies don't respond appropriately they may face increased injuries and reduced productivity. Advanced manufacturing and utilisation of new technologies can help in the fight with aging population.

### **Rapid urbanisation**

More than half of the world's 8 billion people now live in cities. By 2030, that number is expected to increase to about 5 billion. In 1990, there were only 10 so-called megacities in the world with a population exceeding 10 million inhabitants. Currently, the number of such megacities has almost tripled to 28. The population is increasingly concentrated in cities and large urban areas. This will further support technological progress and the impact on climate change. These large-scale population movements bring with them opportunities but also challenges. The requirements of the future urban population will be significantly different from current cities. Residents will require maximum connectivity of each facility. Wireless connectivity will be essential to improving the quality of life in cities. Therefore, the concepts of smart city or a smart region will become increasingly important. These concepts use modern and intelligent technologies, including innovative solutions that enable significant energy savings, raise the living standards of their inhabitants, minimize environmental impact, optimize transport or enable the efficient use of data for public purposes.

### **Shift in economic power**

In less than a generation, developing economic have moved from producers of goods for developed countries to areas of consumption of their own goods and services. They now account for nearly 80 percent of global economic growth and 85 percent of global consumption growth - more than double their share in the 1990s. China will soon become a new global superpower. If it continues to grow as predicted, it will be larger than the US economy by the end of 2028. The Asian market is also expanding due to demographic growth. In 2016, Asia's population was estimated at 4.4 billion, and its number quadrupled during the 20th century. It is now forecasted that it will grow to more than 5 billion by 2050. In order for EU countries to face this economic transfer, they must begin to focus as much as possible on high value-added products and services.



Due to the fact that these megatrends operate on a global level, they also affect sub-economies, regardless of their size. The Czech Republic, together with Hungary as a member of the EU, faces exactly the same global problems.

### 3.2 Responding to trends in Czech Republic

The National Research and Innovation Strategy for Smart Specialization of the Czech Republic for the period 2021 - 2027, referred to as the national RIS3 strategy, reflects these international challenges and transposes them into the national environment. Specifically, the following domains of research and innovation specialization:

- Advanced materials, technologies and systems
- Digitalisation and automation of manufacturing technologies
- Electronics and digital technologies
- Environmental friendly transport
- Technologically advanced and safe transport
- Advanced medicine and drugs
- Cultural and creative industries as a tool to accelerate the socio-economic development of the CZ
- Green technologies, bioeconomy and sustainable food resources
- Smart cities and municipalities

The first three domains focusing on materials, technology, digitization and automation are crucial for development in the field of advanced manufacturing. The following challenges are relevant in these areas:

- Increasing demands on production accuracy, quality, production performance, productivity, reliability, etc .;
- Increasing international competition, pressure to reduce costs, risks of relocation outside the Czech Republic;
- Development and implementation of digital technologies, automation of production processes and replacement of human labor (Industry 4.0);
- Reducing material and energy intensity, wider use of waste raw materials and recycling, greening of production;
- Ensuring the safe operation of value chains by constantly searching for sources of critical raw materials in the Czech Republic and in third countries;
- Climate change, pressure to reduce negative environmental impacts; decarbonisation of industry, transport and energy
- Growing pressure on the use of renewable energy sources, decentralization, energy networks, energy storage, energy savings.
- Development of information and communication technologies and their use in production processes, services and households (including the Internet of Things, IoT);
- Increasing threats to cyber security;



### 3.3 Responding to trends in Hungary

In Hungary the Industry 4.0 related advanced systems and technologies are still in their infancy. Only a few companies have practical solutions using these technologies and those are mainly multinational enterprises with foreign background where knowledge and funding is available. The Hungarian SME sector is highly vulnerable due to their dependence on the German market and the lack of professional labour force which in case increasing time to time. The growing standards and higher expectations encourage Hungarian companies to educate themselves regarding the advanced manufacturing technologies. Hungarian companies look for solutions in order to escape from the insecure low profit toll manufacturing and create higher value added products and services. Advanced manufacturing gives the opportunity to provide more value, solve the lack of labour, create a transparent benchmarking system, higher quality and cost optimization. The problem is that there are small amount of professionals who know how to use these new technologies properly. Implementing these technologies requires to think in a connected system where every piece of data, machine, people are operating together to reach the goals. In fact, lot of Hungarian companies did not developed this system-thinking for their current business processes so far. Other barriers could be the older labour force, traditionally manual work processes and lack of interest on management level. Furthermore, there is a high potential in the Hungarian market as companies becoming more aware that the only way to survive in these uncertain market conditions is process and product development. More education in this topic would improve the attitude of the companies to act.

