Perspectives of sustainable development of cluster organizations through internationalization and dual use

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Abstract
Aims: To explore the prerequisites and opportunities for the internationalization of "Dual-use" cluster organizations in times of crisis in order to increase their competitiveness and maximize their presence in global value chains. To support this process, the authors suggest that cluster organizations in the Republic of Moldova focus on how they can help their SME members and their ecosystem to internationalize and succeed abroad. Previous papers: "Improving scientific and methodological support for the development of innovative process clusters in Moldova's regions based on "Dual Use" research", "The role of Interreg programs in strengthening cybersecurity in the regions of the Republic of Moldova" and "Accelerating digital innovations within the Smart Village concept in the Republic of Moldova." The COVID-19 pandemic, the state of emergency associated with the Russian aggression in Ukraine, has affected international markets and severely affected European and Moldovan companies due to supply shortages. Clusters play an important role in the recovery as they can accelerate access to global chains and improve the resilience of global markets as well as boost the internationalization of SMEs. Approach: literature research, analysis of European and international experience of cooperation in the field of internationalization capacity building of middle and senior managers of private companies, public administration and civil society organizations through high quality training of teaching materials, managers and teaching staff. Results: adaptation of modules on digital skills and competences in curricula and training programs Business and Administration, Cybernetics and Economic Informatics etc. In the context of smart specialization approaches, digital innovation in rural areas with reference to consumers. Impact: civil society, academics, researchers, practitioners, national and regional authorities, European Commission, JRC. Value: Priority geographical directions for the development of cluster initiatives and skills needed to overcome the digital divide and innovation gap between EU regions and the Republic of Moldova. Emergencies associated with Russian aggression in Ukraine have been identified. Examples of international best practices are described regarding the interaction in international and interregional clusters, due to which universities play an important role in innovation clusters, as they can accelerate access to global chains and increase the sustainability of global markets, as well as boost the internationalization of SMEs.

Keywords: smart specialization, green technologies, cluster internationalization, interregional cooperation.

1. Smart connect
The capacity of private and public actors to carry out modern technological research and innovation varies between EU Member States and EU candidate countries. The innovation and digital divides between innovation-leading regions in the EU and candidate countries prevent the EU from fully exploiting its R&D potential in these territories, and are an impediment to economic growth, prosperity and social stability in regions of EU candidate countries. Examination and capitalization of EU and US cluster initiatives will help to

improve methodological approaches and capacities for the initiation and implementation of cross-border international innovative digital platforms [1], in the framework of comparative analysis of international and European initiatives, to coordinate regional priorities "National Program of Smart Specialization of the Republic of Moldova for 2024-2027 "SMART MOLDOVA" [2]. National Development Strategy "European Moldova 2030" [3], vision and goal (NDS) whose main strategy is centered on quality of life, and increasing efficiency is a priority of economic processes by increasing the capacity of companies in the field of innovation and implementation of innovations, including the formation of clusters, hubs and industrial parks, stimulating private investment in the R&D sector and partnerships between companies and educational institutions in this field.

According to the Global Competitiveness Index (GCI) [4], 2019 edition, the Republic of Moldova ranks 86th (88th in 2018) out of 141 countries analyzed. The best scores were obtained for enabling environment, especially for macroeconomic stability (73 out of 100), ICT adoption (60 out of 100) and infrastructure (66 out of 100). The lowest score was attributed to innovative skills (30 out of 100). The Global Innovation Index (GII) [5] for 2023 ranks the Republic of Moldova 68 out of 133 countries analyzed, concluding that the Republic of Moldova outperformed in terms of innovation outputs rather than innovation inputs. Relative to GDP, the performance of the Republic of Moldova exceeds the expectations of its level of development, delivering more innovation outputs compared to the level of innovation investment. Both rankings indicate a low degree of collaboration between representatives of different sectors in the innovation value chain. For example, the IGC ranks the Republic of Moldova 120th out of 141 countries in terms of collaboration between multiple actors, and the IGI ranks the Republic of Moldova 105th out of 141 countries in terms of scientific collaboration between academia and business. Some indicators in this report require special attention, as they reflect a certain state of underperformance of the main aspect of smart specialization, namely: innovation capacity (rank 109 out of 141, score 29.9 out of 100), Interaction and diversity (rank 130 out of 141, score 29) including workforce diversity (114/141), state of cluster development (136/141) and multistakeholder collaboration (120/141).

The predominant part of investments requested by business/organizational-respondents in R&D and innovation is related to access to finance (grants), support for technological skills development and investments for innovation deployment or technology transfer. (Fig. 1) Networking and internationalization (creation of clusters, preparation of internationalization and marketing strategies, joining networks) account for 37.5% of total R&D investment needs.

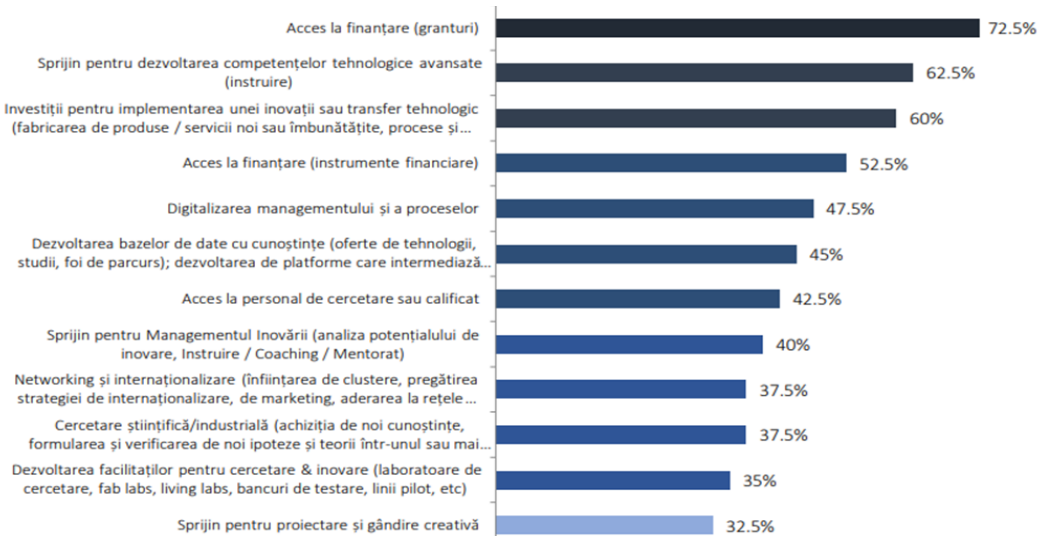


Fig. 1. Investments needed in research and development
Source: https://www.enrichintheusa.com/

