



A 1.3

Transnational SMEs digitalization gap-analysis and identification of key technologies and solutions that SMEs should embrace regarding digital transformation in production and logistics in the region

D.1.3.2

Transnational Guidelines for the smart specialization of the Danube Region



Document Control Sheet

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List of abbreviations

PP(s)	- Project Partner(s)
S3	- Smart Specialisation Strategy
SMEs	- Small and Medium Enterprises
SO	- Specific Objective
EU	- European Union
DR	- Danube Region
TG	- Transnational Guidelines
EC	- European Commission
AI	- Artificial Intelligence
M&E	- Monitoring and Evaluation



Summary

This deliverable supports the project's SO1, entitled "*Establishment of the Danube DNA Network and Platform*" by developing transnationally aligned Smart Specialization Guidelines for the synchronized digital transformation of SMEs across the Danube Region. Deliverable D1.3.2 is linked to Activity 1.3 and aims to provide a Transnational Guideline based on identified need for transnational S3 alignment in the DR, while also highlighting the benefits of cross-border and cross-sectoral collaboration.



1. Introduction

1.1. Document background

According to [1], the main goal of the Smart Specialisation Strategy (S3) is to foster industrial and economic diversification within regions by leveraging local strengths, capabilities, and global trends. S3 places a strong emphasis on the smart specialisation of regional economies, integrating innovation, knowledge-based growth, and the utilization of local resources. This approach aims to enhance regional economic competitiveness and support sustainable development. Introduced as a policy instrument within the European Union (EU) during the 2014-2020 programming period, S3 seeks to enable regions to capitalize on their unique strengths, competitive advantages, and potential in research, technological development, and innovation. By doing so, it contributes to economic expansion, job creation, and social cohesion. The strategy prioritizes sectors where regions exhibit strong capabilities and growth potential, including local industries, scientific and technological infrastructure, and human capital. Its overarching objective is to stimulate the generation and application of innovative ideas, fostering knowledge-driven economic progress.

The essence of S3 lies in the concentration of public resources on knowledge investments in selected activities to strengthen or develop comparative advantage in existing or emerging fields across three key dimensions [2]: (i) scientific, technological and economic specialisation in the development of comparative advantage and in driving economic growth; (ii) policy intelligence for identifying domains of present or future comparative advantage; and (iii) government approach with the key role of regions, private stakeholders and entrepreneurs in translating S3 into economic and social benefits. ***The broader rationale for S3 is primarily economic, rooted in the concepts of comparative advantage and regional competitiveness.*** Within the EU, S3 strategies have a strong regional focus, as they are closely linked to and integrated into regional development policies, aiming to make innovation a priority across all regions.

Through our Danube DNA initiative, we seek to adapt and apply this EU approach to the Danube Region (DR) to enhance the overall innovation processes, promote joint investment, and foster synergies between the policies and funding mechanisms of DR countries. In this context, an appropriate *Transnational Guidelines* has been developed to ensure cross-border and cross-sectoral alignment of national S3 strategies along the entire DR.

This deliverable is part of **Specific Objective (SO) 1**, entitled: “*Establishment of the Danube DNA Network and Danube DNA Platform*”, which, among other objectives, focuses on the development and implementation of transnationally aligned smart specialization



guidelines to support the synchronized digital transformation of SMEs across the Danube Region. More specifically, this report is part of *Activity 1.3*, which aims to develop Transnational Guidelines with the primary objective of defining the need for transnational S3 alignment in the DR and highlighting the benefits of cross-border and cross-sectoral collaboration. The Guidelines is built upon the findings from Activity 1.2 and the detailed gap analysis conducted in the initial stages of Activity 1.3 at the national level.

1.2. Objectives of the Activity 1.3 and Deliverable 1.3.2

Activity 1.3 has a three-fold objective. The first objective is to conduct a detailed gap analysis at the national level to identify key technologies and solutions that SMEs in the PPs countries should adopt to drive digital transformation. The second objective is to develop a structured inventory of suitable technological solutions tailored to different sectors, serving as a comprehensive repository for potential joint solution development. *These two objectives are addressed in Deliverable D.1.3.1.*

The third objective focuses on developing Transnational Guidelines to ensure cross-border and cross-sector alignment of national S3 strategies across the entire Danube Region. ***This objective is addressed in the present Deliverable D.1.3.2.***



2. Methodology for development of the Transnational Guidelines

2.1. General overview of the methodology

The key element of Transnational Guidelines (TG) and one of its main challenges, is **to identify the common smart specialisation priority areas and themes** and their underlying knowledge and economic domains for the PP countries across the DR. This raises a number of challenges. The TG aims to address these challenges and **provide an applicable solution, a 'recipe' on how to elaborate and manage transnational smart specialisations**. The methodology for creating the TG was based on the rules used for developing the national S3 strategy recommended by EU, as well as similar methodology provided in the project GoSmart BRS [2]. The set of 'standard' rules for development of S3 strategy, used across the EU, has been adapted to the transnational context of the DR. The main challenges when adapting the general guidance on S3 were related to the international and cross-border nature of the TG and to the fact that in this new context, a priori governance system which could be adapted and applied were practically non-existent. This is one of the reasons why the steps regarding management and establishment of accompanying policies of TG was treated with limitations, while the specific component dedicated to the identification of transnational priorities and domains was given a more prominent position. Some of the key challenges in developing the TG as compared to a standard national S3 were: (i) cross-border context with large distance; (ii) temporary and relatively weak governance structure (PPs based); (iii) lack of strong shared vision regarding DR future; (iv) national policy not compatible at transnational level.

