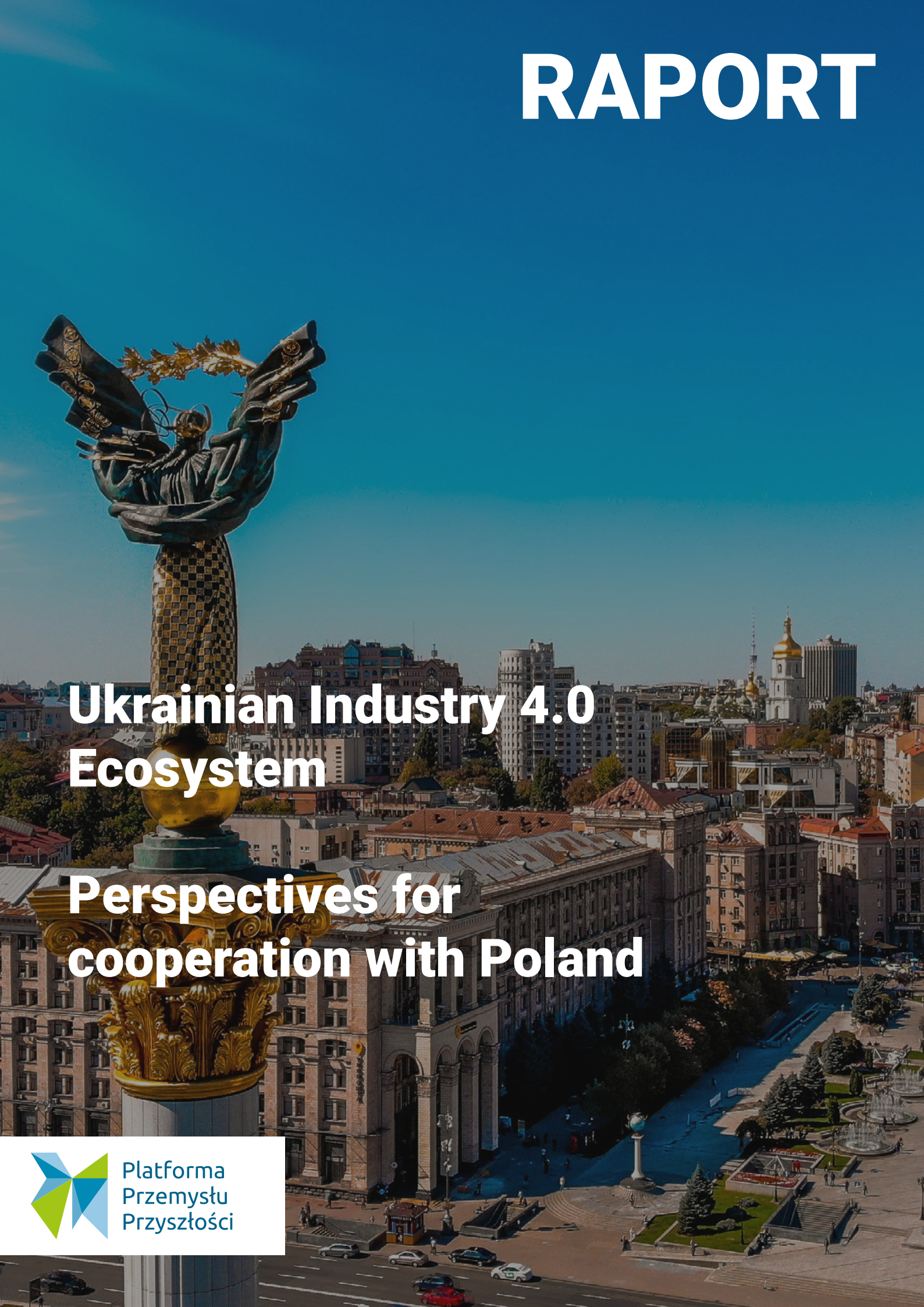
RAPORT



Ukrainian Industry 4.0 Ecosystem

Perspectives for cooperation with Poland

Platforma Przemysłu Przyszłości

Authors of the document:

» **Oleksandr Yurchak** – a leading Industry 4.0 expert, developer of the Industry 4.0 national strategy project, author of many position papers and analytical reports on Industry 4.0 and 5.0 from the Ukrainian Cluster Alliance and the Association of Industrial Automation of Ukraine

» **Yuliia Ryzhkova** – researcher at the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine, member of the Innovations and Smart Specialization Committees of the Ukrainian Cluster Alliance (UCA), co-author of the works of the UCA in the field of Industry 4.0, innovations and smart specialization.

Kyiv, december 2023 r.

Content

Executive summary

A developed innovative ecosystem of industrial sectors is the basis and guarantee for their rapid growth in the global world. Considering Ukraine's path towards EU integration, as well as the growing challenges to this integration in the context of the war in Ukraine, analysis in this area is an important factor for the development of effective programs and strategies for Ukraine's Resilience and Recovery, including in cooperation with EU countries.

This analytical report was ordered by the Polish State Agency for Industry 4.0 (FPPP) and is evidence of the dynamic development of relations between Ukraine and Poland in this area during 2022-23. In the context of the further growth of business relations between the participants of both ecosystems, it is crucial to understand their state, potential and prospects for development.

So, this report presents analytical information on the state of the Ukrainian Industry 4.0 ecosystem - a general overview of 4.0 segments and individual elements of the 4.0 ecosystem.

The report's conclusions indicate the need for more development of most elements of this ecosystem - such as incubators or accelerators of Industry 4.0, specialized DIHs, innovation clusters, R&D centers, laboratories, etc. The main reason for this state of affairs is the almost complete lack of proper State institutions over the past decade. The consequences are significant de-industrialization of the country's economy, which has been ongoing since the beginning of the 2010s, and the loss of competitive positions in many industrial high-tech sectors.

Russian aggression significantly deepened these damaging processes but simultaneously prompted the government and business communities to mobilize and consolidate. The new economic strategy 2030, adopted in 2021, already contains many changes to improve Industry 4.0. Since the beginning of the war, the government has been increasingly focused on developing the processing industry and startup ecosystems related to the defense-industrial complex. The European Union provides excellent assistance in strengthening innovative ecosystems. Together, this creates a much greater consensus in society regarding the direction of development in the next period and increases the sustainability of industrial ecosystems.

The report identifies the following directions as priority areas of cooperation and development of Polish-Ukrainian relations in the field of Industry 4.0:

- Development of Industry 4.0 - 5.0 policies and programs, transfer of best experience to Ukraine from Polish partners.
- The beginning of integration processes along the chains of critical industries, including the sectors of mechanical engineering and dual-use technologies.
- Preparation of construction plans for new processing plants in Ukraine.
- Cooperation in the development of infrastructure elements of the Industry 4.0 ecosystem.
- Personnel training - participation in reskilling / upskilling projects and programs
- Joint participation in innovative programs and projects financed in the EU

The report analyzes business exchanges during 2022-23 and provides critical facts that indicate a significant intensification of cooperation and improvement of relations between both parties.

As challenges in cooperation, the report examines those that have already manifested themselves in the previous period - such as the dominance of ad-hoc approaches, insufficient financing of cooperation projects in the field of high technologies, weak synchronization in policy-making, the need to expand partnerships, improve communications and coordination in projects, as well as the lack of flagship projects that would stimulate better collaboration of a large number of actors from both sides.
Part of the report's recommendations for improving cooperation between Poland and Ukraine in the

field of Industry 4.0 includes the following proposals:

1. To get political support at the highest level from both sides.
2. Launch of the intergovernmental committee for bilateral cooperation of Industry 4.0.
3. Begin preparations for actions already planned for 2024.
4. Expand the circle of partners, including international ones.
5. Continuation of the cycle of analytical works, with the completion of a more complete report at the end of 2024.

This analysis is carried out for the first time in the history of Polish-Ukrainian relations in Industry 4.0. The authors will be grateful for additions to the given facts, comments, criticism and suggestions about future collaborations.

On behalf of the Ukrainian Cluster Alliance clusters, we also thank the Polish State Agency FPPP for their constant support of the Ukrainian Industry 4.0 movement and for ordering this report.

Oleksandr Yurchak
CEO of the Ukrainian Cluster Alliance

Glossary and abbreviation

Cluster – it is a sectoral, territorial, and voluntary union of organizations that closely cooperate with each other, as well as with other entities in the value creation chain, with the aim of increasing the competitiveness of their products and services, exports, and promoting the economic development of the region and interregional cooperation.

ESG (Environmental, Social, Governance) – is a framework used to assess an organization's business practices and performance on various sustainability and ethical issues. It also provides a way to measure business risks and opportunities in those areas.

Industry 4.0 – the next stage of the digital transformation of manufacturing enterprises, accompanied by the accelerated implementation of technologies such as the industrial Internet of Things, big data analytics, artificial intelligence, a new generation of robots, augmented reality, etc. Together, this will lead to better synergy of IT and OT, change of business models, and significant acceleration of innovative development.

Industry 5.0 – is the next stage of the development of smart industries, where the focus shifts from digital technologies to sustainable development, circular production, and strategic governance.

Policy Instruments (industrial, innovative, digital etc) – regulatory acts, laws, and other measures in the legal field, which the government applies to counterparties of specific markets to improve their competitiveness and stimulate the growth of these markets. Typical examples of such measures are the provision of tax preferences, regulation of customs tariffs, crediting of exports, etc.

Policy Institutions (industrial, innovative, digital etc.) – governmental and non- governmental organizations whose mission is to develop the „rules of the game" of market participants in the long term, including the rules of interaction, regulation of structural imbalances in certain sectors, countering „market failures" and others. In a number of cases, such organizations can provide businesses with services that are not available on the market or are too expensive in current market conditions: for example, training, certification or attestation, special consulting and analytical work, etc.

IT – Information Technology.

Operational technologies (OT) – automation technologies of industrial processes and productions.

Digital transformation – organizational or social changes characterized by the introduction of digital technology into all aspects of human interaction. The transformational stage occurs when technology provides innovative ways of working instead of simply extending or supporting traditional (old) methods.

Digital Innovation Hubs (DIH) – are organizations whose mission is to accelerate digital transformation among small and medium-sized enterprises (SMEs). DIHs have 4 main roles - development of regional innovation ecosystems, promotion and practical demonstration of digital innovations, support of SMEs in their innovation experiments (including through the search for funding), and training SME personnel.

Policy-makers – developers of policies and strategies, including their separate elements, such as normative legal acts, draft laws, policy and position papers, and development strategies. This usually includes a wide range of persons: lawmakers - members of parliament, government officials, representatives of regional authorities and local self- government, business associations and other professional associations, particular institutions, and development agencies.

4th Industrial Revolution, 4IR (Fourth Industrial Revolution) – Means the transition of all sectors of the economy, social sphere, public services, etc. to a new level, characterized by the mass introduction of new digital, nano, and biotechnologies.

Skrót często używany w tym dokumencie.

- APPAU - Association of 'Industrial Automation of Ukraine'
- CAGR - Compound Annual Growth Rate
- CMU - Cabinet of Minister of Ukraine
- FPPP - Future Industry Platform in Poland
- SME - Small and Medium Enterprise
- UCA - Ukrainian Cluster Alliance
- UNIDO - United Nations Industrial Development Organization

1. Overview of Industry 4.0 in Ukraine

1.1 State of Industry 4.0 in Ukraine

Global Industry 4.0 has already led to fundamental changes in traditional industrial practices, transforming the manufacturing sector. By 2028, according to the latest market analysis by Emergen Research, the global market of Industry 4.0 will reach a whopping size of USD 279.75 billion, with a steady CAGR of 16,3%[1]. The rapid adoption of IoT, artificial intelligence, robotics, edge computing, and blockchain technologies in various industries, including manufacturing, pharmaceuticals, transportation and logistics, chemical, food and beverage, is driving the revenue growth of the global Industry 4.0 market. Rapid industrialization, growing trends of smart manufacturing and interconnections, increased focus on manufacturing automation, growing demand for industrial robots, and increasing applications of additive manufacturing/3D printing, automated design, and automated manufacturing systems are other significant drivers of market revenue growth.

It is worth noting that Industry 4.0 has different dimensions and interpretations - many countries define industry or sectoral frameworks in their way. According to the definition in the glossary, we are talking about the digital transformation of production enterprises, which, first of all, include enterprises of Manufacturing. Many countries, including Ukraine, have enterprises in other sectors of the economy,

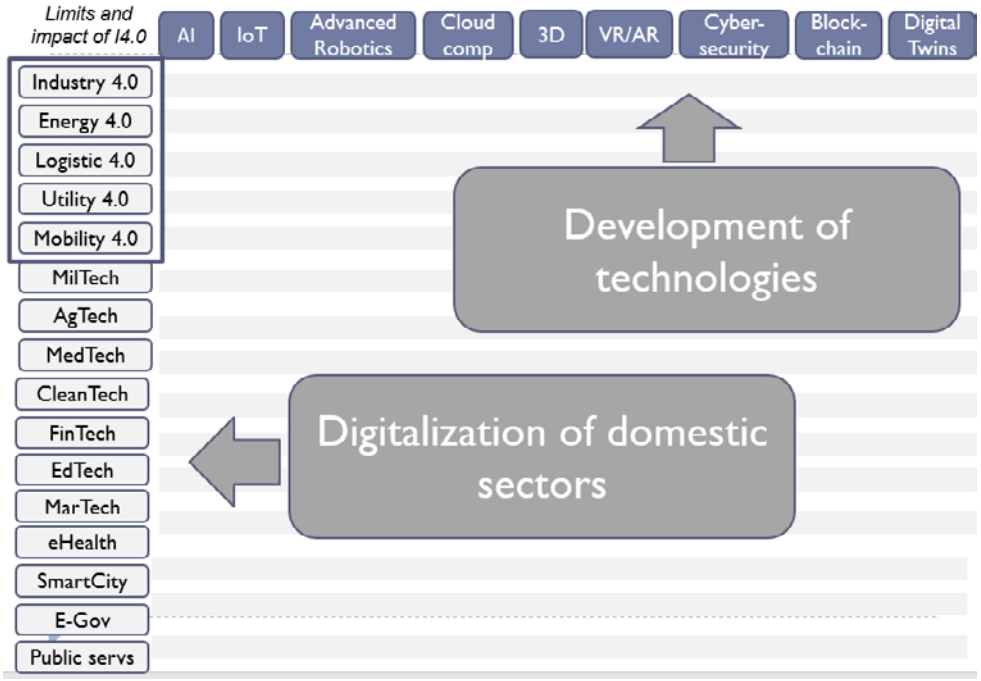
1 Emergen Research (2023).Top 10 Leading Companies Offering Industry 4.0 Solutions. Available under https://www.emergenresearch.com/blog/top-10-leading-companies-offering-industry-4-0-solutions (last access 19.12.2023)

the production of which is similar - usually, it is Energy, Oil and Gas, Infrastructure, and Transport (Fig. 1.).