Currently, interest in green consumer technologies is growing in the regions of the Republic of Moldova. Primarily, this is due to the need to reduce the environmental burden of overconsumption, resource scarcity, rising energy and fuel costs, as well as for the development of digitalization and computerization. Innovation in green technology helps create environmentally sustainable and cost-effective solutions for the transition to a green economy. The Strategic Technology Platform for Europe (STEP) [6] accelerates the development and production of clean energy technologies, energy storage innovations and decarbonization solutions in the EU. The 4 components of green technologies [7] include: sustainable energy and energy optimization to reduce dependence on fossil fuels; providing clean water to all who need it; pollution reduction; recycling and waste management. The integration of innovative public-private partnerships on digital platforms, based on an interdisciplinary approach, should contribute to building a multi-level coordination of innovative international technical support for infrastructure projects in development regions and local initiative clusters and ensure the needs and access to national and international funds programs for all cluster initiative members. Stimulating the creation of a digital innovation ecosystem of green technologies, efficient consumption model in the regions, intensifying the activities of innovative enterprises and communities, is possible by systematically improving the digital competences and skills of the staff of companies and research organizations. Cooperation between universities and business helps to identify new effective ideas and international best practices for the creation of interregional and global value chains in local business sectors, enables innovative public-private partnerships of the regions to consistently identify and solve the problems of innovation and digital divide for each locality of the Republic of Moldova specifically.

In the 18th and 19th centuries, Moldova experimented with various forms of economic cooperation that resemble the modern concept of clusters. One such form was the guilds - groups of craftsmen practicing the same craft, such as blacksmiths, carpenters, tailors or

shoemakers. Guilds provided training, economic stability and protection for their members, allowing them to cooperate and support each other. Another example are regional markets and fairs, which served as meeting places for merchants, farmers and craftsmen. These venues not only facilitated trade but also encouraged cooperation between participants [8]. These historical forms of economic cooperation show that the clustering approach is not new to Moldova. The modern concept of clustering enhances these traditional practices, adapting them to the realities of the modern economy, where success is the result of effective cooperation and specialization. Although each cluster may have a unique structure and mode of operation, depending on the industry and region, the basic principles are similar. For example, "Developing new markets": companies in a cluster can cooperate to expand their access to new markets. They can form strategic alliances to participate jointly in international fairs or to access foreign funding and investment. In addition, clusters are often visited by international investors and customers, attracted by the concentration of expertise and innovation in a particular region.

"Cooperation and competition": although firms in a cluster may compete in the same market, they cooperate to achieve common goals. Collaboration can include sharing information and knowledge, working together on joint research and development projects, sharing resources (infrastructure, logistics, suppliers) or even forming strategic alliances to access new markets. "Support for start-ups": Another important aspect is that clusters provide a favorable environment for start-ups and entrepreneurship. These new companies benefit from the support of larger firms, access to mentoring networks, funding and expertise. Clusters allow companies to capitalize on local strengths and access shared resources such as skilled labor, infrastructure and technological know-how.

Talking about the geographical concentration of clusters, where companies can easily access shared resources, interact frequently and collaborate on research or development projects. It is necessary to note the international character of digital cooperation platforms and cluster initiatives associated with the concept of "Smart Connectivity" [9], which was introduced at the Virtual Three Seas Summit in Estonia in 2020. This was Estonia's additional contribution to finding ways to expand digital components in key infrastructure, including in rural areas, which in turn should support new business models and technologies, such as real-time remote working for managing local economies, smart renewable energy grids, logistics and traffic management. The idea was to make forward-looking investments in energy and transportation and improve the competitiveness of the Three Seas (3S) regions [10]. The Republic of Moldova and Ukraine have been associate partners of the Three Seas Initiative since last year [11]. Therefore, for the regions of our countries, research on the possibilities of planning and compatibility of data models for cross-border information exchange, management and control, which contribute to the sustainable economic development of regional SMEs in sectors of the local economy, becomes relevant.

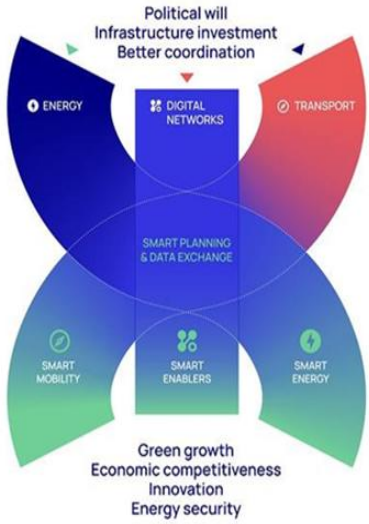


Fig. 2. Smart communication of the Three Seas region (Ref: 3 Sea)
Source: https://3seas.eu/about/smart-connectivity

Realizing this ambitious vision will require the same principles across the Three Seas region to build the transport, energy and information infrastructure (Fig. 2) and will require a greater emphasis on open sharing of new and updated data and the use of accumulated data. The crisis has brought challenging and uncertain times, accelerating the process of digital transformation in the regions. This involves, among other things, equipping SMEs with digital tools. There is also a need for work on compliance with EU legislation and the formation of technological incentives, stimulating lifelong learning approaches available at country and/or regional level.