Considering the abovementioned, the transnational smart specialisation strategy methodology, outlined in this chapter, explains the approach proposed for the identification of transnational smart specialisation priority areas, which is considered the key element of the TG. Other elements of this strategic management tool are just briefly stated. Therefore, for the purpose of methodological clarity, **the Transnational Guidelines methodology is split into two main parts:**

- **Transnational Guidelines: priority identification** - stands for a set of steps which lead to the selection of smart priorities thematic areas and domains at the transnational level.
- **Transnational Guidelines: cooperation and management** - stands for the elements which need to accompany the identification of smart priority areas such as joint solutions development, coordinated pilot actions, and monitoring.



2.2. Methodology for TG priority identification

The TG priority identification process is described below in an easy three steps logic with each part representing different analytical and consultative set of methods and their expected outcomes. The national S3s are considered a starting point for the identification of the transnational priorities and domains. In this case, finding common smart specialisation areas and their underlying knowledge and economic domains, simply described, becomes an exercise of selecting common sets and refining this selection through appropriate further analyses. The proposed three steps approach assumes the following:

- *Step 1: Searching for common set of priority industries/thematic areas among target countries: **Initial priorities identified.***
- *Step 2: Experts review of priority industries/thematic areas: **Final priorities verified.***
- *Step 3: Searching for common set of thematic group of S3 priority areas and thematic partnership: **Thematic priority group and partnership identified.***

Following the proposed set of steps leads to establishing the DR transnational priorities and specific domains in a coherent, logical, and integrative manner, which reflects the main underlying concepts of the smart specialisation strategies. Verification of common priority areas will be followed by identification and selection of strategic thematic areas linked to a identified smart specialisation priorities. For the each identified thematic priority group related transnational partnership have to be identified. It is important to note that the whole process is to a high degree iterative (verifications and validations are carried out throughout all the steps) and allowing extensive feedback loops.

2.3. Methodology for transnational cooperation and management

The TG cooperation and management component, differentiated but intrinsically linked to the previous component, allows the identification of smart priorities to be carried out in a coordinated, purposeful, and rational manner and the TG, once adopted to be effectively implemented.

As the elements comprising this cooperation and management component are fairly 'generic' and applicable regardless of the geographic context, they do not differ much between a typical national S3. In this sense, the standard S3 methodology can be used without much modification. The proposed approach assumes the following steps:

- *Coordinated knowledge transfer and transnational capacity building within thematic groups.*
- *Development of simple road map for joint solutions and pilot actions development.*
- *Monitoring and evaluation of joint actions.*



In the next chapters, the proposed methodology will be presented in a more detail, providing policy makers and smart specialisation practitioners with in-depth instructions and suggestions on each step of TG elaboration, and more specifically, on the steps leading to the identification of the DR transnational S3 priorities and domains.



3. Transnational Guidelines – priority identification

3.1. Prioritisation in S3 strategies in the PP countries

For the purpose of priority identification within S3 strategies, a comprehensive prioritisation database covering all PP countries was created. Based on this database, the project deliverables D1.2.1, D1.2.2, and D1.3.1 were completed, serving as the main input for the creation of the TG and the subsequent Deliverable D1.3.2. These documents provided the foundation for a systematic screening and assessment of national S3 strategies across the PP countries in the DR. The aim was to identify the respective approaches to prioritisation and to analyse whether the priorities defined within these strategies align with national or regional innovation capabilities. In practical terms, the smart specialisation approach focuses resources on carefully selected “priority areas.” These areas may be defined in terms of specific knowledge domains, economic activities, or subsystems within sectors. They may also cut across sectors or correspond to market niches, technology clusters, or targeted applications addressing societal and environmental challenges. Importantly, these priorities should reflect the region’s existing strengths and be positioned to seize emerging innovation opportunities [3].

Deliverable D1.3.1 presents a clear analysis of the national S3 strategies adopted by the PP countries. The analysis reveals that the most common priority areas include **ICT**, **Agriculture**, **Tourism**, and **Mechanical Engineering & Mechatronics**. These sectors demonstrate a strong presence across multiple regions, highlighting their strategic importance for economic growth and technological advancement.