According to this segmentation, the market indicators of the implementation of Industry 4.0 in an individual country are as follows:

- by the volume and speed of penetration of technology 4.0 into the specified sectors of the domestic economy, which lead to a significant transformation of industries, up to a change in their business models by the development of specific technological segments, which are key in Industry 4.0 and where key indicators are the number of innovators and innovative products and solutions, providing them as well to global market.

Figure 1: Segmentation of sectors and technologies adopted in the national movement Industry 4.0



Source; developed by APPAU Note: Sectors of influence of Industry 4.0 are marked with a frame

The good balance between two vectors is important and evident to ensure sustainable and steady growth of national industry 4.0.

In Ukraine, great attention has been paid to issues of digitalization in these dimensions since 2016, from the beginning of the creation of the Digital Agenda Ukraine platform. Created under the Ministry of Economy of the Cabinet of Ministers of Ukraine (CMU), launched of more than 40 specialists from various industries, the main work of which was a joint vision of the digital economy of Ukraine[2].

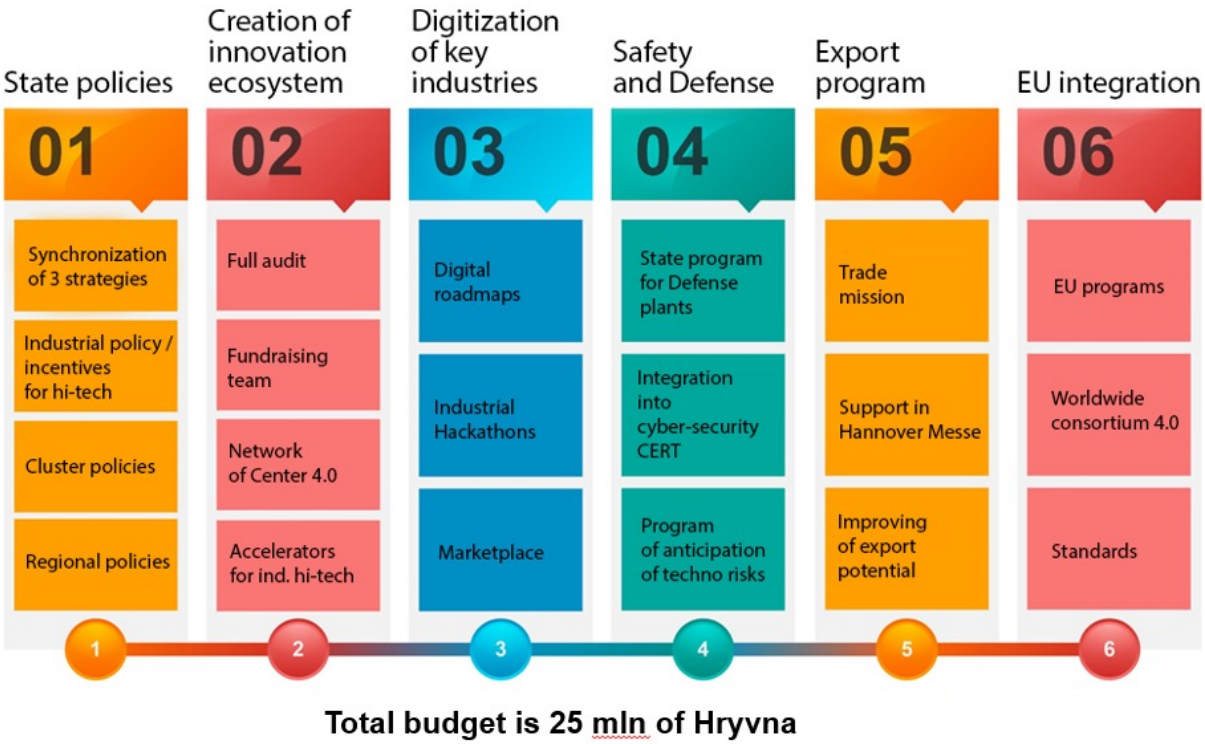
The National Association of „Industrial Automation of Ukraine" (APPAU) was responsible for the direction of Industry 4.0 on this platform. In 2018, APPAU, on the order of the State e-government agency, developed the national strategy of Industry 4.0[3] project. The main directions of this strategy, programs, and projects are schematically depicted in Fig. 2.

It was presented to the CMU at the end of 2018 but, unfortunately, was not approved by the government. The strategy pays a lot of attention to the analysis of domestic ecosystems. The programs and projects include four main directions (see direction 02 in Fig.2). The conclusions presented in the strategy indicate a very close connection between the innovation ecosystem of Industry 4.0 and the results of digitization of real sectors of the economy. At the same time - it is about the significant degradation of these ecosystems and the need for radical steps to stop these damaging processes.

2 Digital Agenda Ukraine.(2018). Available under: https://www.slideshare.net/APPAU_Ukraine/digital-agenda- ukraine (in Ukrainian) (last access 24.12.2023)

3 Yurchak, O. (2019) „Ukrainska Stratehiya Industry 4.0 – 7 Napryamiv Rozvytku". Available under: https://industry4-0-ukraine.com.ua/2019/01/02/ukrainska-strategiya-industrii-4-0-7-napriankiv-rozvutku/ (in Ukrainian) (last access 19.12.2023)

Figure 2: The main projects and directions of Industry 4.0, defined by the strategy I4.0



Source: APPAU (2019) Industry 4.0 Strategy. Available under: https://mautic.appau.org.ua/asset/42:strategia- rozvitku-4-0-v3pdf (in Ukrainian) (last access 24.12.2023)

APPAU and its partners were left alone with this strategy, and the maximum funds for its implementation, which the association could attract from various sources during 4 years, was at most 8 million hryvnias (about 300k euro). Taking into account other sources, as investment and activities of big international vendors, the total spending does not exceed 1 mln euro. In June 2023, APPAU summarized the implementation of this strategy.

According to the identified directions, the progress over the last four years can be evaluated as follows:

1. **National policies and strategies**
   - The most significant progress was recorded in the development of innovative clusters 4.0 - here, the project of the National Strategy for the Development of Clusters until 2027[4], was created, and the Ukrainian Cluster Alliance (UCA) is its de facto executor from 2022. About 7 new clusters can be classified as belonging to Industry 4.0 and they successfully started.
   - Significant progress has yet to be recorded among other policies and strategies related to Industry 4.0. There are several correct proposals for the National Strategy 2030[5], adopted by the Central Government in early 2021, but its implementation has not yet begun, at least concerning Industry 4.0
   - The most significant gaps for 2019-22 in this area should be considered the inability of the 3 governments to launch fundamental changes in industrial policies and strategies - holistically and sustainably, on the long-term period and brought up to implementation; they have yet to appear.

2. **Innovative ecosystems**
   - APPAU considers the development of Centers 4.0 to be the most significant progress, which in 2021 switched to the European concept of DIHs, and eventually, considerable support from GIZ was received in 2023. New Digital Europe call fo 4,5 mln euro will facilitation the launch of 3-4 Ukrainian e-DIHs. It is worth noting that the BOWI project, which was carried out by APPAU and

4 APPAU ((2020). Project of the national cluster development program until 2027. Available under: https://mautic.appau.org.ua/asset/166:proekt-nacprogrami-klasternogo-rozvitku-do-2025-v1pdf (in Ukrainian) (last access 24.12.2023)
5 VRU (2021). the National Economic Strategy 2030. Available under: https://zakon.rada.gov.ua/laws/show/179- 2021-%D0%BF#Text (in Ukrainian) (last access 23.12.2023)

with Kyiv Polytechnic Institute in 2021-23, for the first time, created the contours of a real DIH, able to serve manufacturing SMEs.

» A certain progress should be considered in the appearance of the first analytics on the state of Industry 4.0 innovations (2019), and the release of CMU order in support of Centers 4.0 (2021).

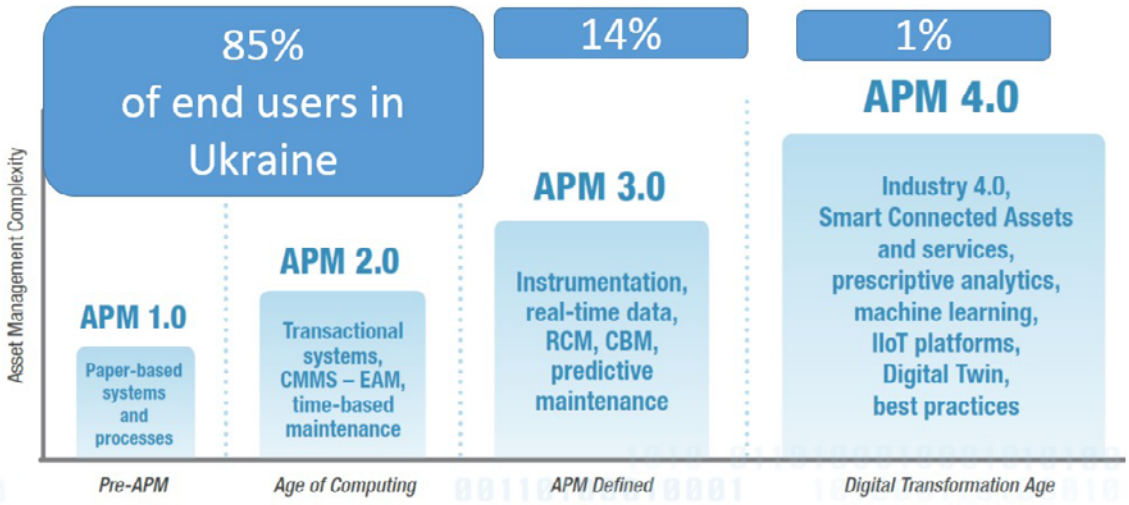
» On the other hand, several proposals to change development policies and programs, incl. those for innovative ecosystems still needed to receive consolidated support at the government level.

3. **Digital transformation roadmaps by sector and industry.**

» APPAU conducted extensive work in this area with business communities - significant holdings, business associations, and regions. Generally, the first attempts to formalize digital transformation strategies were recorded only in big national holdings - such as DTEK, Interpipe, Metinvest, and MHP. APPAU should have convinced the business communities and other stakeholders of the need for consolidated approaches, especially for SMEs. The vast majority of approaches in this area remain at the ad-hoc level - enterprises act spontaneously, „from project to project," the essence of which is determined by the need for modernization of production processes rather than their digital transformation.

For example, assessing the state of the Asset Performance Management segment in the fall of 2021 (APM is No. 1 in popularity in the world Industry 4.0), APPAU notes that the penetration level of modern 4.0 technologies in this area does not exceed 1%.

Figure 3:Penetration of 4.0 technologies in the ARM segment. APPAU expert assessment from November 2021.



Source: developed by APPAU. (2022). Available under: https://industry4-0- ukraine.com.ua/2022/01/18/poperedn%d1%96-p%d1%96d-sumki-kampan%d1%96%d1%97-arm- or%d1%96/ (in Ukrainian) (last access 24.12.2023)

4. **In the field of internationalization and international cooperation**, progress was fixed up only after the start of the war - paradoxically, the war led to a significant intensification of international relations and significantly increased efforts to internationalize economic entities. In this category, progress is based on a number of small projects, which in sum, have a significant effect. We are talking about the technical standardization projects of Industry 4.0, Eastern Partnership programs exchanges, the emergence of new strategies and the development of bilateral relations, the beginning of the integration of innovation clusters in the European space, etc.

In general, assessing the state of implementation of the Industry 4.0 strategy, it is worth noting that although it was not 100% implemented, progress was made in many directions, and it is one of the few digital strategies implemented in Ukraine in the period 2019-2022 among real sectors of the economy. Insufficient government Support has been and remains a key factor in improving the situation in this area.

1.2 Positions of Ukrainian Industry 4.0 among EU countries

The European Union has been actively developing the direction of Industry 4.0 since 2014 when the European Parliament adopted relevant directives and resolutions. Germany was one of the first countries to present the report „Securing Germany's future as a production hub – recommended implementations for the future project of Industry 4.0" in 2013[6], which caused a serious resonance at the time. Most countries adopted state development programs between 2014 and 2018.

The EU is developing Industry 4.0 on 2 levels:

1. Pan-European, where programs are the main factors Digital single market[7], 2030 Digital Compass: the European way for the Digital Decade[8], New industrial strategy of the EU and Research and innovation funding programme such as 2020 (currently, Horizon Europe[9]).
2. The policies of individual countries aimed at accelerating the processes of digitization of industry.