#### **Sensor technology**

Sensor technology is the base of the Industry 4.0 systems. Gathering data from every business process makes available to create the system-thinking atmosphere. Currently a lot of Hungarian SMEs gather data but do not use it to improve their business processes. The ERP systems used by Hungarian companies are unable to store, process and analyse huge amount of data. In addition, the different business processes are not integrated at all and it is not transparent that each event what causes in the system or provide predictive information for future events. Basically, the biggest development for Hungarian companies could be setting up a system where all their machines are connected and real time data is being analyzed.

#### **Intelligent Manufacturing Systems**

Intelligent Manufacturing Systems like 3D printing, robotics, autonomous mobile robots, indoor drones can be seen in practical use at some Hungarian companies. Robotics are the most trending even smaller SMEs use it to make precision work e.g. welding huge parts, painting or even packaging boxes. 3D printing is used in some cases for rapid prototyping but it requires the constant presence of a professional colleague who knows the technology and materials. Autonomous mobile robots can offer a wide range of solution for companies with huge internal handling processes e.g. for small parts and storage processes it is really practical and the workers can do other tasks. Since most of the Hungarian companies are struggling finding labour force these technologies could mean the solution.

The economy of Szombathely is dominantly automotive industry, and within those multinationals are decisive. Local industry has limited added value.



The main motivating idea also behind PBN's pilot action, the so called "smart-test-room" for elderly generation was the fact, which came out due to the COVID-19 situation. It became clear, that this generation is very vulnerable, especially in the case if they can't get help from their family or their care giver. PBN would like to offer a solution with monitoring their health system and showing them different options (e.g. robots or apps) where they can not only ask for help, but can be used for entertainment functions as well.

Therefore, there is a firm commitment from the municipality, with the support of the digital innovation hub am-LAB, to accelerate economic transition towards diversification. **The goal is to have healthcare industry present.** To enable the process, new knowledge and skills have to be created and augmented. The physical infrastructure will be extended and customized with the cooperation of the city and the am-LAB, while the new knowledge will focus on artificial intelligence.

It includes actions related to setting up a new competence center, focusing on AI. **Thematic orientation is on one hand manufacturing, but increasingly on healthcare.** The long run mission is the establish an institute, which will serve as a knowledge background institution for the new economy.

### 3.4 Priority Innovation Actions

Based on the previously mentioned trends and taking into account the RIS3 strategies of the partner countries, the directions of future development were discussed within the regional Industrial Innovation Workshops (D.T4.1.17) and the Transnational Industrial Innovation Roadmaps Workshops (D.T4.1.6).

The survey performed in Czech Republic which was targeted to the Pilsen region identified the bellow stated technological directions that are relevant for both R&D as well as for application area. The Technological direction in the horizon of 5-7 years ranked by importance are:

- Intelligent control of production processes
- Big data, neural networks and machine learning
- Intelligent diagnostics and maintenance
- Cognitive and cooperative robotics
- Virtual and augmented reality in production

Further more the survey identified several support tools that are relevant for achieving the desirable goals for selected technological directions. Those are especially:

- Preparation of joint research and business projects
- Support for business research, development and innovation
- Support for contract research
- Preparation of international research projects
- Innovation center / hub



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PP	Suggested innovation action	Description	Timeframe	
			From	To
PP5	Extension of Virtual democentre	As part of the pilot activity of the Chain Reactions project, the so-called Virtual Demonstration Center was established, which is represented by a web platform associating examples of good practice and successful implementation of projects from the field of industry 4.0. The aim of this center is to inspire the leading management of companies to implement business and process innovations and thus to increase the competitiveness of companies. The pilot activity received a good response among the professional public and for this reason it was decided to continue the activity even after the end of the project. During the solution, a number of project partners took part in the pilot activity, who provided relevant examples from their regions. The virtual demo center will continue to be filled with the aforementioned demonstration projects so as to cover as many examples as possible and to demonstrate possible solutions to the greatest possible degree of business problems.	01/2022	12/2022
PP5	Establishment and development of DIH services	To maintain the competitiveness of Czech companies, it is necessary to monitor the ever-increasing share of digitization of business processes. However, small and medium-sized enterprises in particular do not have sufficient capacity (especially in the area of human resources) to successfully implement the company through digital transformation. From the current meetings not only within the Chain Reactions project workshop but also within the discussion and industry platforms, it proves to be desirable to provide companies with support services in this area. With regard to this need, the services of the DIH HIVE are being modified and will be extended, for example, by digital maturity assessment services.	01/2022	12/2022