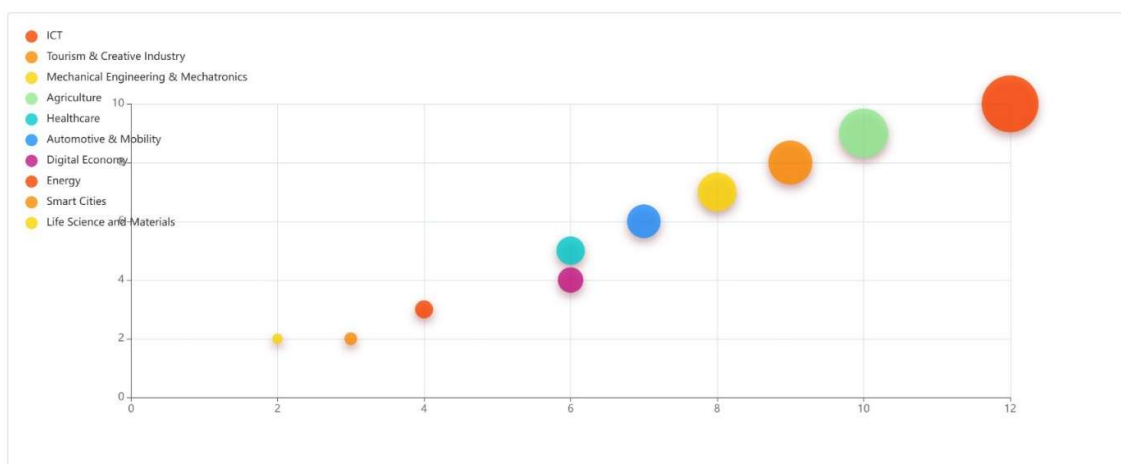


Figure 3.1: Distribution of S3 priority areas in the DR countries (from D1.3.1)



When considering SMEs, Deliverable D1.3.1 indicates that they are represented across all dominant priority areas. However, within the less dominant areas identified in the analysed S3 strategies, the **Energy** sector stands out as requiring additional attention, particularly from the perspective of SMEs operating in the manufacturing and logistics sectors, which are of particular relevance to the Danube DNA project. When it comes to the sector of Mechanical Engineering & Mechatronics, the eight PP countries identify it as a priority sector. Additionally, six of them specify the *Production process improvement* as the main digitalization focus within the Mechanical Engineering & Mechatronics sector.

3.2. Identification of priority industries/thematic areas among PP countries – initial prioritization

The starting point for identification of priority industries/thematic areas within the identified PP's S3 strategies was the concept of S3 Thematic Platforms, launched by European Commission (EC) in 2015, as a instruments to support bottom-up collaboration between business and researchers along value chains across the EU. These platforms target key priorities in order to facilitate the emergence of transnational projects to modernize EU industry and provide opportunity for policy makers at EU, national and regional level to pool experience and combine instruments to address these priorities in a regional context, where change is felt most [4]. The platforms provide the structure to support the creation of an interregional collaborative network of strategic Thematic Smart Specialisation Partnerships and enable these partnerships to work together in shared smart specialisation areas. Since June 2016 there are three S3 Thematic Platforms:

- For **Energy**,
- For **Industrial Modernization**,
- For **Agri-Food**.

The S3 Platform for Industrial Modernization (or S3P-Industry Platform) is particularly relevant to the Danube DNA project, as it is directly linked to the theme of enhancing SMEs in the manufacturing and production logistics sectors.

The concept of Industrial Modernization is relatively broad and relates to areas such as high-performing manufacturing, key enabling technologies, digital transformation, advanced materials, as well as service innovation concepts. Against this background, S3P-Industry Platform has been established to offer hands-on support for European regions to match their smart specialisation priorities related to industrial modernisation. The core activities of the S3P-Industry Platform are executed in thematic Smart Specialisation Partnerships where regions initiate and explore new value chains with the aim of modernising the underlying industry by developing interregional investment projects, interregional collaboration projects and / or working to align S3 in a shared domain [5].



The desire to respond to business needs, particularly those of SMEs, and to mobilize private investment are key drivers of the S3P-Industry initiative. S3P-Industry plays a crucial role in fostering SME digitalization by promoting interregional cooperation and piloting innovative solutions that deliver tangible value [6]. These efforts encourage SMEs to participate in technology transfer and innovation-driven activities. Regions involved in the initiative often leverage cluster organizations as intermediaries to actively engage with SMEs and support their digital transformation.

This makes S3P-Industry a strong starting point for defining and checking the thematic areas within S3, particularly in the context of regional collaboration. By aligning regions with shared industrial strengths and innovation potential, S3P-Industry facilitates the identification of common challenges and opportunities across borders. This collaborative framework enables the co-development of thematic priorities that are both demand-driven and innovation-oriented, grounded in real market needs and supported by interregional value chains. Thematic areas identified through the S3P-Industry framework are more likely to reflect both regional capabilities and transnational synergies, ensuring better alignment with EU policy priorities and funding mechanisms.