Analysis of policies, development programs and strategies of individual European countries[10] proves that:

1. Many EU countries have already their national Industry 4.0 development programs approved by their governments. In most countries, these programs are part of industrial development strategies. Still, in many countries (e.g., Sweden and Italy), a significant emphasis is placed on the innovative component common to numerous sectors of the economy.
2. The 4.0 programs' main goals are accelerated growth, modernization and improvement of competitiveness of key sectors, growth of new segments – through better preparation for digitization, adoption of innovations, and new business models.
3. Most of the programs were launched in 2012-2017; as of today, the countries are already analyzing the first results. For example, France demonstrates „factors that provide a breakthrough» – loans were granted to 800 companies; 3,400 companies have passed diagnostics for production modernization, and there are 300 experts in 18 regions. Holland focuses on „accelerated R&D»: the government established 10 areas of R&D development from 14 special laboratories at the end of 2016; each had a turnover of 250,000 euros to 4 million euros.
4. State funding (including local administration programs) is the main financing instrument of Industry 4.0 programs, but private co-financing is equally essential. Thus, the developers of strategies should foresee measures to attract private financing - both voluntary and mandatory.
5. Policies 4.0 benefit greatly when clear goals with measurable KPIs and control points are in place, supported by other quantitative and qualitative metrics, with appropriate evaluation mechanisms.
6. Bottom-up approaches and approaches, which are managed by the industries themselves – instead of "top-down" – from the government – have a greater effect in attracting stakeholders.
7. More innovative and closer to the market financing instruments, such as special business loans and tax credits, are important to consider everywhere.
8. Effective SME engagement often requires a customized approach, i.e. involvement of special funding and support tools.

The conclusions of the benchmarking analysis of Industry 4.0 policies from 2018-2019 are as follows:

1. The countries' governments consider Industry 4.0 as an essential element in increasing the competitiveness of national industrial sectors and economies as a whole. Not only developed but also many developing countries compete today for the speed and volumes of implementation in the digitization of Manufacturing and are heavily investing in the transition to 4.0.
2. It is also evident that the smaller the country, the weaker the governments, the further the 4.0

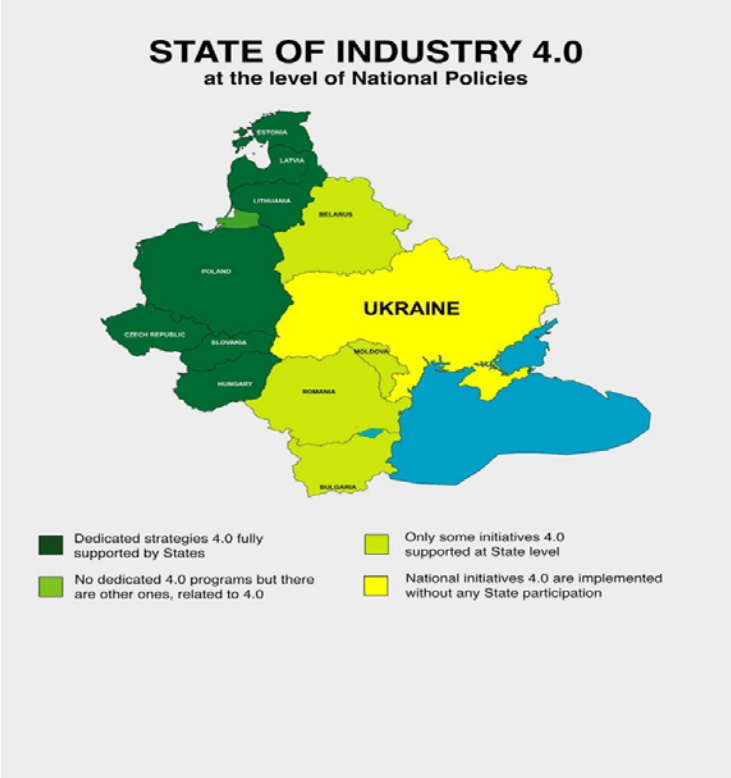
6 Schroeder Wolfgang (2016).Germany's Industry 4.0 strategy. Available under: https://uk.fes.de/fileadmin/user_upload/publications/files/FES-London_Schroeder_Germanys-Industrie-40- Strategy.pdf (last access 20.12.2023)
7 see EU (2015). A Digital Single Market Strategy for Europe. Available under: https://eur-lex.europa.eu/legal- content/EN/TXT/?uri=ce-lex%3A52015DC0192 (last access 20.12.2023)
8 see EU (2021). 2030 Digital Compass: the European way for the Digital Decade. Available under: https://eur- lex.europa.eu/legal-content/en/TXT/?uri=-CELEX%3A52021DC0118 (last access 22.12.2023)
9 see EC (2021) Horizon Europe. Available under: https://research-and-innovation.ec.europa.eu/funding/funding- opportunities/funding-programmes-and-open-calls/horizon-europe_en last access 22.12.2023)
10 Digital Transformation Monitor (2017). Key lessons from national industry 4.0 policy initiatives in Europe. Available under: https://es.sistematica.it/docs/379/DTM_Policy_initiative_comparison_v1.pdf (last access 20.12.2023)

issues are on the economic and political agenda, and the greater the gap is created with those who have already started the movement.

3. 4.0 strategies are unique - they are different for different countries, and even in the EU, where policies are in place at the level of the entire community, 4.0 strategies differ from country to country.
4. To launch effective strategies, all countries approve 4.0 strategic development plans at the governmental and national levels and further invest in implementing these strategies.
5. Developing countries are looking for their place (their niches) on the 4.0 map - it is obvious that most places among the leaders are „already occupied". Weaker countries are looking for niches and developing strategies for adapting techno 4.0 from developed countries to their specific conditions.
6. In Eastern Europe, Ukraine is lagging behind all its main neighbors - Poland, the Czech Republic, Slovakia, and Hungary - from the West, the Baltic countries - from the North. All of these countries have already approved, to one degree or another, government programs for the development of Industry 4.0, in which governments invest funds and human resources (Fig.4).

The intersection of EU and Ukrainian interests is presented in Annex 1.

Figure 4: The state of implementation of Industry 4.0 in 2018



Source: the analysis is based on the report of World Economic Forum (2018) 'Readiness for the future of Production'. Available under https://www3.weforum.org/docs/FOP_Readiness_Report_2018.pdf (last ac

In spite lack of State support, during the last 4 years, in the context of the development of Industry 4.0, Ukrainian businesses together with scientific institutions implemented several projects[11]:

1. Regional penetration through the inclusion of special programs for developing innovation clusters and their involvement in regional smart specialization projects. Two APPAU projects were implemented in 2020 in this direction:
   a. IAM clusters in 2 pilot regions - Kharkiv and Zaporizhzhia,
   b. „Integration 4.0"[12] - about unification of smart specialization and clustering approaches in Kyiv, Vinnytsia, Mykolaiv, Zaporizhzhia and Kharkiv regions.

11 Yurchak, O. (2019) „Ukrainska Stratehiya Industry 4.0 – 7 Napryamiv Rozvytku". Available under:https://industry4-0-ukraine.com.ua/2019/01/02/ukrainska-strategiya-industrii-4-0-7-napriankiv-rozvutku/ (in Ukrainian) (last access 20.12.2023)a

12 see Industry4Ukraine (2020). „Smart-spetsializatsiya ta klasternyy rukh – proekt ‚INTEGRATSIYA 4.0'". Available under https://www.industry4ukraine.net/publications/smart-spezializacziya-ta-klasternyj-ruh-proekt- integracziya/ (in Ukrainian) (last access 20.12.2023)

Both these activities resulted in quick growth of innovative clusters with strong orientation to I4.0, as well, in other regions (Kyiv, Vinnytsia, Sumy, Mylokaiv, Lviv).

2. Development network of Centers 4.0[13] (an analog of DIH) - in 2018-20 they were opened in Kyiv, Odesa, Kharkiv, and Poltava.
3. Development Technical Committee 185[14] – standardization in the field of Industry 4.0.
4. Creation of digital transformation roadmaps at the industry level - notably, these were published by Ukrzaliznytsia and the agro-food industry.[15]
5. Starting a program of Export-Internationalization-Fundraising.[16]

As well as some other projects, in particular, there are many activities to popularize Industry 4.0 at the industry and regional levels.

A specific feature of the implementation of Industry 4.0 is the almost complete absence of active State policies and programs - all the above mentioned projects and programs are implemented by businesses where the primary coordinator was the business association APPAU. The creation of the Ministry of Digital Transformation in 2019 did not speed up the development of I4.0 in any way. There are still no responsible bodies in the State in this activity area.

Together, the institutional weaknesses with unbalanced and weak industrial ecosystems, lack of strategic approach and consolidation of all main stakeholders are reasons for a significant drop in the share of high-tech sectors in the country's GDP and exports.

According to the Index of Industrial Competitiveness in 2021, Ukraine took 69th place among 152 world countries. As can be seen from Table 1, over 20 years, Ukraine as a whole has not yet improved its industrial development position, but has also decreased by 9 positions compared to 2001.

At the same time, the Eastern European countries significantly improved their positions in industrial competitiveness indexes (see Table 1).

Table 1. Ratings of Ukraine and individual countries of the world according to the UNIDO Industrial Competitiveness Index

Country	**2001**	**2006**	**2011**	**2016**	**2021**
Czech Republic	24	22	18	17	16
Hungary	27	25	27	26	26
Türkiye	33	30	30	29	27
Poland	35	28	26	23	23
Slovakia	41	34	29	27	28
Romania	47	37	34	33	36
Ukraine	60	54	56	71	69
Number of countries in the ranking	75	125	142	150	153

Source: UNIDO (2023).Competitive Industrial Performance Index (CIP). Available under: https://stat.unido.org/cip/# (last access 19.12.2023)

In the conditions of a full-scale invasion of the Russian Federation into Ukraine, Industry 4.0 is a strategic

13 see Land 4 Developers. Available under: https://land4developers.com/company/network-of-centers-4-0-in- ukraine/ (in Ukrainian) (last access 20.12.2023)
14 APPAU (2019). TK 185. Available under: https://appau.org.ua/category/tk-185/ (in Ukrainian) (last access 20.12.2023)
15 APPAU (2023). Building Digital Transformation Roadmap In Agri-Food. Available under: https://agri- food.appau.org.ua/en/home-page/ (last access 21.12.2023)
16 APPAU (2022) Pidsumki 1-ho roku programi EIF – vid ad hoc do systemnoyi roboty. Available under: https://appau.org.ua/ (in Ukrainian) (last access 20.12.2023)

marker for increasing the technological efficiency of real economic sectors. Rapid implementation requires the State, business, science, and education synergy.

The first step is already the adoption in July 2021 of the Resolution of the CMU „Regarding the promotion of the implementation of the technological approach „Industry 4.0" in Ukraine"[17]. The document envisages support for creating Industry 4.0 centers based on the infrastructure of universities, scientific institutions, and scientific and industrial parks.

Many measures with regard to the development of Industry 4.0 have been considered in the National Economic Strategy 2030[18]. However, this strategy has not been launched in 2021.

Since 2022, Ministry of economy of CMU make strong and special focus on precessing industries, trying to support SMEs in their relocation, re-launch of production on new territories, providing loans on modernization, facilitating internationalization programs etc.

In December 2023, the Ministry of Digital Transformation presented the Project for the Strategy for the Development of Innovative Activity of Ukraine until 2030.[6] One of the goals of the Strategy is to ensure the implementation of the „Industry 4.0 - 5.0" technological approach in supporting innovative activities by supporting the creation and development of centers for the implementation of Industry 4.0 in the regions of Ukraine, in particular, factories-laboratories at universities, to increase the technical knowledge-intensive base and create experimental, innovative products.

In addition to the much-needed State support, among the factors inhibiting innovative changes in Ukraine are the outflow of young personnel from industry, the training of specialists mostly without considering the requirements of Industry 4.0, and the need for a network of experts for its promotion.

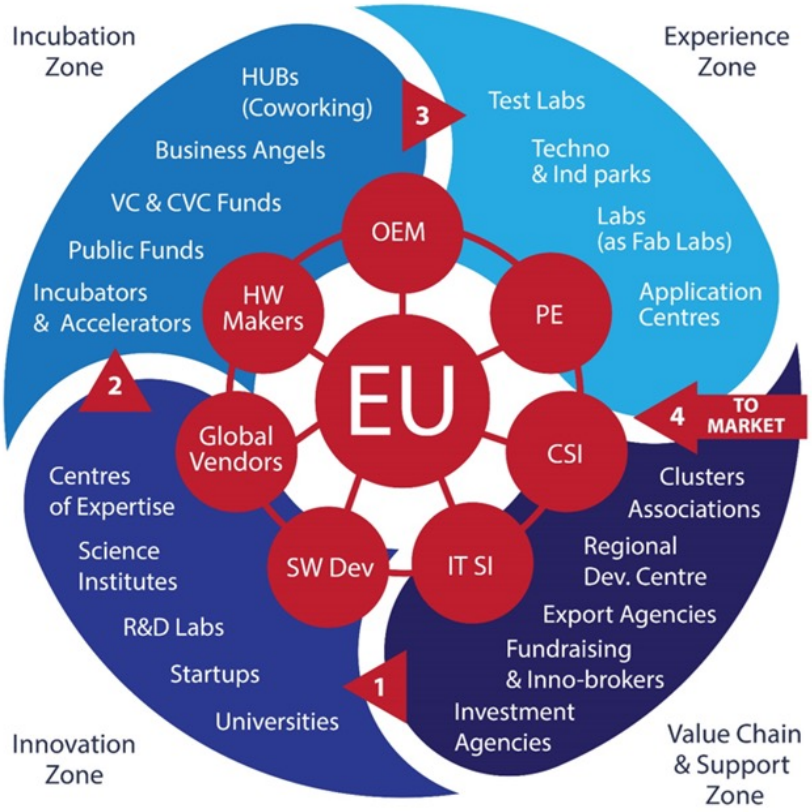
2. Analysis of the Ukrainian ecosystem of Industry 4.0

2.1 Description of the Industry 4.0 Ecosystem model. Assessment methodology.

The Association of Industrial Automation in Ukraine (APPAU) defines many policies regarding national development in the expert environment in so-called „positional" documents (policy or position papers). One such document was developed in 2019 to substantiate the model of innovation ecosystems in industrial high-tech sectors.