2. Stimulating the creation of start-ups, cluster initiatives that ensure the dual use of European KETs4Dual-Use key technologies worldwide

Systematic comparative marketing benchmarking of best practices of international projects based on digital "spatial planning" [12] contributes to the modernization of localized digital education products and innovative services. This approach enables an acceptable level of joint decision making in sectors of the local economy, in line with the data information exchange model for managing, monitoring and advising NATO member countries and NATO Partner countries of the Partnership for Peace [13]. Short deadlines for ICT-based management decision making can significantly reduce the costs of infrastructure projects and reduce the risks of financial losses and poor quality work in the regions of EU and candidate countries. The EU and the US have well-established economic ties and already share most of the world's trade and investment relations, underpinning the ongoing Transatlantic Trade and Investment Partnership (T-TIP) negotiations [14]. The United States has a sizable cluster community that can be easily identified by mapping US clusters. The EU-US Cluster Cooperation Agreement was signed on April 22, 2015 between the US Department of Commerce and the European Commission's Directorate-General for Development, aimed at facilitating transatlantic links between EU and US clusters and helping SMEs find strategic partners. Cooperation between US and EU clusters is already

ongoing and well supported through business networks and cooperation facilitators. The strong relationship between Europe and the United States is based on shared values between like-minded people on both sides of the Atlantic.

A culture of strategic partnership, cooperation and trust has been created over the years in formal contexts such as NATO. Effective transatlantic cooperation has generated a large number of successful industrial cooperation projects, making significant contributions to European and US capabilities and interoperability. At the expense of intense defense cooperation between Europe and the United States, a number of common misconceptions about the nature of the relationship continue to persist. Through the five facts below, the EU-US Chamber of Commerce aims to highlight the importance of Transatlantic Defense Technology and Industrial Cooperation (TADIC) [15]:

- American manufacturers are open to partnering with European defense companies;
- European countries can import US equipment at the expense of US export controls;
- The US procurement market is open to European defense companies;
- US defense companies welcome European Defense Fund initiative;
- US foreign military sales program puts European companies on a level playing field.

ENRICH in the USA (H2020 Project) [16] has launched study visits as a priority to showcase smart city best practice in Dallas, Texas, enabling smart city stakeholders to connect with early adopters of the smart city concept and find a relevant US demonstration site comparable to the EU for effective solutions in urban IoT infrastructure serving a huge population. The study tour allows participants to gain "behind the scenes" access to regional infrastructure initiatives currently being implemented to support smart city applications in the most comprehensive smart city plan in the US, which includes the following deployment areas:

- Citizen engagement/services;
- Equitable/inclusive access;
- Infrastructure;
- Management/utilities;
- Mobility;
- Public health/health care;
- Public safety;
- Sustainability/environmental monitoring.

The European Network of Defense-Related Regions (ENDR) [17] is a network of regional authorities and groups that come together to share experiences and best practices. It focuses on the integration of defence into smart specialization strategies (RIS3) and on access to EU funding so that defence-related SMEs can make the most of the instruments and funding schemes that are offered at regional and European level. ENDR has three objectives:

1) To bring together regional organizations and clusters to share best practices in the development of dual-use (defence-related) development strategies, including the

integration of defence industrial and research assets into smart specialization strategies, and to support defence SMEs;
2) Facilitating the flow of information on funding opportunities (such as the European Defense Fund and the European Structural and Investment Funds);
3) Promote the development of regional clusters of excellence.

As of 20 September 2024, 63 organizations from 23 EU Member States and Norway are members of the network. In the conditions of the pilot regions of the Republic of Moldova, it is proposed to take into account the results of the European projects "Key European technologies with dual use for the whole world" (KETs4Dual-Use) [18], in order to develop and adapt a methodology to promote the exchange of knowledge interregional and transnational, based on digital technologies, implemented in several countries in the EU and in the world. The main purpose of the EU KETs4Dual-Use consortium is to act as a springboard for European dual-use companies that want to integrate into global value chains and promote the development of long-term sustainable partnerships. However, before they can effectively support European companies, especially SMEs, in conquering non-EU non-EU dual-use markets, consortia must undertake various actions described below to achieve specific objectives, namely:

1) Selection of the most promising dual-use market segments for KET cross-fertilization;
2) Identification and verification of target third countries (non-EU);
3) Pioneering routes into non-EU dual-use KET markets;
4) Formation of a sustainable partnership.

The KETs4Dual-Use value chain, as shown by the survey responses, is quite comprehensive and represents all relevant segments of the KETs value chain.

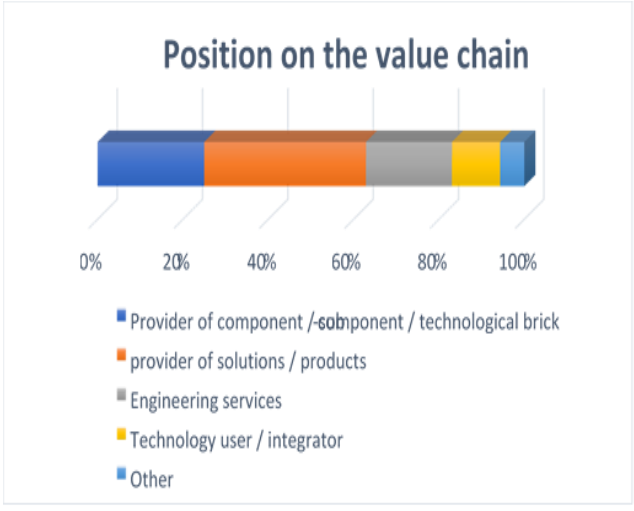


Fig. 3. K4DU ecosystem map
Source: *https://profile.clustercollaboration.eu/profile/cluster-partnership-initiative/bcb1ac65-d9ab-4b58-842c-00d8e51944c6*.

The consortium partners have identified 13 technologies/services provided by various members of the partner ecosystems and considered to be among the most important for the security and defense sectors. Top 5 technologies/services common to the members of the four organizations: software, design and development tools, cameras, test and measurement components and equipment.