Therefore, the thematic areas defined through the S3P-Industry platform serve as a strong starting point for establishing a well-coordinated, evidence-based foundation for identifying thematic S3 priorities in the Danube Region (DR). More specifically, the thematic areas proposed within the S3P-Industry platform are combined with the thematic priorities related to industrial modernization identified in the S3 strategies of the PP countries. This integration forms the basis for defining the initial list of prioritized thematic areas, as presented in Table 3.1.

Table 3.1 presents the initial set of common priority industries/thematic areas for the DR, along with definition of their underlying knowledge domains and technologies. This initial identification of priority thematic areas supports the dual definition of Transnational Guidelines, both in terms of broad smart specialization priorities (such as **ICT, Agriculture, Tourism, Production process improvement, and Energy**) and their more specific thematic areas and enabling technologies, as outlined in Table 3.1. The strength of this approach lies in its ability to identify cross-country and cross-regional shared priorities while also providing a clear explanation through the lens of specific common smart domains. These domains can serve as the basis for more detailed analysis and targeted consultations moving forward.

Table 3.1: Thematic areas regarding Production process improvement and Industrial modernization of SMEs

No	Thematic areas	Short description
1	Advanced manufacturing for creating new value chains	Collaboration and partnerships aimed at positioning the Danube Region as a leader in innovative manufacturing, focused on developing new and



		integrated value chains across sectors such as agriculture, chemistry, plastics, and energy.
2	Efficient and sustainable manufacturing	Collaboration and partnerships aimed at transferring innovative research-based solutions to industry and leveraging the potential of smart specialisation to promote efficient, high-value-added supply chains.
3	Industry 4.0 for SMEs / production performance monitoring system	Collaboration and partnerships aimed at involving and supporting SMEs in advancing toward the Industry 4.0 paradigm by enhancing their capacity to absorb specialized digital services. For a successful transition, SMEs must undergo technological upgrades, adopt new behavioral patterns, and adapt their business models.
4	Innovative textile industry	Collaboration and partnerships aimed at strengthening the textile industry across the DR and positioning it within various EU and global supply and value chains.
5	Digitalisation and safety for tourism	Collaboration and partnerships aimed at strengthening the tourism industry in the DR, with a particular focus on tourism digitalization. The main goal is to enhance regional innovation capacity and facilitate investment in regional innovation ecosystems.
6	Cybersecurity	Collaboration and partnerships aimed at fostering interregional cooperation to create synergies among regions specializing in cybersecurity, and to support the development of the cybersecurity value chain in the DR and across the EU.
7	Artificial Intelligence	Collaboration and partnerships aimed at enabling SMEs in the DR to effectively adopt and integrated AI technologies, enhancing their innovation capacity and digital transformation through shared knowledge, resources and targeted support mechanisms.
8	Advanced manufacturing in energy and machinery sector	Collaboration and partnerships aimed at positioning the DR as a leader in advanced manufacturing within the energy and machinery through a joint effort to develop and implement innovative strategies and technologies..
9	High performance production through 3D printing	Collaboration and partnerships aimed at identifying opportunities for joint demonstrations between countries and regions, based on a thorough mapping exercise and the identified complementarities between existing demonstration facilities and company needs.
10	Healthcare technology	Collaboration and partnerships aimed at aligning improved health outcomes with growth opportunities for the healthcare industry, particularly through the adoption of new and emerging technologies.



3.3. Experts review of priority industry/thematic areas – priorities verified

In the second stage of TG development, the initially identified priority thematic areas must be reviewed collaboratively by all PPs, as future Danube DNA molecules, together with accompanying national experts and all interested stakeholders. The main reason for this review were:

- To reset the reference points for priority thematic areas, moving beyond those used solely in the development of individual national S3 strategies as well as S3P-Industry platform.
- To cross-check and validate that the identified priority thematic areas are relevant and strategically important to both the PPs and their respective national S3 priorities.

Including national experts (experts from each PPs and other relevant experts) and relevant stakeholders in the process of defining the final list of priority thematic areas is essential for several reasons:

- Expertise and insight: national experts bring sector-specific knowledge, policy experience, and a deep understanding of regional strengths, challenges, and innovation capacities. Their input ensures that the selected thematic areas are grounded in real-world conditions and aligned with existing policy frameworks.
- Stakeholder relevance: engaging stakeholders, such as businesses, research institutions, clusters, and civil society organizations, helps to capture on-the-ground needs and emerging opportunities. This participatory approach increases the relevance and practical applicability of the thematic areas across different sectors and territories.
- Strategic alignment and buy-in: involving experts and stakeholders fosters greater alignment with national and regional S3 strategies while promoting ownership of the process. This is crucial for ensuring long-term commitment, resource mobilization, and the successful implementation of future joint initiatives.
- Cross-sectoral synergies: stakeholder engagement supports the identification of potential cross-sectoral and transnational synergies, which are vital for creating active training and knowledge transfer centers, as key components of the Danube DNA network, that facilitate integrative smart specialization, skills development, cross-sectorial collaborations, SMEs transformation and transition towards Industry 4.0.