17 CMU (2021) Postanova „Schodo spriyannya vprovadzhennyu tekhnolohichnoho pidkhodu ‚Industriya 4.0' v Ukrayini". Available under: https://zakon.rada.gov.ua/laws/show/750-2021-%D0%BF#Text (in Ukrainian) (last access 21.12.2023)
18 see VRU (2021). the National Economic Strategy 2030. Available under: https://zakon.rada.gov.ua/laws/show/179-2021-%D0%BF#Text (in Ukrainian) (last access 23.12.2023)

Figure 5: Model of the Innovation Ecosystem of Industrial hi-tech.



Source: APPAU (2020). Innovative ecosystem Industry 4.0 in Ukraine. The model and current status. Available under: https://land4developers.com/innovative-ecosystem-industry-4-0-in-ukraine-the-model-and-current-status/ (last access 19.12.2023/)

Note: Marking in the center: EU (End users) – end customers, OEM – machine and other xxx builders, PE (Process engineering) – technologies engineering companies, CSI (Control System Integrators) – system integrators of automated control systems, IT SI – system integrators IT, SW dev (Software developers) – software developers, HW (hardware) makers – device developers

This model explains how the innovation cycle works for industrial high-tech companies (Fig. 5). In the center, there are eight categories of participants in the value creation chain (the chain of creation of innovative solutions for the end users), on the outer circle - elements of the infrastructure (organizations and institutions) responsible for innovative development. They are divided into four zones that form a complete innovation cycle.

The split into two circles suggests that players in the inner circle can exist without the outer circle, at least for a while. Any engineering company can fully equipped with imported equipment and deliver ready-made innovative solutions to the end user (EU) (center of the drawing).

The first conclusion from the above concerns local machine builders' shallow level of competitiveness (in all their categories – aviation, shipbuilding, processing equipment, etc.). The level of investment into R&D in local machine-builder sectors was less than 2%, when on the contrary, Ukraine still has sufficient potential in many segments of developers and engineering designers; there are about 20 thousand.

The second outer circle provides a more detailed picture. It explains why, when exiting the inner ring (arrow 4), end users receive innovative products or not (and are replaced by imported ones).

The value chain area (innovation cycle management) includes participants who are policy enablers and regulators. They are designed to manage challenges and gaps that arise at different stages of the innovation cycle and different levels, from national to sectoral. As a rule, there are various clusters and associations, development agencies, innovation and investment agencies.

The innovation zone includes organizations that typically generate innovation. These are universities, research laboratories, design bureaus, research institutes, and startups.

The Incubation Zone includes organizations that create opportunities for incubation and acceleration of innovators. It is pretty simple to understand but relatively complex and unusual for manufacturers. Meanwhile, incubators and accelerators, business angels, various funds, donor organizations, etc., are the elements that are necessary to transfer an innovative idea to the prototype stage.

The experience and testing area contains elements enabling the innovation to test for viability. This area is the last for rapid testing and market entry. This is where the big difference between industrial and B2C markets becomes apparent.

The logic of this model is quite simple and is based on three main principles:

- The completeness or sufficiency of the infrastructure elements in each zone of the cycle determines the bottleneck in each zone, which forms the constraints of the systems. Note that there are only a few technology parks, centers of expertise, modern laboratories, etc. All this is the area of capital investment, which States usually support.
- Quality of elements: many questions arise regarding the level of innovations of Ukrainian universities (of which there are more than 300 in Ukraine) and scientific institutions (more than 100). In spite of a big quantity of innovative proposals, their level remains at TRL 3-5, which is not acceptable by market consumers.
- Integrity and reliability of interaction between different categories of participants. The issue of the integration of universities and research institutes into the internal market circle, as well as many other interrelationships - both on the two circles, between them and at the intersection - becomes essential. In world practice, these connections are not established „by themselves."

Thus, in the context of understanding the progress of innovations in Ukraine, considerable attention should be paid to the rapid development of the second circle. Because it will depend on whether innovations from the Ukrainian ecosystem will enter the market or whether local end users will consume exclusively imported products.

This model can be used as a checklist (see Section 2.3).

For a better understanding of the current situation in Ukraine, let's compare the industrial ecosystems with those of the Ukrainian IT industry, which is the closest to Industry 4.0. (See Annex 2).

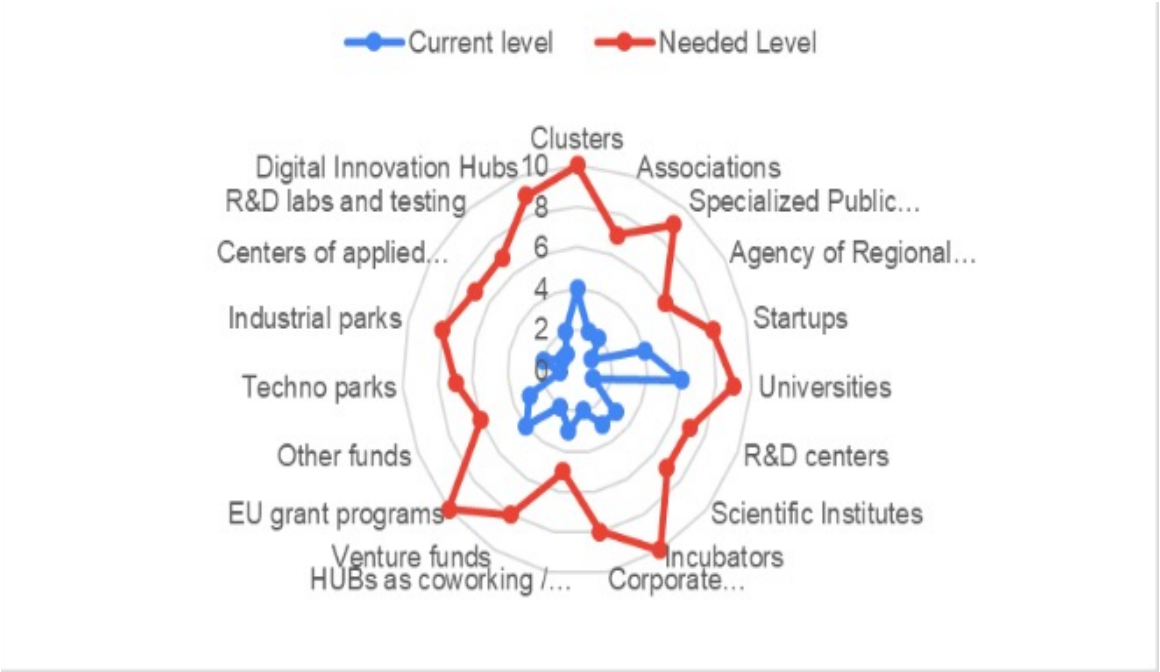
According to these data, the situation in the local Industry 4.0 ecosystem could look more attractive. The weakest are the Incubation and Testing zones. It is not surprising that most of the scientific development in Ukraine, and deep tech startups can not overcome the so-called 'death valley', typically associated with TRL 5-6. Indeed, Ukraine still needs modern technology parks, and there are almost no industrial incubators and accelerators.

On the other hand, this is a good opportunity for potential stakeholders in Recovery period. The country still has significant human potential, with hundreds of technical universities, research institutes, and dozens of thousands of industrial developers.

2.2 The state of individual ecosystem elements of Industry 4.0

A complete analysis of the elements of the innovation ecosystem is given in Annex 2. These indicators following the needs of ecosystem development are evaluated as follows (see Fig.3).

Figure 6: State of the elements of Industry 4.0 in Ukraine



Source: expert assessment / by authors. Note. This assessment is expert and is based on preliminary surveys and work of working groups of committees of the Industry4Ukraine platform in preparing the National Economic Strategy 2030 and, later - the Committee on Innovation and Double Transition of the Ukrainian Cluster Alliance.

According to these data, the top elements in the most critical condition are as follows:

1. Zone of management of innovative development

State Institutions – as a dedicated State agency of Industry 4.0 and regional agencies responsible for development in this area - are absent. In part, the role of the national coordinator of Industry 4.0 was assumed by the Ministry of Strategic Industries in 2020. Still, due to frequent changes in the ministry's responsible teams, no changes in policies or individual projects took place.

They could play a much more significant role in the digitalization of industry **innovation clusters**. Significant progress has been noticeable in this area in the last three years, especially with the emergence of the Ukrainian Cluster Alliance (UCA). Over the past three years, clusters of engineering, shipbuilding and instrumentation, automotive industry, photonics, industrial automation, IT, cyber security, etc., have appeared in various regions of the country. However, they are pretty young structures. They still need adequate support from the authorities or other stakeholders and do not take on significant roles in implementing Industry 4.0 projects.

2. Zone of innovation

WR&D centers are the most critical in this area. There needs to be an accurate accounting of private or public R&D specializing in the field of 4.0 technologies in Ukraine. The IT industry claimed to have about 100 R&D centers before the war, but according to the APPAU, the share of those related to Industry 4.0 was at most 5-10 %. The situation with other R&D centers is similar - the number of those who systematically launch innovative products and solutions of Industry 4.0 on the market is still being determined.

Among 1600+ startups (data until February 2022), the share of industrial startups is at most 10-15 %. One of the main reasons for this state of affairs is the need for more State policies and instruments for innovative industry development.

3. Incubation zone

The practical absence of acceleration programs for technological, industrial SMEs, and deep-tech startups is the weakest point in the Incubation zone of innovative solutions 4.0. Among the 10+ existing incubators and accelerators in Ukraine, only two were partially focused on industrial sectors - 'Sikorsky Challenge' Incubator from Kyiv Polytechnic Institute and 'EO' Business Incubator from Kharkiv (currently, it stopped its activities).

Another area for improvement is the need for more Ukrainian startups and SMEs in European programs. Over the past three years, participation rates have increased somewhat, but in general, Ukraine lags behind most EU countries in programs like Horizon Europe, especially with the participation of SMEs. In particular, in the I4MS / Horizon 2020 program (digitalization of industrial SMEs), before the appearance of the first contact points, such as APPAU, Ukrainian SMEs or startups did not participate in this program at all until 2020.

According to the results of participation in the Horizon 2020 program (period 2014-2020), out of 174 institutions and organizations of Ukraine that participated in the preparation of proposals and received funding, small and medium-sized enterprises (SMEs) accounted for 24%. In the Subprogramme of the SME Instrument contests for SMEs, the experience of participation was new for Ukraine. 14 projects received funding of more than 4.05 million Euros.[19] Unfortunately, one of the lowest indicators regarding the level of participation and funding is demonstrated by the participation of Ukrainian enterprises and organizations precisely in the contests and subprograms of the Industrial Leadership block, 12.6% in terms of participation (number of submitted and number of supported proposals) and 14.6% in terms of funding. Active participation and significantly better performance emerged only in 2021-22 when APPAU began promoting these cascading calls under its EIF program.

4. Testing and demonstration zone

In this zone, the most critical point is the low number of centers equipped with modern laboratory and demonstration facilities. Usually, modern equipment available for demonstration and training of a wide range of SMEs is available only in 2 institutions - universities and demonstration centers of international vendors, for example, Siemens, Festo, or Schneider Electric. But neither the first nor the second can create full-fledged testbeds for specific applications of industrial SMEs, so the role of 'test before invest', which is characteristic of European DIHs, is practically absent in Ukraine.

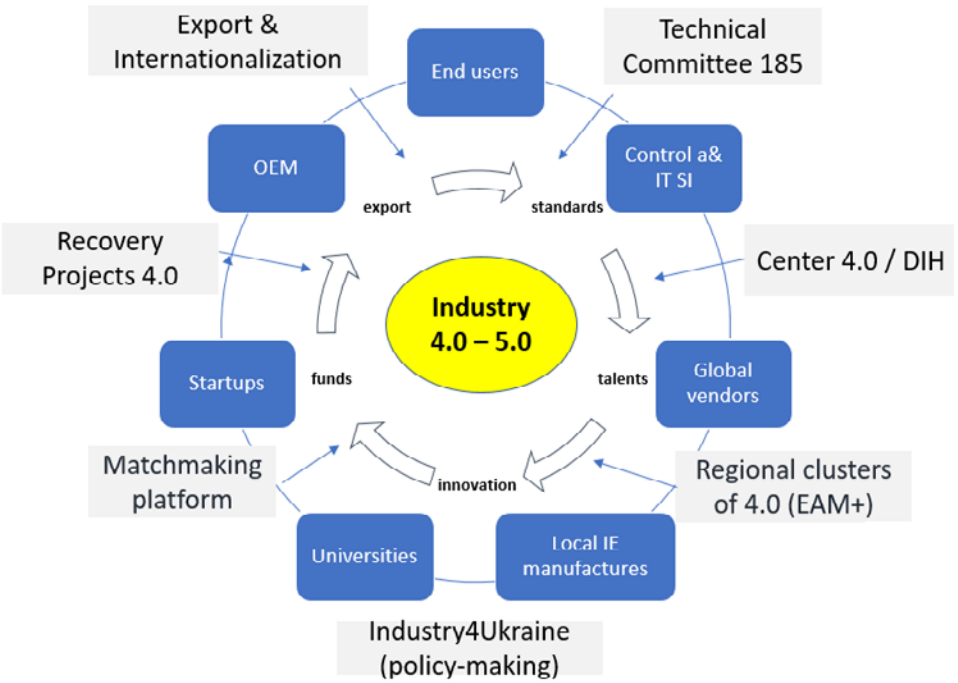
In 2020-2023, four DIHs were created in Ukraine, and only 2 of them are operational by the end of 2023 - at Kyiv Polytechnic Institute (DIH KPI)[20] and Kyiv Academic University (DIH NOSC)[21], which represents 10+ research institutes of Kyiv.