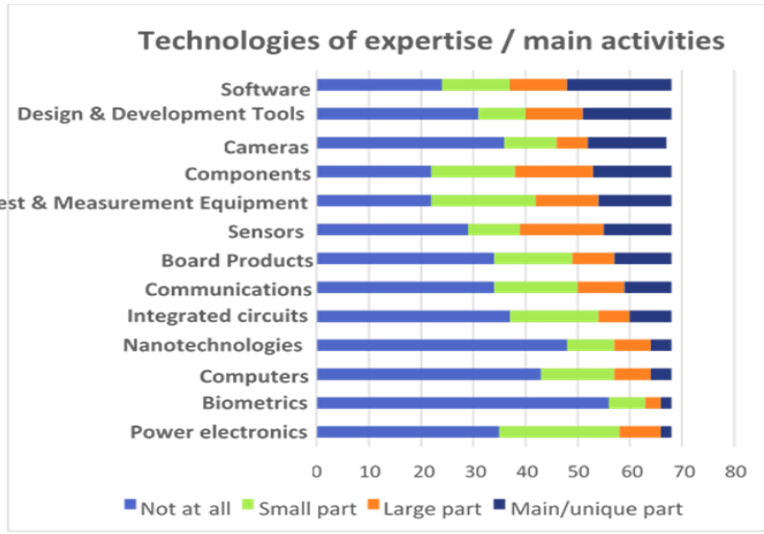


Fig. 4. K4DU technological areas of expertise
Source:[18] https://profile.clustercollaboration.eu/profile/cluster-partnership-initiative/bcb1ac65-d9ab-4b58-842c-00d8e51944c6.

The European Defense Skills Partnership (EDSP) [19] brings together industry, academia, government and innovation, research and professional organizations to promote collaboration in skills development for the European defense industry. EDSP was launched in 2018 with funding from COSME to help its members share knowledge, skills and best practices to work together to develop and implement scalable and sustainable solutions. Members from 20 EU countries are developing sector-specific skills analyzes needed for informed decision-making across Europe and developing the European Defense Skills Strategy. To contribute to the implementation of the strategy, scientific researchers from European higher education institutions formed a team within the Assets+ project, receiving an Erasmus+ grant of 4 million EU euros for the period 2020-2023, in order to develop training, improvement and retraining related to new and emerging technologies for the needs of the defense sector.

Industry visibility in government defence equipment spending plans, export and import ambitions and corporate targets provides key signals to education and training organisations about the type and volume of skills required. Skills mismatches can arise when problems arise at any point in this continuum – from cuts in spending on capability programmes to poor coordination and planning across capability plans and inadequate forecasting mechanisms for new skills in the education sector (Fig. 5). While each EU Member State may face its own specific challenges with skills in the defence sector [20], candidate countries also needed to identify common areas of skills gaps and shortages:

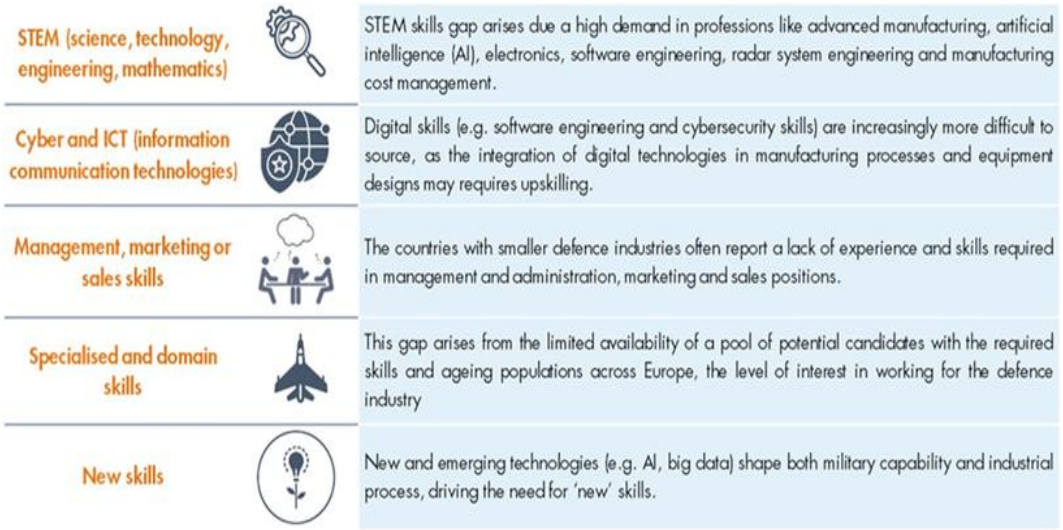


Fig. 5. Key identified skills mismatches in the defence sector in the EDTIB
Source: https://www.eudsp.eu/event_images/Downloads/1%20Main%20report_1.pdf

It is worth noting that the internationalization of research and development in the interaction of the academic community with the business environment, within the dual-use cluster initiatives, in relatively new and critical conditions for the regions of the Republic of Moldova and Ukraine, forces an emphasis on promoting the training of high-level specialists management qualification. An example of effective international engagement is the experience of the University of South Australia (UniSA), which developed the Global Executive MBA in Defense and Space (GEMBA) [21], in response to increasing global geopolitical instability and the creation of the AUKUS alliance between Australia, the Great UK and USA. The AUKUS Security Pact opens up significant opportunities for those working in and serving the defense and space sectors. Skills development in particular is critical to the growth of the two ecosystems. While technical skills are required under Pillar 1 of the AUKUS agreement for the construction of submarine infrastructure, including the construction and maintenance of operational submarines, the enhanced cooperation outlined in Pillar 2 will require the development of the entire supply chain. The AUKUS Pact holds important promise as efforts to develop advanced capabilities are supported by trilateral information and technology sharing aimed at accelerating defense and space innovation. The deal involves different cultures, agencies, organizations and teams. This requires technical understanding as well as future-oriented skills such as communication, teamwork and problem-solving skills.

As another example, we can refer to the experience of IAE FRANCE "Institut d'Administration des Entreprises" - a network of 38 management schools located in universities. All IAE management schools offer a wide range of courses covering all areas of management, some taught in English, and offer bachelor's, master's and doctoral degrees accredited by the French government. Several business and management schools in France have received EQUIS accreditation from the European Foundation for Management Development (EFMD). EQUIS (European Quality Improvement System) is a quality

assurance system for schools and students, a highly appreciated international accreditation granted by this foundation.