By incorporating expert and stakeholder perspectives early in the process, the final list of priority thematic areas becomes more robust, inclusive, and strategically impactful, laying the groundwork for effective cooperation and innovation across the Danube Region.



Through this joint review process, consensus has to be reached on a final list of priority thematic areas to be targeted moving forward. This selection was guided by several key factors:

- Capacity-building requirements necessary to transform PPs into functional Danube DNA molecules, envisioned as one-stop-shops for supporting SME digitalization across the region.
- Identified needs of SMEs from all participating countries, particularly in enhancing competitiveness and integration into EU and global value chains.
- Complementarity with existing priorities outlined in national and regional S3 strategies, ensuring alignment with broader policy frameworks and funding mechanisms.

This structured, participatory approach ensures that the selected thematic areas are both strategically relevant and practically grounded, reflecting real regional needs while supporting long-term transnational cooperation and innovation in the DR.

Through this review process, the initially identified priority thematic areas were validated. Several were eliminated, while the remaining ones were organized into two categories, *core* and *transversal*, as shown in Table 3.2.

Table 3.2: Final verified thematic areas regarding Production process improvement and Industrial modernization of SMEs

Core thematic areas	Transversal thematic areas
Advanced manufacturing for creating new value chains	Digitalisation and safety for tourism
Efficient and sustainable manufacturing	Artificial Intelligence
Industry 4.0 for SMEs / production performance monitoring system	Advanced manufacturing in energy and machinery sector

Core thematic areas represents domains in which the PPs aim to strengthen their competitiveness and develop skills, with the goal of equipping SMEs with the necessary knowledge and competencies. Transversal thematic areas, on the other hand, are enabling domains that support and enhance the development of skill, capacities, expertise and capabilities in core thematic areas. They serve as cross-cutting pillars, such as specific technology or industry, that either provides the appropriate tools and enabling technology, or defines the business or industry sectors where joint efforts are needed to strengthen the PPs innovation capacity by fostering synergies and facilitating the transfer of knowledge and technology among PPs (Danube DNA network molecules).

3.4. Identification of thematic priority groups and partnerships

In the final stage of priority identification, a corresponding thematic group was established within the consortium of PPs for each thematic priority area defined in the previous stage. **These thematic groups were formed based on shared goals, specific capacity-building needs, and common challenges related to the respective thematic areas.** The composition of each thematic group reflects both the expertise and interest of participating PPs, ensuring a focused and collaborative approach to addressing the identified priorities.

Table 3.3: Thematic groups within the Danube DNA network

Thematic group members	Thematic areas
PP2 (IT&C Cluster “Lower Danube”, RO); PP7 (Institute of Technology and Business in Ceske Budejovice, CZ); PP9 (TUM International GmbH, DE); and PP10 (CAMPUS 02 University of Applied Sciences, AT)	Efficient and sustainable manufacturing; Advanced manufacturing in energy and machinery sector
PP3 (Foundation Cluster Information and Communication Technologies, BG); PP7 (Pomurje Technology Park, SI); PP11 (Sarajevo Economic Region Development Agency, BA); PP12 (Chamber of Economy of Montenegro, ME)	Advanced manufacturing for creating new value chains; Digitalisation and safety for tourism
PP1 (Faculty of Technical Sciences, RS); PP 4 (TERA Tehnopolis Ltd, HR); PP6 (South Transdanubian Regional Innovation Agency, HU); PP8 (SOVA Digital Inc, SK)	Industry 4.0 for SMEs / production performance monitoring system; Artificial Intelligence

The first thematic group is centered around **Efficient and sustainable manufacturing** as the core thematic area, while **Advanced manufacturing in the energy and machinery sectors** serves as the transversal thematic area. The latter specifies the industrial focus of the participating PPs, defining the targeted application domain of their collaboration as part of the Danube DNA network. The second thematic groups is focused on **Advance manufacturing for creating new value chains** as the core thematic area, with **Digitalisation and safety for tourism** serves as the transversal thematic area, specifying tourism sector as the primary industrial focus of the participating PPs, aiming to enhance innovation and competitiveness in this domain. The third thematic groups is centered around **Industry 4.0 for SMEs / production performance monitoring system** as the core thematic area. Here, **Artificial Intelligence** serves as the transversal thematic area, indicating the key enabling technology guiding the collaboration and innovation efforts of the participating PPs within Danube DNA network.