To this picture, it is worth adding information about the low indicators of other elements, such as industrial parks or technoparks - practically absent in Ukraine.

During the last 5 years, APPAU as the national association tried to develop and consolidate ecosystems, as indicated on Fig. 7.

19 Horizon Dashboard. Available under: https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/1213b8cd-3ebe-4730-b0f5- fa-4e326df2e2/sheet/62509062-153c-48c2-9716-afdc498336c8/state/analysis (last access 23.12.2023)
20 For more information see https://science.kpi.ua/news/tsentr-4-0-kpi-im-igorya-sikorskogo-2/ (last access 23.12.2023)
21 For more information see http://cloud-5.bitp.kiev.ua/?page_id=1169&lang=en (last access 23.12.2023)

Figure 7: Presentation of the national ecosystem led by APPAU



Note: see more detailed description by the source, - https://appau.org.ua/ekosystema-appau/

2.3 The landscape of Industry 4.0 innovators

APPAU regularly keeps track of Ukrainian innovations and innovators in the field of Industry 4.0 since 2017. In October 2017, the 1st landscape of innovators 4.0 was released, and in July 2019, the 2nd version was released. This 2nd version is the basis of the web resource https://land4developers.com/, representing an information hub and marketplace of Ukrainian Industry 4.0 innovators for a foreign audience. There was no other studies since 2019.

2.3.1. Overview of innovators 4.0 in 2019

The 2019 Analytical Report[22] provides a wealth of information on the state and solutions of Industry 4.0, and this is the only report released since then. The report provides data on 70 Ukrainian companies, divided by the criteria of technologies and applied solutions (Fig. 8).

22Fedak, M. (2019). Ukrainian Landscape Industry 4.0 – друга версія. Available under: https://industry4-0-ukraine.com.ua/2019/05/27/ukrainian-landscape-industry4-0-druga-vers%D1%96ya/ (in Ukrainian) (last access 20.12.2023)

Figure 8: Landscape of Ukrainian innovators of Industry 4.0. Version 2.0

Source: Industry 4.0 in Ukraine (2019).Ukrainian Landscape Industry 4.0 – the second version. Available under https://industry4-0-ukraine.com.ua/2019/05/27/ukrainian-landscape-industry4-0-druga-vers%D1%96ya/ (in Ukrainian) (last access 20.12.2023)

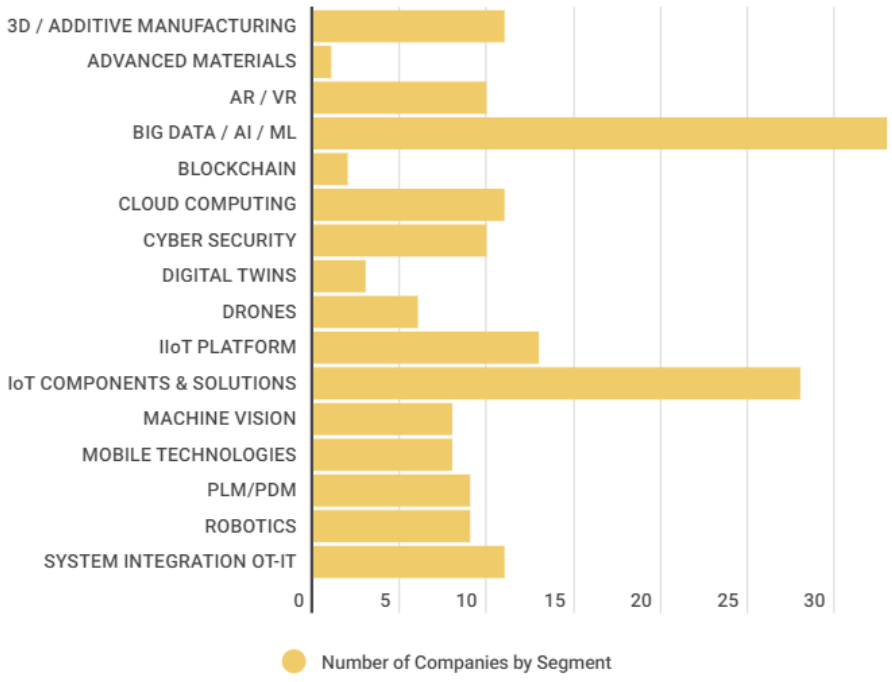
Thus, the technological landscape 4.0 includes 70 companies distributed across 16 segments + 1 system integration. The latter is the most numerous (21 companies), which is logical - many system integrators and technology companies in Ukraine have long been offering solutions based on new technologies that come from Western vendors.

Among the technological segments, the Big data / AI / ML segment is leading - it is located heren 16 companies that have their own products and solutions based on these technologies for industrial applications. In second place is the segment of IoT devices (12 companies), on the third – AR/VR (11 companies).

Comparing with 2017, progress is recorded in several areas:

- The total number of companies grew, primarily due to better accounting. If in 2017 there were about 50 companies on the landscape, mainly those that work in the domestic market, the growth to 70+ is due to the inclusion of companies that work exclusively in global markets.
- If we evaluate the dynamics of growth by individual segments, rapid growth was recorded in the field of IIoT components & solutions, big data, drones, AR/VR, 3D, cyber-security (Fig. 9).

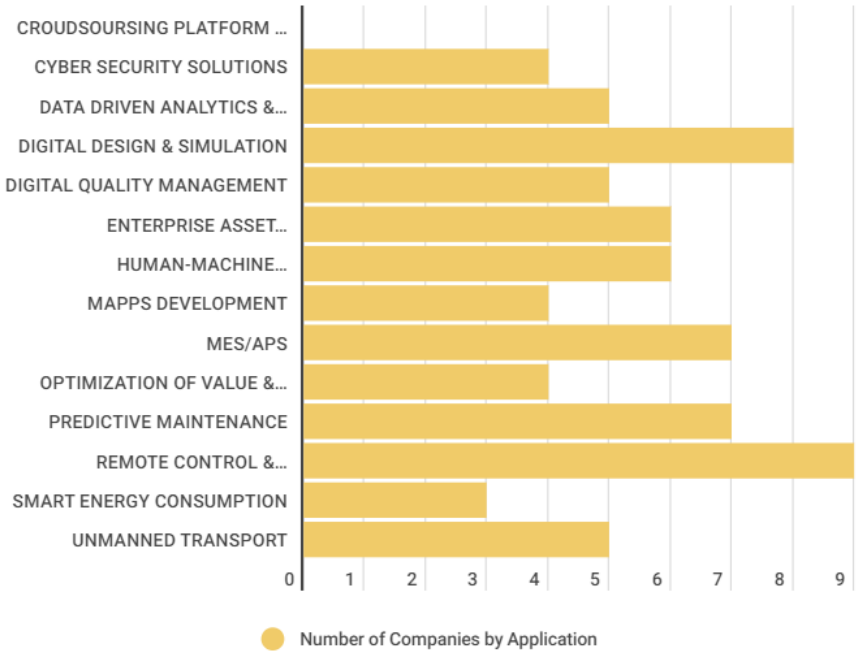
Figure 9: Number of companies by segment



Source: APPAU (2020). The Landscape Industry 4.0 in Ukraine. Available under: https://land4developers.com/the-landscape-industry-4-0-in-ukraine/ (last access 20.12.2023)

The segments that are associated with significantly larger investments in hard or complete, complex solutions remain weak or without growth at all - these are segments such as IIoT platforms, digital twins, UGV (unmanned ground and air transport) and robotics. A higher entry Threshold, lack of development strategies in global markets, and weak demand from the domestic market were assessed in 2019 as the main factors behind the lag in these segments (Fig.10).

Figure 10: Number of companies by application



Source: APPAU (2020). The Landscape Industry 4.0 in Ukraine. Available under https://land4developers.com/the-landscape-industry-4-0-in-ukraine/ last access 20.12.2023)

2.3.2. Segmentation of innovators and best examples

Innovators of various types are presented in the segments of the landscape, so it is better to segment them:

- **True product innovators**: about 50% of those who produce their own products and solutions. Typical examples are Infocom Ltd, IT-Enterprise or 482.Solutions. These companies produce finished products and solutions that have references both in Ukraine and abroad.
- **Service companies - developers**: these are companies that produce software for projects and orders. About 30% of such companies are on our list. Do they reach the product level? Obviously, in some cases, yes, sometimes no. The difficulty in understanding this situation is that we are talking about outsourcing companies (Epam, Luxoft, SoftServe, Lohika, Infopulse, etc.). They are known to work in industrial segments and have excellent references..
- **Control System Integrators and IT-intergrators** – about 20% of them. These companies can implement complete turnkey solutions with both hardware and software parts. Typical examples are Control Systems integrators such as „Naftogazhim Service", „Azov-controls" or „Infocom Ltd". They are based on the solutions of big international vendors (Yokogawa, Emerson, Rockwell Automation, Schneider Electric), so their affiliation in this landscape concerns the use of relevant products and solutions of their vendors.

According to the Analytical Report (2019)[23], there are already many examples of actual innovations and innovators of Industry 4.0 in Ukraine. Below are examples from different segments:

- **Infocom Ltd** (Zaporizhia) is a leader in the UGV (unmanned ground vehicle) segment, which has created a whole portfolio of new products. These are unmanned cars, robotic platforms for security, fire safety, and military purposes, other unmanned military equipment, high-tech products for solar energy and electric transport infrastructure.
- **Smart Factory** (IT-Enterprise, Kyiv) is also a Ukrainian development of MES/APS, which is in great demand by industrial enterprises when they go through the stages of automation of lines and machines. IT-Enterprise also has many other modern products and often appears in the 4.0 segments.
- **SoftElegance** (Kyiv) is one of the first outsourcing firms that, after successful implementations in the USA, is returning to the Ukrainian market. The company's solutions in the field of predictive analytics and predictive maintenance have already attracted the attention of several large Ukrainian customers.
- **482.Solutions** (Odessa) is one of rare software developers company working in industrial blockchain application and decentralized energy solutions. It is a leader of national Industry 4.0 - 5.0 movement with regard to ESG and Data space applications.
- **Molfar technology** (Sumy) is one of the few young companies that came out of the University (Sumy University) and has promising developments and solutions in several related areas - AI/ Drones/Machine vision.
- **SmartZavod** (Ukraine - Germany) - modern solutions in 3D/additive technologies for hybrid production. In 2022-23 Smart. They won several prestigious Ukrainian and European competitions for digital innovations in Manufacturing.
- In the Robotics segment, it is worth to highlight a developer - integrator **Triada-Welding** from Zaporizhzhia. Their robotic complexes in the welding field are in great demand in Ukraine and are based on Yaskawa's products. The company offers complex turnkey solutions and, in addition, is experimenting a lot in the areas of AR/VR and 3D.
- Examples in the field of 3D, such as those from Kyiv, are interesting **IMATEK**, Sprybuild and "Red Wave». The first can make complex solutions - up to 3D farms, the second is a manufacturer of Ukrainian 3D printers, and as stated on their website, these are the fastest printers in the world. „Red Wave" invented innovative 3D printing technology, significantly saving the aerospace industry's titanium costs.

23 Fedak, M. (2019). Ukrainian Landscape Industry 4.0 – друга версія. Available under: https://industry4-0-ukraine.com.ua/2019/05/27/ukrainian-landscape-industry4-0-druga-vers%D1%96ya/ (in Ukrainian) (last access 20.12.2023)

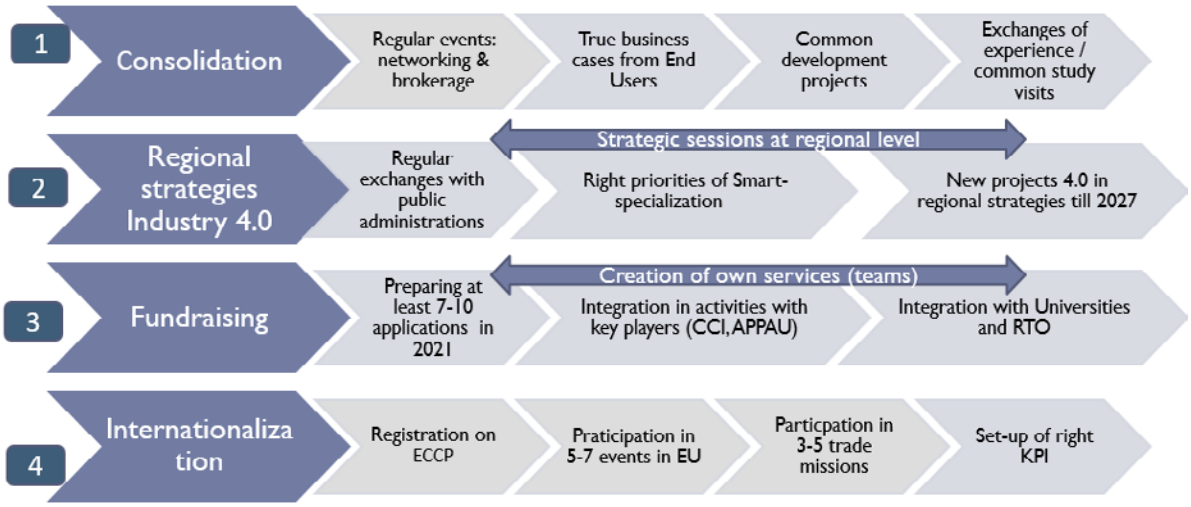
» **MELTA** (Kyiv) is a research and production company at the Institute for Metal Physics of the National Academy of Sciences. It can start production purposes based on its know-how in nanocrystalline materials.