The IAE Nice Graduate School of Management at the University of the Côte d'Azur (South Region) France, offers students and professionals a high-level education in the field of management sciences through initial and further training. The Master of Business Administration in Security, Defense and Space (MBA SDS) [22] is a one-year program taught entirely in English and designed for professionals who wish to acquire in-depth knowledge of business administration in sectors such as aerospace, security and civil protection, as well as defense. These markets behave somewhat differently from an open market: competitive forces are shaped by regulatory, safety and security requirements, and businesses in these sectors require management practices not typically required in other industrial and commercial sectors. These markets are characterized by:

- Products are often unique and limited edition, most customers are governments or governmental organizations; where SMEs are involved, the industrial structure is highly fragmented, with little or no international presence; Public procurement is often an exception, and other characteristics significantly influence investment strategies from research and development to production; marketing relies heavily on government lobbying;
- Intellectual property management and export decisions are subject not only to commercial reasons, but also to internal security or national sovereignty constraints, while demand, although largely national, is becoming increasingly international and sometimes global;
- Investment and business cycles are unusually long, and it is necessary to retain valuable technical and managerial capabilities - highly skilled human resources - over the long term, while ensuring that technology development remains state-of-the-art;
- Companies in these sectors are more likely than others to be targeted not only by competitors, but also by terrorists or even foreign agencies. Managing such risks is similar to managing critical infrastructure security in energy, transportation, etc.

3. Benchmarking of digital technologies and software for project management in the process of intellectual specialization of the regions

Production methods are changing and improving around the world, both in cities and in rural areas. In addition to automation, the degree of system integration and the use of artificial intelligence in manufacturing is increasing. These activities are often classified using the keywords "Smart Manufacturing" or "Industry 4.0", "Agriculture 4.0". Thus, the border between manufacturing and IT companies is increasingly blurred. In this context, the best practices considered in education can serve as motivation for a series of subsequent benchmarking projects so that in the implementation of infrastructure projects, not only producing companies, but also non-producing ones registered in the regions of the Republic of Moldova at the sub regional level are involved and local. This will give them the opportunity to participate in the formation of cluster initiatives together with more

developed companies in the region and to share their experience in digital innovation in certain priorities of the S3 smart specialization, sectors of the local economy, as well as to training the staff of companies and educational organizations.

S3 are regional strategies aimed at transforming the economic structures of the region by identifying and developing transformative activities based on reflection on existing opportunities, on the one hand, and opportunities for change, on the other (Fig. 6).

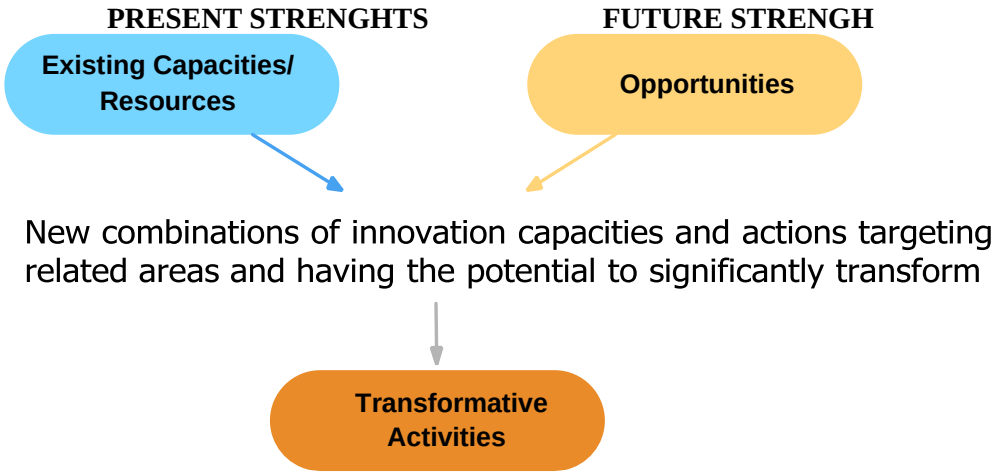
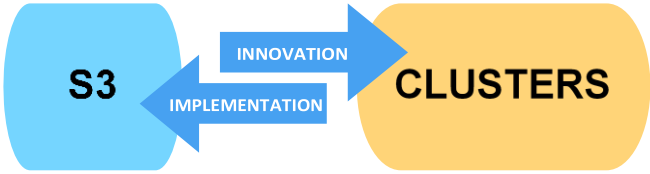


Fig. 6. Transformative Activities for Smart Specialisation
Source: https://www.clusterportal-bw.de/fileadmin/media/Download/Downloads_News_Presse/Keller_et_al.__2018_.pdf

The competitiveness of regions depends on long-term industrial development policies. Smart specialization strategies (S3) help to identify new value chains worth developing in two or more industrial sectors present in a region. However, implementing the S3 model in practice is often difficult. The S3-4AlpClusters project [23] developed the innovative S3 model to overcome four major barriers that often prevent effective smart specialization: identifying opportunities, prioritizing development options, enabling needs-based collaboration between regions, and finally achieving the desired transition to industry intelligence. This approach has been successfully tested in the pilot regions of the Alpine countries: Franche-Comté (France); Piemonte, Autonomous Province of Trento, Veneto, Lombardy (Italy), Oberbayern, Berlin (Germany); OberAustria, Salzburg (Austria); lead partner: region Espace Mittelland (Switzerland). A cluster initiative is an organized effort aimed at promoting the development of a cluster, either by strengthening the capacity of cluster entities or by forming relationships between them. They can be compared to regional networks and are usually organized by cluster management. The interaction between S3 and clusters implies a bidirectional relationship with mutual benefits between the two entities (see figure 7). As "a geographically close group of interconnected companies and associated institutions in a given area, linked by commonalities and externalities", clusters are of obvious interest to the development and implementation process of S3. The reliance on regional capabilities in S3 highlights the importance of

existing local resource concentrations. The cross-sector connectivity inherent in the cluster concept is essential to creating a critical mass for transformative action. Public administrations have the responsibility and authority to identify local needs. The results of their initiation of innovative partnerships with universities, research organizations and NGOs – potential operators of public-private partnership projects, serve as a basis for development, implementation and adaptation to local conditions.