**CHAIN REACTIONS**

PP5	Development of infrastructure for demonstrations and testing in digitisation	Providing expert services to support digitization is one of the key activities for the development of regional businesses. However, for many specific applications in the field of applied research, it is necessary to have a sufficient infrastructure for testing and verifying the proposed solutions. The disadvantage currently characterized by rapid development is the rapid obsolescence of production and laboratory technologies. Acquisition of these technologies is also to some extent quite expensive. An effective way is to share this experimental infrastructure in specific testbeds. This proposed innovation activity aims not only to retrofit this technical infrastructure, but also to create communication and other channels for the use of remote testing, remote access.	01/2022	12/2023
PP5	Support in establishment of new companies and acceleration of the promising ones	Incubation and acceleration of companies is the priority either on national or in regional level. This innovation activity is incorporated in RIS3 strategy of the Pilsen Region and it is in the status of piloting support schemes for both target groups. The incubation will contain piloting new grant scheme in regional level, the acceleration of existing companies will be supported by expert services in frame of the network Ynovate. The tools developed in Chain Reactions project – innovation toolbox, digital maturity – will be used for both programs.	01/2022	12/2022
PP5	New university study program for intelligent manufacturing	In response to the rapid development of technology, Industry 4.0. and the demand for highly qualified professions, the University of West Bohemia has started to prepare a new study program that will reflect these trends and needs. Currently, a study program called "Intelligent Manufacturing Systems" is in an advanced stage of preparation. As the ambition of the program is to make available to students knowledge not only from companies in the Czech Republic but also abroad, it is necessary to establish long-term co-workers with various entities from research organizations to companies. Collaborating institutions will participate not only in teaching, but also in excursions, for example.	01/2022	8/2022



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PP5	TRANS-FORMER project	<p>Initial project idea has been developed by RTech and is primarily focused on changes foreseen for automotive industry especially within its shift towards electromobility. The sector of advanced manufacturing is very much interconnected with automotive sector, Czech Republic and Pilsen Region are confronted with new requirements regarding environmental issues (Green Deal), which means radical changes in production chains in this sector. The following thematic areas are particularly affected:</p> <ul style="list-style-type: none"> <li>- Electric and Autonomous driving</li> <li>- Mobility services</li> <li>- Digitization of the vehicle</li> <li>- Evolution of cars into a driving IoT device "always on"</li> <li>- Multiple sales channels</li> <li>- Use of digitization for process automation</li> <li>- Cross-cutting value chains: intermodal transport - electricity supplier - service provider service provider</li> <li>- Change in customer demand from vehicle ownership to on-demand mobility</li> </ul>	1/2022	12/2025
PP1	AR/VR utilization in healthcare	<p>Partners could collaborate in the sector AR/VR in medical industry. PBN (connected with am-LAB and at.home) are connected to both sector (health and AR/VR), while RDA Pilsen (connected with DIH HIVE and VR medical) are connected to VR solutions, and GAPR and Professor Zbigniew Religa Foundation of Cardiac Surgery Development are related to the health sector. Each partner would be able to provide relevant expert for the topics. Transnational workshops or trainings (face-to-face or online) would be useful for the interest groups. Special trainings (both for general public and health sector) in smart senior room (PBN) about available technologies.</p>	1/2022	Planned activity
PP1	Promotional campaign for elderly generation, social care workers and the community	<p>Promotion campaign for awareness raising among local citizens: Trainings for the elderly generation and for the social care workers about the available technologies in health care and digitalization</p>	2022	2022
PP1	Artificial Intelligence in healthcare training	<p>Physical and online trainings focused on Artificial Intelligence in healthcare. Training material was composed with national and international knowledge. The execution on the prepared material will be at am-LAB.</p>	2022	2022



PP1	I4.0 assembly line	In the case of the production line, the goal is to continuously develop, adapt and transform possibly into a new research Centre	2022	
PP1	Szombathely2030	Strategic planning for the next 10 years of the city of Szombathely, including digitalization, education and health related topics.	2022	

### 3.5 Conclusions and recommendations

This report summarizes the activities carried out to establish a roadmap for the advanced manufacturing sector. The main starting point for the creation of the roadmap were local workshops, from which inspiring proposals from the business and research spheres emerged. These proposals were subsequently further communicated at a transnational workshop of PBN and RDA partners. The proposed innovation actions are fully in line with current global trends as well as with national smart specialization strategies in the partner countries. Innovation actions will now be cultivated again on Transnational Industrial Innovation Agendas workshops at both national and international levels in order to specify those innovation agendas. Once again, national priorities for the advanced manufacturing sector will be taken into account, which pays attention to the constant development of artificial intelligence and cybernetics. As in many cases we try to develop international cooperation on scientific research projects, where the protection of intellectual and industrial property is also an integral part. The proposed activities generally aim not only to the strengthening of innovation potential of industrial companies, but also to startups support or their subsequent acceleration. All this in the context of current European challenges, such as climate protection (Green deal) and reduction of energy consumption.