Beyond their role in thematic alignment, these groups will serve as functional platforms for targeted skills development and structured knowledge transfer. They will facilitate peer learning, joint problem-solving, and the exchange of best practices across regions. These activities will be operationalized through dedicated sessions in the upcoming Activity 2.1, where thematic groups will act as the main vehicles for delivering tailored training, technical support, and innovation-driven collaboration aligned with the needs of SMEs in the DR. In addition, the established thematic groups will play a central role in facilitating the development of joint solutions among PPs, aligning with the core objective of Activity 2.3. Their collaborative structure will enable the co-creation of innovative approaches tailored to shared challenges within each thematic area.



4. Transnational Guidelines – cooperation and management

4.1. Coordinated knowledge transfer and transnational capacity building

The methodology for defining coordinated knowledge transfer and transnational capacity building is, first and foremost, based on a comprehensive evaluation of digital readiness across each participating Danube Region country, as provided in Deliverable D1.3.1.

For each thematic group, the first step, based on the digital readiness assessment, is to define the appropriate methods for knowledge transfer and identify the key topics that need to be addressed. These findings will serve as input for Activities 2.1 and 2.2, which focus on cross-border knowledge exchange among Danube DNA molecules and their capacity building. Additionally, these activities will support knowledge transfer from Danube DNA molecules to national SMEs, ensuring that insights and innovations are effectively disseminated and applied at the local level.

By comparing the results of the digital readiness assessments, presented in the form of a comparative analysis, and identifying gaps across four key indicators (Enabling Infrastructure, Production Capabilities, Innovation Capabilities, and Digital Capabilities) within each thematic group, a deeper understanding of the digital maturity of the participating PPs can be achieved. This comparative analysis should be conducted separately for each thematic group and will serve to highlight strengths, weaknesses, and strategic opportunities specific to each institution, while also identifying common challenges across the group and institution-specific needs. The common challenges should be focused on digital skills gaps, training and education gaps, digitalization challenges for SMEs, problems of adaptation to new technologies, and cultural and social differences between countries within DR that impact the perception of digital skills and their necessity.

Based on these insights, tailored peer-learning activities should be designed, such as virtual or in-person study visits, thematic workshops, and expert exchange sessions. These formats should be carefully structured into a joint transnational capacity building program that responds directly to the findings of the readiness assessment. To ensure practical relevance and impact, this program should involve external stakeholders, such as SMEs, representatives of digital innovation hubs, technology providers, and research institutions, as guest contributors and knowledge co-creators. Their inclusion will help contextualize learning, share real-world practices, and foster collaborative innovation. The ultimate aim of this capacity building program is to co-develop targeted transnational training modules aligned with the



needs and priorities of each thematic group. These modules should address both technological and strategic topics, support institutional learning, and be adaptable for future use in national and regional SME support schemes. These modules should be aligned with key training needs related to digital literacy, emerging technology adoption, cultural sensitivity in digital transformation, and data analysis and management.

4.2. Development of simple road map for joint solutions and pilot actions development

Creating a comprehensive roadmap, set of instruments, joint solutions, action plans, and a unified budget for the entire project consortium is extremely challenging, primarily due to the diverse economic, policy, and social conditions across the Danube Region. However, it is both necessary and feasible to develop and agree upon at least a simplified roadmap of joint solutions development, including a pilot action, outlining the essential steps that PPs must take to achieve the Danube DNA objectives. This roadmap should typically highlight what actions need to be carried out jointly and/or individually by the involved PPs, while following a common logic and aiming for similar impacts, particularly in supporting SME digitalization.

Relatively simple roadmaps and action plans can still be highly effective, even when full integration of policy instruments and funding mechanisms is not feasible. It is sufficient for partners to align their capacities, expertise and budgets toward common strategic goals, while coordinating and monitoring the achievement of the Danube DNA objectives. Joint solutions and pilot projects are particularly valuable, as they create additional policy and funding opportunities to achieve the agreed transnational goals. The insights and lessons learned from these joint initiatives can be reintegrated into future cycles of the Danube transnational strategy for SME digitalization and can be mainstreamed in various ways to enhance long-term impact.

The model presented in the EC's *Handbook: Implementing Smart Specialisation Strategies* [7] was adopted as a reference framework for developing the roadmap for transnational cooperation on SME digitalization in the DR. This model outlines a series of stages, beginning with a bottom-up approach based on data and information exchange. It then progresses through the implementation of collaborative pilot projects, eventually evolving into strategic platforms and the alignment of funding instruments. This staged approach enables a comprehensive policy framework, facilitating the creation of joint programmes and the integration of various policy tools and instruments. Our *Transnational Guidelines for Smart Specialisation in the Danube Region* have been developed in line with the principles and structure of this model, as illustrated in Figure 3.1.

Transnational collaboration on smart specialisation can be visualized as a stairway, where each step paves the way for the next (see Figure 3.1). While it is possible that some



steps may be skipped, continuous efforts and strong partnerships help to establish a solid foundation for effective transnational cooperation. This process ultimately supports the joint development of suitable solutions, action plans, and, eventually, policy recommendations and strategic frameworks.