2.3.3 Update 2023

There have been no new studies in the field of Industry 4.0 since 2019.

In 2021, several attempts to account local innovators at the regional level (Zaporizhia and Kharkiv) were unsuccessful due to the lack of resources for such works. Instead, these exchanges in the ClusteRISE project have been useful in identifying priority areas of action. Fig. 11 presents them schematically.

Figure 11: Roadmap for regional innovative clusters 4.0 developed in ClusteRISE project



Source.: APPAU (2021). Rozvytok innovatsiynykh ekosystem v rehionakh Zaporizhzhia ta Kharkova. Available under: https://mautic.appau.org.ua/asset/185:analyticalandinformationcampaign-2021-v1pdf (in Ukrainian) (last access 24.12.2023)

According to the information from Ukrainian Cluster Alliance (UCA), several clusters of UCA approached these indicators in 2022, but this movement is still slow.

The war in Ukraine greatly impacted the growth of various startups and innovative companies related to Industry 4.0.The most significant growth was fixed in the following areas:

- Production of drones and UAVs
- Means of EW (Radio-Electronic Warfare)
- Additive technologies (as part of the technological ecosystem of drones)
- Other types of modern weapons

In general, the number of developers in these segments exceeds 300. The common problem of innovative firms is the lack of modern prototyping centers that would accelerate the development cycles of new innovative products.

2.4 The state of instruments and policies for supporting digital innovation in Manufacturing

In developed countries, there are many policy instruments for influencing the development of Industry 4.0:

- Fiscal instruments - as a reduction of taxes when implementing certain 4.0 technologies;
- Financial - special credit lines and grants;
- Targeted programs for the development of certain technology sectors, for example A.I.; or, in Manufacturing, there is a high demand for reskilling - upskilling programs;
- Development of ecosystem infrastructure - prototyping centers, DIHs, etc.

For instance, as the question of financial incentives is often raised by national policymakers, APPAU prepared this overview of KPMG[24] with regard to possible incentives I4.0.

Briefly, the consistent, balanced, and comprehensive inclusion of innovation development and digitalization tools ensures the achievement of the goals of the digital transformation of Manufacturing. Unfortunately, the government of Ukraine failed to implemented such policies in previous years. According to the UNIDO 2020 report "Industrialization in the digital era"[25] Ukraine is in the category of „latecomers as producers" (16 countries), while Poland is in the category of „Followers" (23 economies), right behind the leaders (10 economies) (Fig.12).

Figure 12: Countries and economies by the level of involvement of ADP technologies used in production

Table A1.2
Countries and economies by level of engagement with ADP technologies applied to manufacturing

Frontrunners (10 economies)	Followers (40 economies)		Latecomers (29 economies)		Laggards (88 economies)
	As producers (23 economies)	As users (17 economies)	As producers (16 economies)	As users (13 economies)	
Economies actively engaging with ADP technologies					
China	Australia	Algeria	Bosnia and Herzegovina	Costa Rica	All other economies that, according to the United Nations Statistical Division, had more than 500,000 inhabitants in 2017
France	Austria	Argentina		Côte d'Ivoire	
Germany	Belgium	Bangladesh	Bulgaria	Ecuador	
Japan	Brazil	Belarus	Chile	Egypt	
Korea (Republic of)	Canada	Colombia	Dominican Rep.	El Salvador	
Netherlands	Croatia	Hungary	Estonia	Ethiopia	
Switzerland	Czechia	Indonesia	Greece	Malawi	
Taiwan Province of China	Denmark	Iran (Islamic Republic of)	Kyrgyzstan	Serbia	
	Finland		Latvia	Tunisia	
United Kingdom	Hong Kong SAR, China	Malaysia	Moldova (Republic of)	Turkmenistan	
United States		Mexico		Uganda	
	India	Portugal	New Zealand	Uzbekistan	
	Ireland	Romania	Nigeria	Zambia	
	Israel	Saudi Arabia	Philippines		
	Italy	South Africa	Slovenia		
	Lithuania	Thailand	Ukraine		
	Luxembourg	Turkey	United Arab Emirates		
	Norway	Viet Nam	Venezuela (Bolivarian Republic of)		
	Poland				
	Russian Federation				
	Singapore				
	Slovakia				
	Spain				
	Sweden				

Source: UNIDO elaboration based on dataset by Foster-McGregor et al. (2019).

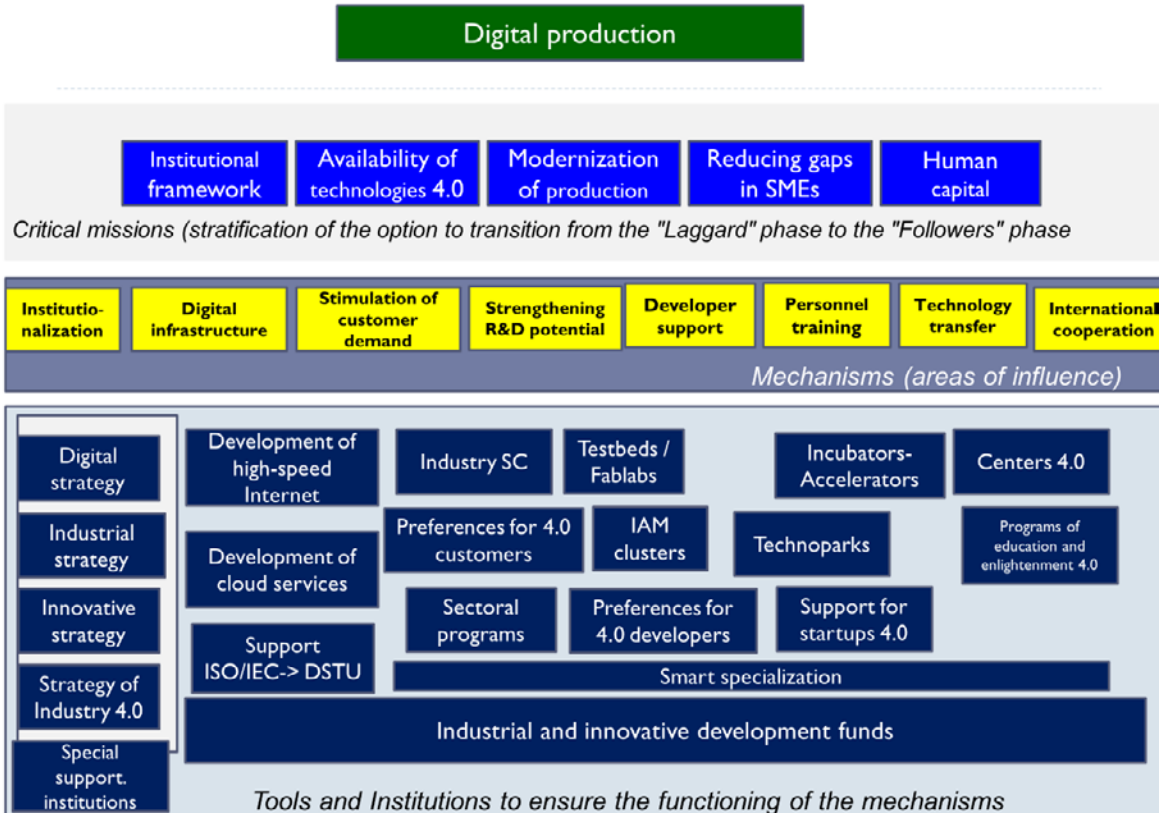
Source: UNIDO (2020). Industrial Development Report 2020. Industrializing in the digital age. Available under: https://www.unido.org/sites/default/files/files/2019-11/UNIDO_IDR2020-MainReport_overview.pdf (last access 23.12.2023)

24 Yurchak, O. (2021), Industry 4.0. Tax incentives value. Available under; https://industry4-0- ukraine.com.ua/2021/12/05/regulatory-incentives-to-implement-industry40/ (in Ukrainian) (last access 23.12.2023)

25 UNIDO (2020). Industrial Development Report 2020. Industrializing in the digital age. Available under; https://www.unido.org/sites/default/files/files/2019-11/UNIDO_IDR2020-MainReport_overview.pdf (last access 23.12.2023)

In this report, UNIDO recommends that the country's „latecomers" include the governance 4.0 tools, which are presented in Fig. 13.

Figure 13: Tools and institutions that ensure the functioning of mechanisms



Source: UNIDO, adapted by APPAU in 2020.

Most of the tools presented in Fig. 15 are not available in Ukraine or are in their initial state. As part of the preparation of proposals for the National Economic Strategy 2030, in 2020 the APPAU working group developed the above-mentioned framework in order to determine key instruments and institutions[26].

Top 5 priority instruments:

- Incentives for end users to use Industry 4.0 technologies, and to increase the penetration of new technologies
- Testbeds 4.0 - laboratories and demo stands that allow to implement 'Test before invest' functions
- Programs to support the internationalization of Ukrainian innovators 4.0
- Modern, and specialized in Manufacturing sectors, Incubators and Accelerators of Industry 4.0
- Targeted programs to launch independent experts of Industry 4.0 (like SIRI)

Top 3 institutions:

- State Agency of Industry 4.0
- Network of innovation clusters of Industry 4.0
- Network of Centers 4.0 (or with industry-oriented DIHs)

Mentioned report from August 2021 fixes up the relative, small progress only in clusters and DIHs development, - no progress is observed in other elements. Respectively, in 2023, this set is considered again in the Conference Resolution 5.0, - APPAU, already within the of the UCA, continues the advocacy of these priority instruments and institutions (see more in Chapter 1.7). Regarding the specific instruments of Industry 4.0, the comparison provided by the Polish FPPP with APPAU (due to the lack of a similar agency in Ukraine) is presented in the Table 2.

26 For more information see https://www.industry4ukraine.net/bez-kategoriyi-uk/priorytetni-instrumenty-ta- instytucziyi-industriyi-4-0/ (last access 24.12.2023)

Table 2. Tools 4.0. in Poland and Ukraine

Instruments	Poland (FPPP)	Ukraine (APPAU)	Comments
Assessment of maturity levels SMEs	self-diagnostic tool	no	FPPP provided this tool in Sep-23 for Ukrainian SMEs
Market education: regular conferences I4.0	regularly: national and regional levels	Irregular and only national (discontinued in 2020)	the last major conference on I4.0 was offline in 2019, Trans4mation
Reskilling - Upskilling programs	system policy, including due to the development of DIH	programs at the national level are absent	There are only 2 DIHs in Ukraine, none of them provide regular training programs for SMEs
School of leaders Digital transformation	yes	no	
Awards among End Users	yes	no	In Ukraine, there was a tentative to fix up best practices by series of case studies
Network of certified experts	yes	no	in Ukraine there was an attempt to launch a project with SIRI
Benchmarking / Orientations	yes	partly	Industry4.0 in Ukraine resources, separate reports
Knowledge base	yes	partly	Industry4.0 in Ukraine resources, different reports

Source: developed by the author / based on studies tours in Poland in 2023. Available under; https://www.clusters.org.ua/en/blog-about-clusters/tour-of-ukrainian-policymakers-to-poland/ (last access 24.12.2023)

Obviously, such a comparison is not in favor of the Ukrainian side. The budget of an individual business association, even at the national level, is disproportionate to State budgets. For example, the budget of the Ministry of Digital Transformation of Ukraine in 2021 amounted to almost 1.6 billion hryvnias (more than 500 million euros), of which there were practically no expenses for supporting the digitization of sectors of the real economy. At the same time, the yearly budget of APPAU for market development of Industry 4.0 never exceeded 50k euros per year.

2.5 Other strategies and programs related to Industry 4.0

Strategies and programs carried out in the last five years by various stakeholders and related to Industry 4.0 include:

- Development of startups in deep-tech segments. In particular, since 2019, the Ukrainian Startup Fund[27] has been constantly developing startups, some related to Industry 4.0.
- Active participation of Ukrainian universities and research institutes in European grants, such as Erasmus, Horizon etc. The number of universities involved in large EU consortium and projects (more than 1 million euro) on the topic of Industry 4.0 is about 10.
- The development of youth start-ups and the culture of entrepreneurship in universities are mainly

27 For more information see https://usf.com.ua/#usf-sc-3 (last access 22.12.2023)

YEP projects. [28]Another strong players with young startups are Incubator 'Sickorsky challenge' and Noosphere. They are active in spite of all difficulties of wartimes.

» The development of smart specialization in Ukraine is rather controversial in its implementation, but it had an impetus for the development of several projects that consolidated the expert community and allowed to develop own methods and approaches to the implementation of the Entrepreneurial Discovery Process[29].

» The cluster initiatives, which tend to be institutionalized in the UCA, also grow, and some clusters actively support the development of Industry 4.0 - 5.0. In July 2023 the Manifesto of transition to Industry 5.0.[30] was signed by 26 clusters

» TechUkraine made a lot of activities in consolidation all key opinion leaders of different Tech-segment, incl. Industry 4.0. In 2021 they also provided awareness campaign about impact of IT-industry on domestic market where there were 10+ stories about innovators Industry 4.0

» Almost all international vendors - Siemens, Schneider Electric, Festo, Fanuc, Phoenix Contact, ABB, etc. - periodically hold promotions supporting Industry 4.0. „Siemens- Ukraine" had significant investments in university laboratories and classrooms.

» APPAU, in addition to developing the National Strategy of Industry 4.0, implemented many more specific polices, industries guides and cases studies (Fig. 14):

Figure 14: Contribution of APPAU to positional and educational documents on Industry 4.0

Source: developed by the author

» High dynamics in 2023 are demonstrated by the European programs that are more and more opening for Ukraine. According to information as of December 2023:

- An EIT community office is opening in Ukraine. Before that, in November, the EIT Manufacturing forum[31] was held in Zakarpattia, with the participation of 15 participants from EU countries (incl FPPP was from Poland). In general, more than 120 Ukrainian startups took part in the EIT Startup jumper programs, among them a third related to Industry 4.0
- Also, on December 20, the Ukrainian office of Horizon Europe was opened.
- On December 20, the EIC program to support 200 Ukrainian startups - the Seeds of Bravery project[32] for 20 million euros - was launched.