Main Benefits of the Interplay

S3 triggers	**Clusters represent**
Transformation processes	Local concentrations of capacities
Entrepreneurship Innovation	Entrepreneurial resources
	Mid-grained level of aggregation
	Cross-sectoral connectivity
	Actors of the quadruple helix

Fig. 7. The Interplay between S3 and Clusters
Source: https://www.clusterportal-bw.de/fileadmin/media/Download/Downloads_News_Presse/Keller_et_al.__2018_.pdf

The Management, Control and Advisory Information Exchange Data Model (JC3IEDM) [24] aims to achieve compatible interoperability of national information systems associated with common project management processes. Research related to the development of information systems, territorial digital business ecosystems and standards is increasingly drawing attention to the need to adapt project management methodologies based on localized software. At the European level, we see our EU partners already integrated into the Interoperable Europe Program (ISA²) [25], an initiative of the European Commission that supports the development of digital solutions that allow public administrations, businesses and citizens across Europe to benefit from interoperability crossed. -border and cross-sectoral government services.

The management of knowledge transfer processes in the regions of the Republic of Moldova remains the legislative prerogative of nationally and internationally accredited universities. Speaking of benchmarking best practices, it is proposed to consider the OpenPM² project management methodology [26], developed by the European Commission. Its purpose is to enable project teams to effectively manage their projects and deliver solutions and benefits to organizations and stakeholders. Although the methodology is suitable for any type of project, it is adjusted for public sector projects or EU programs and grants implemented in regions. OpenPM² is a free version of PM² developed by the

Commission in 2007. It incorporates elements of internationally recognized best practices, standards and methodologies. We note that PM² is an initiative supported by ISA² to bring the PM² methodology and its benefits closer to a wider range of stakeholders and the user community. OpenPM² provides open access to PM², expanding the range of beneficiaries across Europe and enriching the methodology with additional best practices and examples. It aims to improve project management competence in the EU.

Small and medium-sized enterprises (SMEs) represent 99% of all businesses in the EU. The European Defense Agency's (EDA) SME Corner [27] aims to provide defense SMEs with simple, smart and concise advice on how to easily access the defense market. Identifying SMEs is important for accessing EU funding and support programs specifically targeting these businesses. In general, the main factors that determine whether a business is an SME are the number of employees and either turnover or balance sheet total. In the EU, SMEs are defined in EU Recommendation 2003/361. Companies can also use the SME Self-Assessment Questionnaire to determine if they qualify as an SME. The future success of the European defense industry will depend on the effective use of human capital and innovation wherever it is found in Europe, including SMEs and non-defense suppliers. EDA's support to industry focuses on promoting industry participation in defense and ensuring access to funding at EU level. Interaction with the industry is done through agency platforms.

- EDA Business Opportunities - Economic operators interested in participating in the procurement procedures carried out by the European Defense Agency for the provision of goods and/or services can find the necessary information on this platform and prepare a request for participation.
- EDA research and technology is at the heart of defense capability development and is therefore one of the agency's top priorities. Tomorrow's defense effectiveness depends on today's investment in new capabilities. To achieve this, Member States must remain at the forefront of defense innovation and research.
- Technology Capabilities – EDA has established a number of dedicated Capability Technology Teams (“CapTechs”) to conduct research and technology (R&T) activities in response to agreed defense capability needs. They also contribute to the Agency's projects and programs in broader policy areas with their specific expertise.
- EDA Capability Plan - Effective joint EU defense cooperation requires Member States to choose the priorities to which they wish to devote their limited efforts and resources. EDA works to set priorities in the areas of capability development (Capability Development Plan), defense research (Comprehensive Strategic Research Program), and skills, technology, and manufacturing capabilities (Critical Strategic Activities).
- Defense-related SMEs are key drivers of innovation and growth. The European defense industry must be able to take full advantage of innovations coming from SMEs, including those SMEs operating mainly in the civilian sectors. More than 2,500 SMEs play a central role in Europe's complex supply chains. However, the most important characteristic of these supply chains is that they operate primarily at the national level, with limited cross-border cooperation.

- EU Funding - The Agency aims to inform and strengthen the capacity of defense ministries and the European defense industry to access EU funding opportunities and programmes. The EDA in particular encourages the active participation of small and medium-sized enterprises (SMEs) in EU funding programs and facilitates the access of defense stakeholders to relevant EU funding mechanisms.
- Governments dominate the defense sector through various roles such as regulators, owners, controlling shareholders, sponsors of research and development, and major customers. It is therefore important for the government to focus on all stakeholders, for example suppliers, including SMEs. EDA supports governments to improve the ability of SMEs to access defense supply chains and maximize the added value they can bring to the development of EU defense capabilities.

The European System of Defense Standards (EDSTAR) [28] is a central EDA database containing links to best practice standards (BPS) in support of European security and defense programmes, organizations and agencies, with a focus on the following users:

- Program managers and experts in acquisition, security and defense organizations (national and multinational) must select standards when developing personnel requirements or technical specifications for defense capabilities throughout their life cycle;
- Program managers and industry experts recommend standards to clients for a specific security and defense contract or must specify standards to be implemented by their subcontractors.

BPS are standards or specifications that have been selected by consensus by industry experts and government organizations within the EDSTAR Expert Groups (EDSTAR EGs) or the EDA Project. The selected EDSTAR BPS should be the most reliable and applicable standards for defense purposes in the EU. Each panel report is linked to an EDSTAR technical area and provides expert recommendations to support their BPS selection. Along with the rationale for their selection, they provide recommendations on BPS applications and expectations for future standardization recommendations to optimize the efficiency, effectiveness, and interoperability of security and defense materials, products, and services. As part of standardization in support of European Defense Agency (EDA) projects, the Project Management Standardization Plan (PSMP) describes the activities that EDA project managers must implement in the project life cycle. It is a multi-domain analysis of the standards, technical specifications and standards-like documents used in a project, translating its requirements into a list and report applicable to the project. The PSMP may lead to the identification of standards to be proposed as "best practice" standards in EDSTAR.