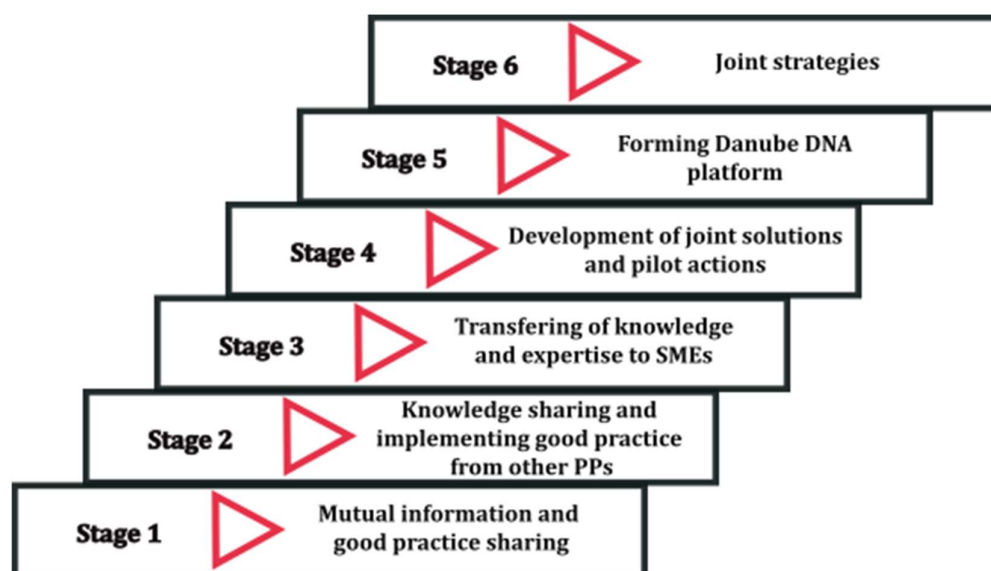


Figure 3.1: Steps of transnational collaboration development regarding smart specialization (adapted from [7])

Information sharing and transnational learning through peer review have provided the foundational knowledge needed to establish a joint transnational smart specialisation framework and to sustain partnerships within the identified priority thematic areas supporting its implementation (**Stage 1**). Knowledge exchange and the adoption of good practices from other partners (**Stage 2**) can empower Digital Transformation Centres, referred to as Danube DNA molecules, to enhance their capacity to address challenges in innovative ways, solve problems more effectively, and form new collaboration networks. The next step (**Stage 3**) involves these centres transferring knowledge and expertise to SMEs within their regions, thereby facilitating practical implementation and broader digital transformation across the Danube Region.

Development of joint solutions and pilot actions (**Stage 4**) can open new trajectories for S3 priority areas and themes and redefine strategic focuses. This stage is crucial in TG for the smart specialization in DR, since it is focused on development of practical tools and solutions for digitalization of SMEs. According to Deliverable 1.3.1 three digital transformation themes (or enablers) have been proposed for the development of joint solutions, along with six corresponding joint solutions tailored to the context of SMEs:



Danube DNA

- **Business Digital Transformation Enablers.** The objective of Business Digital Transformation Enablers is to facilitate and accelerate the adoption of digital technologies, enhancing SMEs' competitiveness, efficiency, and resilience in an increasingly volatile economy. It will consist of a cluster of three solutions designed to help SMEs define an appropriate pathway toward digital transformation, identify suitable business solutions, and secure funding for their implementation. The proposed joint solutions are:
 1. **Digital Maturity Assessment**
 2. **Digital Business Solutions Generator,**
 3. **Digital Project Proposal Generator.**
- **Energy Efficiency Enablers.** The objective of Energy Efficiency Enablers is to enhance energy efficiency, reduce operational costs, and improve sustainability of SMEs through the adoption of smart energy management technologies. These enablers help SMEs optimize energy consumption, comply with environmental regulations, and increase competitiveness in an increasingly energy-conscious market. Therefore, in this project, the *Energy Efficiency Enablers* should focus on developing two joint solutions:
 4. **Energy Optimization,**
 5. **Energy Measurement.**
- **Production Optimization Enabler.** The objective of Production Optimization Enablers is to enhance production efficiency, reduce waste, and improve overall performance through data-driven and smart manufacturing technologies. These enablers support SMEs in adopting high-tech solutions to optimize production processes, improve resource utilization, and increase competitiveness. In this project, within the context of Production Optimization Enablers, the aim is to develop the following solution, leveraging one of the most promising and emerging technologies for enhancing production efficiency:
 6. **Production Optimization Solution based on AI.**

The aforementioned enablers and proposed joint solutions will be mapped onto the identified priority thematic areas and thematic groups, as outlined in Table 3.4. **It is important to note that joint solutions 4, 5, and 6 will be developed and implemented through pilot actions conducted within the same thematic group**, ensuring focused, domain-specific innovation. In contrast, joint solutions 1, 2, and 3 will be developed and piloted as outcomes of cross-group collaboration, fostering interdisciplinary synergies and leveraging complementary expertise across thematic areas. This dual approach supports both specialization within individual groups and integration across the broader transnational partnership, enhancing the overall impact of the smart specialisation strategy in the DR.