28 For more information see https://www.yepworld.org/ (last access 22.12.2023)
29 See Industry4Ukraine (2020). Smart-spettsializatsiya v Ukrayini – yakoyu maie buty tsilova model.". Available under: https://www.industry4ukraine.net/publications/smart-spezializacziya-v-ukrayini-yakoyu-maye-buty-czilova- model/ (last access 22.12.2023)
30 UCA (2023). Manifesto Industry 5.0. Available under: https://www.clusters.org.ua/en/blog-about- clusters/manifesto-industry-5-0/ (last access 24.12.2023)
31 see https://www.eitmanufacturing.eu/news-events/events/manufacturing-day-ukraine/
32 see https://seedsofbravery.eu/

Thus, there is a sufficiently high dynamic of development of innovative ecosystems in Ukraine. At the same time, these processes lack systematicity and a better strategic approach, especially when it comes to sectors such as Industry 4.0.

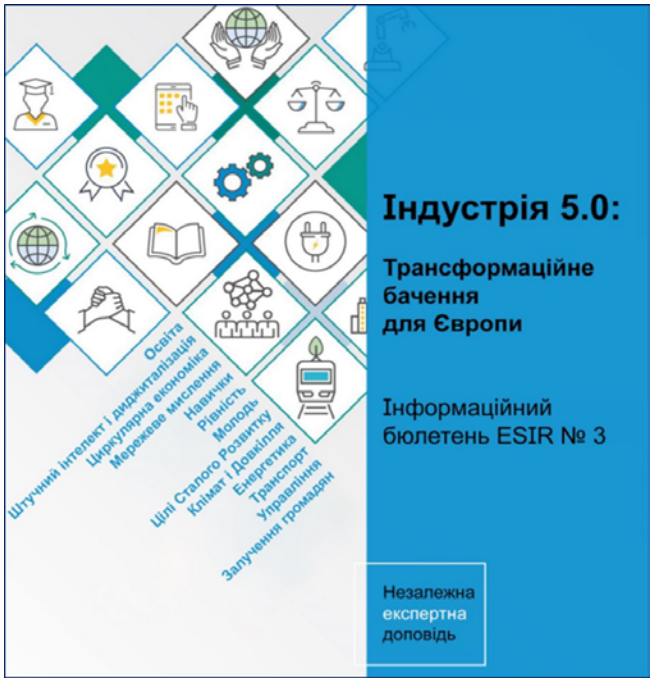
2.6 Transition to Industry 5.0 - the first steps

APPAU - already within the UCA - began actively promoting the concept of Industry 5.0 only in 2023. There are several reasons for such a belated, or more precisely - cautious approach to this topic, and they are apparent to specialists:

- Most of the industries in Ukraine are at the 3.0 level - so the specialists' doubts are reasonable: „Why do we need 5.0, if we have not passed 4.0?"
- COVID-19, and then the war, significantly slowed down the work with domestic industries and related Industry 4.0 programs. Should we be ahead of time again in this case?
- The almost complete lack of State support is another, and very big, obstacle. In the conclusions of the results of 2021, APPAU showed that most of the programs planned in the 2018 strategy, which were designed for 3 years, remained unimplemented due to the lack of funding and support from the State. Then what is the point of transition to Industry 5.0?

So, to talk about Industry 5.0, it was necessary to have answers to all these questions. At the same time, in 2023, more and more voices were heard in the UCA environment about the need to promote Industry 5.0 - after all, this is the new vision for industry of the EU, and a number of Ukrainian actors, such as universities, are already involved in European research projects in this field.

In November 2022, APPAU started a promotion on the translation of the document of the European Commission „Industry 5.0: A Transformational Vision for Europe"[33]. The translated document was widely distributed and thus prepared an expert opinion and contributed to informing target audiences.



In June 2023, APPAU took advantage of the grant opportunity provided by UNDP and directed these funds to the holding of the national Industry 5.0 conference. It was held in July 2023 and was the first step towards a large-scale consolidation of all stakeholders of Industry 4.0-5.0. The event was attended by 100+ people offline and more than 200 online; among the speakers - representatives of the European Commission, the Polish agency FPPP, an expert from the Czech Republic, a number of state institutions (2 Ministries, deputy of Parlements), leading experts from business associations and enterprises.

The key results of this conference should be considered:

- Consolidated positions of all stakeholders - they are laid out in 2 documents:
  - Manifesto for the transition to Industry 5.0[34] - which sets out 10 key statements of expert communities
  - Conference resolution 5.0, which is already a consequence of the discussions at the conference. Among other additional statements to the Manifesto, the Resolution[35] sets

33 For more information see: https://www.clusters.org.ua/blog-single/industry-5-0/ (in Ukrainian) (last access 24.12.2023)
34 UCA (2023). Regarding transition of Ukrainian industries to a new industrial paradigm. Available under: https://www.clusters.org.ua/en/blog-about-clusters/manifesto-industry-5-0/ (last access 22.12.2023)
35 UCA (2023). Resolution of the 1st conference "Industry 5.0 in Ukraine. Available under: https://www.clusters.org.ua/en/blog-about-clusters/resolution-of-the-first-international-conference-industry-5-0/ (last access 23.12.2023)

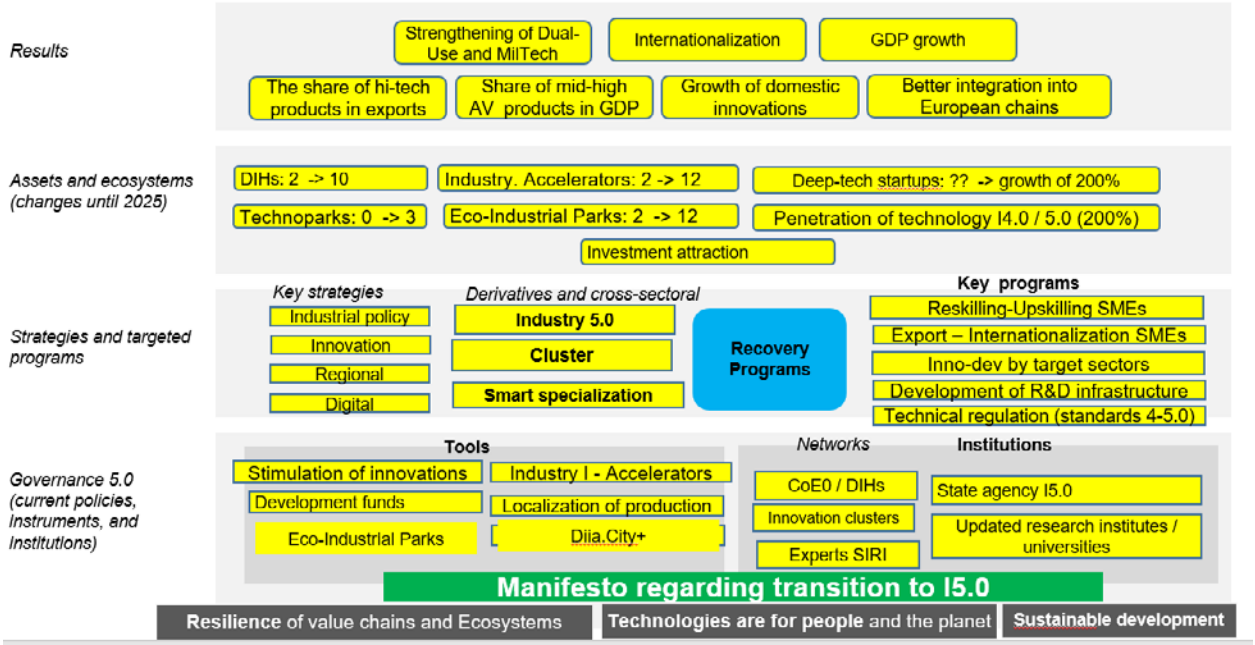
directions for specific actions.

» Another consolidation of the expert community around the key instruments and institutions necessary for the implementation of Industry 4.0-5.0 in Ukraine. This list is clearly stated in both documents above.

- Legislative changes to stimulate demand for innovation among industrial enterprises.
- Targeted programs for retraining and upgrading the skills of workers of industrial SMEs (reskilling-upskilling).
- Targeted programs for the development of innovation cluster networks.
- A targeted program for the development of digital innovation hubs (DIHs).
- Launch of a network of independent experts (according to the SIRI methodology).
- Programs for improving the R&D infrastructure - DIHs, universities, and research institutes of the National Academy of Sciences.
- Creation of industry accelerators — especially for industrial and deep-tech startups.
- Implementation of Industry 4.0 and 5.0 technical standards.

» Development of a single framework of Industry 5.0 policies and programs. De facto, this framework is the heir to all the achievements and works of the APAU in the period 2018- 21 (Fig. 15).

Figure 15: Strategy framework for Industry 5.0



Source: Ukrainian Cluster Alliance, Double Transition Committee.Note: adopted in July 2023. UCA focuses on the foundation - the levels of Governance 5.0 and Strategies, without which it is impossible to get new results (top).

» Significant consolidation of UCA clusters to support this transition. The manifesto on the transition to Industry 5.0 was signed by 36 organizations, among them 26 clusters of the UCA (see Photo 2)

» Acceleration in the formation of relevant working groups and committees at UCA. In particular, the next month after the conference, the committee of the twin transition of the UCA (TWINS), which is developing its action plan.

» Entry of the CEO of APPAU, Oleksandr Yurchak, and Roman Kravchenko, CEO 482.Solutions as 2 representatives from Ukraine, to the Industry 5.0 Community of Practice Working Group at the level of the European Commission.

In general, the statements of the Manifesto and Resolution 5.0 fully comply with the provisions of the European Commission and are based on them. The confirmation of the European Commission that the transition to 5.0 does not necessarily mean a gradual passage through 4.0 was important for the decision of the UCA and APPAU to change towards Industry 5.0 - it is rather about changing businesses paradigms and their business models, as well as about new State policies equal.

At the same time, there are a number of differences in the Ukrainian statements regarding 5.0 in relation to the positions of the European Commission, and which reflect the special situation of Ukraine. In other words, we took into account 2 main factors - a low level of maturity, both at the level of domestic industries and State policies; war in Ukraine with all the consequences that follow from it.

These differences and emphases are reflected in the following statements Manifesto and Resolution[36,37]:

1. Moving towards governance 5.0. The emphasis on the key role of the State was also in the Ukrainian Industry 4.0 strategy from 2018. But now, expert communities are emphasizing this factor with greater force as a fundamental one, and precisely in the context of the responsibility of governments not only for the efficiency of the economy, its technology or competitiveness, but much more in the context security, reliability and resilience of critical industries. Exactly, the effective functioning of defense enterprises, energy, transport infrastructure, production of essential goods, as well as the level of support programs for integration into European industrial ecosystems depends on the government of Ukraine. Therefore, the relevant policies and strategies 4.0-5.0 as enablers of higher effectiveness and reliability, are the direct responsibility of the Ukrainian government.
2. Integration and cooperation with the military-technical industry in order to strengthen critical infrastructure and develop dual-purpose technologies - is the second factor different from the provisions of the European Commission. A successful economy of independent Ukraine is possible only under the conditions of proper territorial integrity and collective security. The Ukrainian Industry 5.0 community should maximally promote development in the sectors of critical industries and dual-purpose technologies, and together strengthen the domestic defense industry.
3. Preservation and restoration of human capital is an imperative for the Ukrainian industrial community in the context of the huge losses of the last decade and the war. The transition to Industry 5.0 should mean the development of effective, balanced strategies to restore the potential of engineering personnel, science and education both at the state level and at the level of communities. At the same time, the enterprises themselves undertake to introduce an innovative culture and production organization, where people take an active part, show their creative potential and constantly learn.

Also, the statements of the Manifesto slightly expand the concept of S (Social responsibility) in the concept of ESG, which is an integral part of Industry 5.0. Ukrainian experts fully agree with the EU theses regarding the need to comply with and transition to ESG standards. This is an axiom for Ukrainian enterprises seeking to integrate into the EU. At the same time, the war should push European partners to expand the principles of social responsibility. It is not simply and not only about the joint fight against climate changes. Any support for businesses from aggressor countries or their governments is unacceptable today and is also part of social responsibility and governance.

All other provisions of the Manifesto and Resolution of the 5.0 conference are practically identical to the European vision.