What could be the actions of local public administrations aimed at combating the proliferation of weapons of mass destruction (WMD) and related materials, equipment and technologies in the new conditions of a candidate country for EU accession? The EU P2P program for dual-use goods aims to improve the effectiveness of export controls on dual-use goods worldwide. Export controls or strategic trade controls aim to administer and facilitate international trade in dual-use goods. Dual-use goods are highly sensitive

products and technologies used for both civilian and military purposes. The overall structure of these efforts is set out in the EU Global Strategy, the previous EU Security Strategy (2003), the EU Strategy to Combat the Proliferation of Weapons of Mass Destruction and EU Regulation No. 2021/821 and its amendments, the EU Delegated Act containing the annual review of the EU dual-use control list as reference material [29].

The UK Ministry of Defense has approved the JC3IEDM as a C2 information exchange model. It is highly recommended for other environments and required for all tactical level environments. The JSP 602 :1005 model for shared services has also validated the JC3IEDM model in the tactical domain for all systems/projects that provide shared data exchange services. JC3IEDM's predecessor, the Command and Control Information Exchange Data Model (C2IEDM) is a data model maintained by the MIP Administration [30]. This model was developed with the input of experts from various NATO partner countries in the Partnership for Peace and was submitted to the renowned Object Management Group interoperable application development consortium to be considered as a standard for information exchange. The Joint Command, Control and Consultation Information Exchange Data Model (JC3IEDM) of MIP is primarily an information exchange data model and can serve as a consistent basis for other information exchange mechanisms such as formats of messages, which currently do not have a unified information structure.

The adaptation of digital tools for distance learning will ensure sustainable cognitive mobility, which will also contribute to the digital transformation of small and medium-sized enterprises included in the cluster initiatives. Competences characteristic of the mobilization economy are required for participation in infrastructure projects of the "National Fund for Regional Development" and "National Fund for Agriculture and Rural Development" programs. Thus, it will be possible to initiate interregional and international cooperation on online learning issues in the interest of certain settlements in the developing regions, directly with the participation of the regional administration. This will help local authorities to engage in the coordination of voluntary learning processes related to the promotion and support of mobility as a core component of education and training policies, with a particular focus on digital mobility, internships for staff of cluster initiatives in general.

Depending on the nature of the infrastructure projects, initiated by the researchers and the resident of the innovation incubator IT4BA – Trimetrica SRL, the "SIMA" information system and the "Academic Departmental Agreement" program [31], include distance learning modules and technological solutions of the ESRI IT Company (USA), having a representative office in the Republic of Moldova. The primary purpose of these initiatives is to provide educational institutions with ESRI software products to familiarize them with their capabilities, implement them in their curricula, and conduct research. A 12-month license includes all key components of the ArcGIS platform: ArcGIS Enterprise, ArcGIS Desktop, ArcGIS Online, as well as many web and mobile applications. The program is divided into three levels: 5, 50 and 100 users. The innovative digital products proposed with the participation of the representatives of the American company ESRI in the Republic of Moldova - ArcGIS [32] will support researchers in developing regions in the

visualization (presentation in the form of a digital map) of large volumes of statistical information (created) and updated data that are represented geographically. Having such a methodological and software complex, the innovation community increased the opportunities to achieve synergy between National Funds and external support programs.

4. What is the cluster policy and innovation audit at the European level?

Clusters are defined as "geographical concentrations of interconnected companies, specialty providers, service providers, and related institutions in a specific area that are present in a country or region" (Porter). The main aim of the cluster policy is to contribute to the external economy and thus to strengthen the innovative potential of companies. It also aims to support employment, promote economic restructuring, develop university-industry links or build interregional partnerships. The main benefits that cluster support policies bring are related to the reduction of transaction costs and coordination failures [33]. The main risks relate to regional overspecialization, weakening of regional economic resilience and technological lock-in [34]. Cluster policy can be built around different pillars, depending on what the decision-makers would like to emphasize: locations (leading regions, less developed regions, metropolitan centers), sectors (dynamic, impactful, strategic, significant from a social point of view) or entities, specific groups of entities (universities), SMEs, transnational corporations, etc. Often, they tend to be a combination of these different categories. The policy tools used in cluster policy can be grouped into three areas of action:

- Stakeholder involvement, emphasizing the role of coordinators and facilitators, the desired level and type of interaction, the presence of a formal cluster initiative and the spatial considerations of the cluster.
- Provision of collective services such as department stores, business support advice, training opportunities, skills development or joint marketing.
- Encouraging larger-scale collaborative research and development, such as group participation in research and development programs, university-industry cooperation programs, external funding of research and development.

The European Commission has launched numerous initiatives to support clusters, such as the European Observatory on Clusters and Industrial Change, Cluster Excellence, Cluster Internationalization, Clusters and Industrial Value Chains and the European Cluster Cooperation Platform (ECCP), the main hub promoting cooperation clusters in and beyond the EU. There are approximately 3,000 specialized clusters in the European Union, representing 54 million jobs (European Commission) [35].

Four Interreg Europe projects aim to develop and implement more effective cluster policies. CLUSTERFY aims to promote cross-regional collaboration between clusters and their integration into global value chains (GVCs). The project specifically focuses on policies that promote the clustering of SMEs in Key Enabling Technologies (KETs). CLUSTERIX2.0 aims to improve regional innovation policies for clusters, namely by strengthening intra- and inter-regional cooperation and links between universities and industry. CLUSTERS3 aims to adopt cluster policies to improve S3 adoption. The project aims to include SMEs in global value chains (GVCs). The purpose of STRING is to improve innovation policies for food industry clusters as well as to strengthen links with

their regional innovation ecosystems. Experiments with cluster policy carried out within the four Interreg Europe projects have generated a wealth of good practice in three types of policy instruments, namely: engaging actors, providing shared services and promoting large-scale collaborative research and development. In terms of stakeholder involvement, the ClusterS3 strategy to support regional clusters in Piedmont, Italy, created seven regional innovation clusters in each S3 thematic area. In 2009, the region supported 12 regional innovation groups for 12 different thematic areas. In 2015, the region undertook a cluster review process, launching a public call for the creation of the following clusters: Smart Products and Manufacturing, Green Chemistry and Advanced Materials, Energy and Clean Technologies, Information and Communication Technologies, Agri-Food, Textiles, Life Sciences, to align them with S3 strategic priorities. Good practices highlight the role of clusters in engaging actors around S3 regional priorities to promote regional economic restructuring.