Table 3.4: Positioning of Joint solutions within thematic groups

Thematic group members	Thematic areas	Joint solutions
PP2 (IT&C Cluster “Lower Danube”, RO); PP7 (Institute of Technology and Business in Ceske Budejovice, CZ); PP9 (TUM International GmbH, DE); and PP10 (CAMPUS 02 University of Applied Sciences, AT)	Efficient and sustainable manufacturing; Advanced manufacturing in energy and machinery sector	5. Energy Measurement 3. Digital Business Solutions Generator
PP3 (Foundation Cluster Information and Communication Technologies, BG); PP7 (Pomurje Technology Park, SI); PP11 (Sarajevo Economic Region Development Agency, BA); PP12 (Chamber of Economy of Montenegro, ME)	Advanced manufacturing for creating new value chains; Digitalisation and safety for tourism	4. Energy Optimization 2. Digital Project Proposal Generator
PP1 (Faculty of Technical Sciences, RS); PP 4 (TERA Tehnopolis Ltd, HR); PP6 (South Transdanubian Regional Innovation Agency, HU); PP8 (SOVA Digital Inc, SK)	Industry 4.0 for SMEs / production performance monitoring system; Artificial Intelligence	6. Production Optimization Solution based on AI 1. Digital Maturity Assessment

To create a continuous pipeline of initiatives and projects, regional and national stakeholders join the Danube DNA network (**Stage 5**) to collectively address common challenges and pursue shared goals. To ensure long-term support and sustainability of the Danube DNA network, the *Danube DNA Platform* will be established. This platform will serve as the backbone for the project’s communication, coordination, and dissemination activities.

The final stage of Transnational Smart Specialisation (**Stage 6**) involves the development of joint strategies, representing an advanced form of cross-border cooperation. Although this stage lies beyond the scope of the current project, it could serve as a foundation for future follow-up project initiatives and policy development.

4.3. Monitoring and evaluation of joint solutions and pilot actions

Monitoring and evaluation (M&E) form an essential sub-system of any effective strategy, and this also applies to the Transnational Smart Specialisation approach, despite inherent challenges such as building joint ownership and ensuring partner accountability. For the M&E system supporting the Danube Transnational Smart Specialisation for SMEs to be effective, it must be clearly defined using measurable indicators across all strategic levels, including general objectives, specific objectives, results, and outputs.

The performance of implemented joint solutions and pilot actions must be systematically tracked through M&E activities. This will enable timely updates and adaptations,



ensuring that the initiative remains aligned with its ultimate objectives, even under changing conditions. M&E elements will be embedded directly within each pilot action, providing real-time feedback loops. A peer review mechanism will also be introduced as a valuable component of the M&E process. It not only enhances objectivity and learning across the partnership but also serves as a motivational tool, fostering continuous improvement and mutual accountability.

To support this, Danube DNA partners will develop a comprehensive project-based monitoring plan. This plan will include all critical control elements of effective project management, such as content specifications, timelines, budget allocations, expected outcomes, and key reporting milestones, thereby ensuring structured oversight and measurable progress of joint solutions development and pilot action realization.



5. Conclusions

The development of *Transnational Guidelines for Smart Specialisation in the Danube Region* represents a significant milestone in fostering coordinated cross-border digital transformation efforts for SMEs. Through systematic gap analysis, priority identification, stakeholder consultation, and strategic planning, the TG has created a robust framework that ensure cross-border and cross-sectoral alignment of national S3 strategies along the entire DR.

The guidelines have demonstrated how national S3 can be harmonized at a transnational level, despite differing economic, policy, and institutional landscapes. By identifying core and transversal thematic areas, forming focused thematic groups, and proposing joint digital transformation enablers and solutions, the project has laid the foundation for actionable and scalable cooperation across partner countries.

Regional economic development typically builds on existing specialisations. However, smart specialisation requires both the renewal of existing development paths and the creation of new ones. This transformation depends on the ability to combine knowledge in novel ways, an effort that is significantly enhanced through transnational cooperation. To fully capitalize on the benefits of smart growth, future actions should focus on expanding cooperation across borders and levels of governance. This includes developing path extension strategies, strengthening transnational innovation networks, and building more effective policy tools that support continuous discovery and innovation. Ultimately, the transnational approach presented in these TG opens new opportunities for the Danube Region to achieve more efficient, better-targeted policies and to foster long-term economic development through collaborative innovation at regional, macro-regional, and European levels.



6. References

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