The EIT Community is a collaborative network comprising the long-term partnerships of the European Institute of Innovation and Technology (EIT), known as Knowledge and Innovation Communities (KICs) [36]. Speaking about the needs to achieve interoperability between the regions of EU candidate countries, we believe that it would be advisable to pay more attention to innovation management approaches that are compatible with the tasks of vertical and horizontal integration of the regions in the European Research Area within the priorities their smart specialization.

The EIT launched regional innovation schemes [37] in 2014 to help countries develop their capacity to innovate based on their scores in the European Innovation Scoreboard. EIT RIS activities are tailored to meet the diverse innovation needs of eligible countries. The EIT has established hubs in eligible countries and regions scoring in the 'moderate' or 'emerging' score categories to help lead the implementation of these activities. EIT RIS Hubs encourage closer interactions between local innovation actors and link local innovation ecosystems to the pan-European innovation ecosystem of the EIT. It also helps to integrate potential new partners and participants from the local innovation ecosystem into the activities of the EIT community. By the end of 2025, the EIT will have hubs in all EIT areas eligible for RIS. There are two types of hubs:

- EIT RIS Hubs, each led by different knowledge and innovation communities, where they carry out their activities and fulfill their mission to stimulate innovation at regional level;
- EIT RIS Community Hubs which will be hubs for all EIT communities, a one stop shop where you will find information about all the opportunities and activities that can be offered.

One of the EIT models can contribute to the development of transatlantic cooperation by stimulating the innovative development of the regions of the candidate countries, ensuring a more efficient growth of economic potential and strengthening the EU as a whole. EIT Hub Silicon Valley [38] is an outreach location of the European Institute of Innovation and Technology (EIT). The Hub creates synergies between the EIT community and the Silicon Valley innovation ecosystem to support the growth of innovative startups and increase the number of Europe-California collaborative projects and the EIT Community. Building on

the achievements and network of the EIT Digital Silicon Valley Hub, the European Institute of Innovation and Technology (EIT) opened the EIT Hub Silicon Valley in 2019 as its first community center outside Europe. It supports European innovators to attract US customers, partners and investors by showcasing innovations made in Europe in California's innovation and education ecosystem.
EIT Hub Silicon Valley enhances European leadership by transferring know-how from California to address the world's major challenges and establish an effective link between the innovation ecosystems of Europe and California. EIT Hub Silicon Valley focuses its activities in:

- Supporting the recruitment of US students for Europe and facilitating internships for EU students in the US;
- Assisting European entrepreneurs to develop businesses in the US;
- Developing contacts for participating CCIs and their partners (especially universities);
- Creation of a network that includes the EU Delegation, European Consulates, T&I Offices, etc.

The EU Liaison Office in Silicon Valley coordinates the activities of innovation organisations, SME clusters, with European policymakers and reflects the views of small innovative companies and regions in their policy work with US-based companies [39].

Renewable energy sources and green hydrogen are increasingly recognized as essential for achieving sustainable development goals (SDGs) and mitigating climate change impacts. Green hydrogen, in particular, offers opportunities for economic and social development by creating job opportunities and reducing greenhouse gas emissions. Its application across various industries, including agriculture, steel production, concrete, transportation, and energy, demonstrates its potential to contribute significantly to global sustainability efforts. The Republic of Moldova could benefit from the experience of European countries, in particular Romania, where clean hydrogen is increasingly recognized as vital for the decarbonization of regional economic ecosystems. Local initiatives, such as the blending of hydrogen and natural gas in distribution systems, have demonstrated significant potential for reducing greenhouse gas emissions, highlighting the technical and economic feasibility and environmental benefits of these approaches [40]. Within the framework of the Implementation Plan for Strategic Directions for Adaptation to Climate Change in the Dniester Basin [41] and the agreements with the EU, all Union agencies are open to the participation of the Republic of Moldova in accordance with the relevant provisions on the basis of which these agencies are established. In order to participate in each such agency, the Republic of Moldova will have to enter into separate agreements with the EU reflecting the amount of the financial contribution [42]. Thanks to the initiatives of the Consultative Forum on Sustainable Energy in the Defence and Security Sector (CF SEDSS) [43][43] to improve energy efficiency in the army, as well as pilot projects to optimise energy use in buildings and efforts to electrify transport at defence sites, Phase III has generated more than 30 project ideas and 15 research papers. Initiatives also include the integration of hydrogen fuel technology into military vehicles and promoting behavioural change among military personnel. CF SEDSS is a Commission-funded initiative managed by EDA. It is

Europe's largest defence energy community, strengthening the defence sector's engagement in the energy transition.

5. Conclusions

The implementation of digital solutions in regions based on the results of international best practices will contribute to:

- realization of regional and cluster policies regarding smart city and village projects in the regions of the candidate countries;
- preparing the regions and local initiative groups for the implementation of the digital transformation and rural mobility policy within the regional and national action plans;
- compatibility of technological landscapes of populated areas, localized software solutions for planning "dual-use" cluster initiatives, international "military mobility", localization of smart infrastructure and digital educational products, project management services, expertise.

Beneficiaries of the solutions proposed in the benchmarking of digital technologies can be dual-use regional SMEs, companies with foreign capital and educational institutions. The following results are expected:

- drawing up summary reports for consumers, for businesses (example: big data research);
- comparing the effectiveness of companies in the industry with successful practices at national and international level;
- developing incentives and ideas for business improvement related to digital technologies and smart manufacturing.

Depending on their performance, the staff of companies participating in the platforms of European clusters can be selected as candidates for participation in "Best Practice" projects at the national and international level, which will allow:

- studying the best practices of other companies in the country and abroad;
- establishing contacts with other employees, managers and experts from industry and science (network) in the country and abroad;
- participating in discussions about local, sectoral and international issues and opportunities, as well as exploring and finding new approaches for business and career development.

The implementation of the listed results will have a positive impact on the transnational and interregional compatibility of digital innovations, guaranteeing a high quality of cross-border and intersectoral electronic services available to the public and an easier exchange of information between national, including cross-border, electronic registers. This will make it possible to effectively approach the implementation of the smart village concept, taking into account international best practices.

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