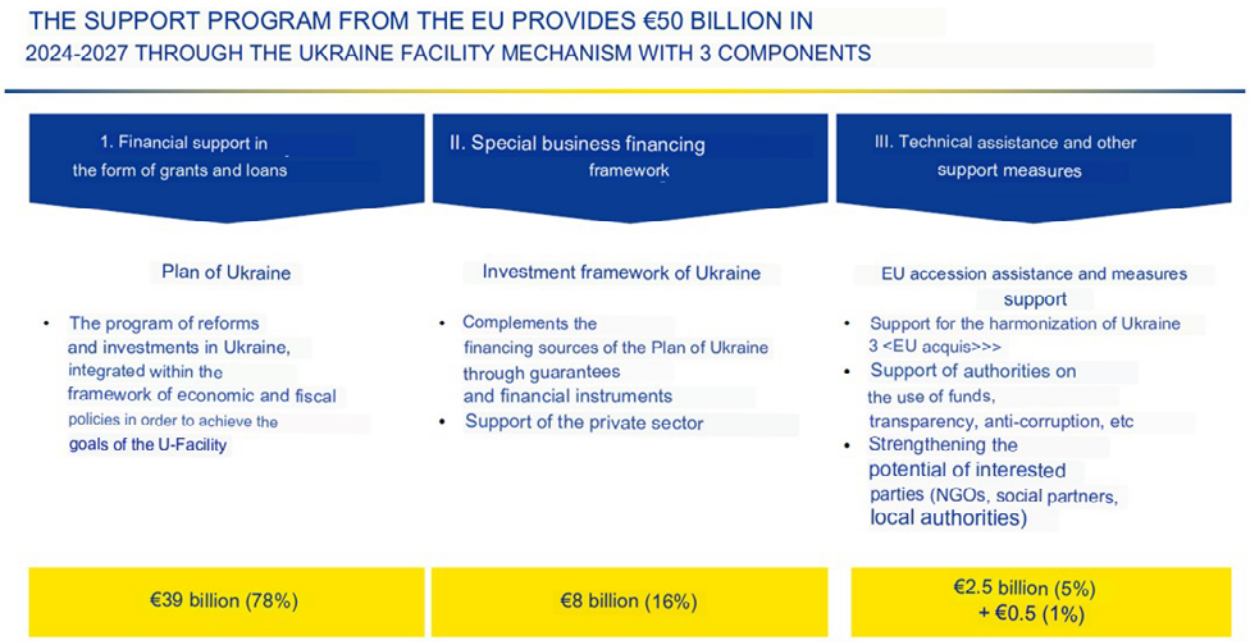
For European and, first of all, Polish partners, this Ukrainian transition towards Industry 5.0 potentially means specific cooperation programs not so much in the classic sectors of Industry 4.0-5.0, but above all, in the fields of dual-purpose technologies. We are talking about such sectors and applications as UAVs, robotics, digital twins, cyber security, photonics (quantum technologies, laser technology, industrial optics and electronics), application of AI etc.

36 UCA (2023). Regarding transition of Ukrainian industries to a new industrial paradigm. Available under: https://www.clusters.org.ua/en/blog-about-clusters/manifesto-industry-5-0/ (last access 22.12.2023)
37 UCA (2023). Resolution of the 1st conference "Industry 5.0 in Ukraine. Available under: https://www.clusters.org.ua/en/blog-about-clusters/resolution-of-the-first-international-conference-industry-5-0/ (last access 23.12.2023)

2.7 Ukrainian Resilience and Recovery Projects related to Industry 4.0

A few months after the start of the war and the significant destruction caused to the territories and economy of the country, the Ukrainian government started planning the Recovery programs. These programs had several iterations throughout 2022-23. The first major program was offered in July 2022 in Lugano[38]. The latest government program is submitted under the aid package of the European Union in 50 billion euros with distribution as indicated in Fig. 16.

Figure 16: Distribution of the package of 50 billion euros for the Restoration of Ukraine



Source: see Government presentation Available under: /https://drive.google.com/drive/folders/1BaVcO3vQ92Ucjsyy80XkjIJh- Zsge-MA8?fbclid=IwAR0PhSFKryHlCh4ViEra1L3fTwtJq-gSlY3_RFlDm1rnWcZpwNckcXEGV5Q (last access 24/.12.2023)

For NGOs and soft projects, including those on European integration, a part of the package of 2.5 billion euros is an obvious reference point.

In preparation for this agreement, from July to December 2023, the Cabinet of Ministers of Ukraine prepared detailed recovery programs for 12 industry sectors, Fig. 17.

Figure 17: The role of private business in the recovery and development of Ukraine

Source: see Government presentation Available under: /https://drive.google.com/drive/folders/1BaVcO3vQ92Ucjsyy80XkjIJh- Zsge-MA8?fbclid=IwAR0PhSFKryHlCh4ViEra1L3fTwtJq-gSlY3_RFlDm1rnWcZpwNckcXEGV5Q (last access 24/.12.2023)

38 see Recovery Plan of Ukraine. Available under: https://recovery.gov.ua/ (in Ukrainian) (last access 24.12.2023)

Soft development projects provided by UCA, in particular, on Industry 4.0, are included in certain sectors, such as mechanical engineering.

By the end of December 2023, detailed recovery and development plans for the specified sectors were to be sent to the European Commission. According to the latest information, the European Commission's meeting on allocating 50 billion euros to Ukraine is scheduled for February 1, 2024.

In its turn, the European Commission has developed a set of programs to support Ukraine[39], Including Boost up from EIT Manufacturing, Bridge of Businesses, extended and special for Ukraine Interreg programs, and others.

UCA as the national clusters association, was active and proposed a number of projects to the government to be included into the official Recovery portfolio. The project portfolio of UCA[40] lists of 52 projects about 14 of which have relation to Industry 4.0-5.0.

While generally supporting the government's plan and taking an active part in it, the positions of UCA and APPAU, as representatives of Advanced Manufacturing associations of Industry 4.0, differ somewhat in terms of emphasis and priorities. In particular:

» Given the complex military-political situation of the country, much more attention should be paid to strengthening the Defense industry, including the Dual-use technology and MilTech sectors. Many technologies and development tools in these sectors directly relate to Industry 4.0.

» The government's current plans do not sufficiently consider the issue of the twin transition SMEs, which affects all sectors of the economy.

» Similarly, these plans do not consider the development of shared infrastructure of technological ecosystems and support tools.

Positions and proposals of the Ukrainian Cluster Alliance regarding a better focus on the innovative development of industrial sectors are presented in the position paper „Proposals for innovative development programs.[41]"

39 see https://single-market-economy.ec.europa.eu/support-actions-ukraine_en
40 For more information see https://www.clusters.org.ua/en/future-projects/
41see https://www.clusters.org.ua/blog-single/posision-paper-innovational-ecosystems/

3. Exchanges between the ecosystems of Poland and Ukraine during 2023

3.1 Overview of cooperation between APPAU and FPPP in 2023

The cooperation of APPAU with Polish partners of Industry 4.0 began in 2018 with the project of the Eastern Partnership for the exchange of clusters in the field of innovative developments. Project EaP Horizon 2020 „Development of clusters in IoT"[42], which was carried out by APPAU together with the Lublin IoT cluster, gave impetus between both ecosystems at the national level. Through partners from Lublin, APPAU approached to FPPP, and already in September 2019 Andrzej Soldaty, the then head of the agency, visits Kyiv on 1st Trans4mation conference[43].

After that, there is a pause for 2 years, and cooperation resumes in September 2022, when a new memorandum on cooperation between FPPP and Ukrainian partners was signed, - European Agency of Innovation (Lviv) and APPAU.

Since March 2023, the meeting of European cluster communities in Košice at the Clusters meet regions forum, cooperation between partners is gaining momentum.

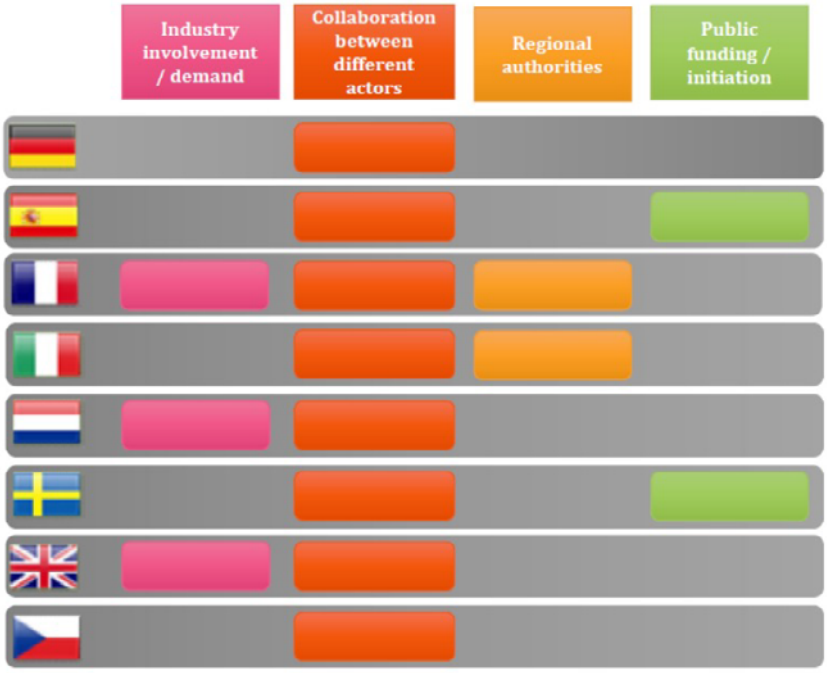
- On June 2, the partners made the first attempt at systematization of current projects between both countries. It can also be considered the beginning of systemic action planning. At this online meeting with the Polish Association of Clusters, the idea of creating a joint committee between Poland and Ukraine in the field of Smart Industry was discussed for the first time.
- FPPP, by Mariusz Hetmanczuk was the speaker on the 1st Ukrainian conference of Industry 5.0 on July 2023 (online), with the presentation 'Structure of the Polish Industry 5.0 ecosystem'
- On September 7, the participants of the UCA took part in the meeting of the Innovation
- Council of the Lesser Poland Voivodeship of Industry 4.0
- From September 11 to 15, FPPP will organize a study tour of the Ukrainian delegation of Industry 4.0 policymakers to Poland. The delegation included representatives of APPAU, clusters of Ukrainian Clusters Alliance, and the Ministry of Economy of Ukraine. The delegation visited the key ecosystem actors of Industry 4.0 in Rzeszów, Krakow, as well as the Eastern European Forum in Krynica. An essential result of the trip is the signing of a new memorandum of cooperation between UCA and FPPP, according to which the Polish side will support UCA by transferring all its best experience and ready-made tools in the field of SME digitization. The first is the SME self-diagnosis tool, which is the most accessible and popular in Poland.
- On October 10, Adrian Jasik and Oleksandr Yurchak met in Brno, at the Smart.Industry exhibition, where cooperation in a tripartite format was discussed with Tereza Shamanova CEO of CzechInno. The Czech Republic is the second country with which APPAU (UCA) is developing the format of bilateral cooperation.
- From December 5 to 7, FPPP will organize the 2d study tour of APPAU - this time the partners will visit the Special Economic Zone in Legnica. During the visit, elements of cooperation between the regions of Ukraine and Poland, including cluster development and Industry 4.0, are discussed.
- On December 18, Adrian Jasik participated in the final online meeting of the Professionals4Ukraine program, where ambassadors of the program discussed cooperation plans for 2024. UCA positions Ukrainian - Polish cooperation in 2023 as the best example of supporting UCA clusters and developing Ukrainian Smart.Industries. The main criteria of such an assessment consider the involvement of various stakeholders of Industry 4.0, State structures, and organizations of joint actions.

42 see https://industry4-0-ukraine.com.ua/2018/09/04/zv%d1%96t-po-konferenc%d1%96%d1%97-rozvitok-klaste/
43 see https://appau.org.ua/%d0%b1%d0%b5%d0%b7-%d0%ba%d0%b0%d1%82%d0%b5%d0%b3%d0%be%d1%80%d1%96%d1%97/%d0%b0%d0%c%d0%b1%d1% 96%d1%86%d1%96%d1%97-%d1%8f%d0%ba-%d0%bd%d0%b0%d1%88-%d1%80%d1%83%d1%88%d1%96%d0%b9-%d1%80%d0%be%d0%b7%d0%b2%d0%b8%d1%82%d0%ba%d1%83-%d0%b7%d0%b2%d1%96%d1%82-%d0%b7/

3.2 Exchanges with other ecosystem actors

According to the European Commission's assessment of the development of Industry 4.0 in various EU countries, the cooperation of various ecosystem actors is a common and key factor in developing this area (Fig. 18).

FIgure 18 : Driving factors behind I4.0 policies



Source: Digital Transformation Monitor (2017). Key lessons from national industry 4.0 policy initiatives in Europe. Available under: https://es.sistematica.it/docs/379/DTM_Policy_initiative_comparison_v1.pdf (last access 20.12.2023)

Polish-Ukrainian cooperation in Industry 4.0 is a vivid evidence of this thesis, including in the context of bilateral cooperation. During 2022-23, the development of relations and exchanges, in addition to FPPP and APPAU, also continued with other actors related to Industry 4.0.

From the Ukrainian side:

- A number of UCA clusters, in addition to APPAU, are also Kyiv hi-tech cluster, clusters of Engineering - Mechanical Engineering from Kharkiv and Zaporizhzhia, Vinnytsia AIM cluster, cluster of advanced materials technologies, Photonics cluster initiative and others.
- The European Innovation Agency and the „Lviv School of Startups" contributed to significant activation in the scientific and educational sphere
- Lviv Regional Development Agency
- Digital Innovation Hub „Center 4.0 KPI" from Kyiv Polytechnic University

On the Polish side, apart from the FPPP in 2023, the st active cooperation is developing with organizations:

- The Polish Association of Clusters and individual clusters included in it - Composite Materials, Life Science and Sustainable Infrastructure from Krakow, Metalworking from Białystok
- Lesser Poland Voivodeship
- Polish Photonics platform
- Polish Institute of Automation named after Lukasevich (PIAP), and at its base DIH „Mazovia".

The most important exchanges between the actors mentioned above of both ecosystems in 2023 should be considered

- Signing of the Memorandum on cluster cooperation with Ukraine by 5 Eastern European countries in Kosice (among the signatories is the Polish Association of Clusters)
- The visit of the Polish delegation to the conference on sustainable regional development in

Lviv in June. There was a significant convergence of the clusters of both countries, as well as improved relations at the regional level with the participation of representatives of the Lesser Poland Voivodeship.

- The participation of the Ukrainian delegation in the cluster conference in Krakow in December, where specific agreements on cooperation were reached with the clusters of Composite materials, Metalworking, and the Krakow Technology Park - see the detailed report on link[44].

APPAU is also a member of the IDEALIST (Horizon Europe) consortium of 14 companies, where 2 Polish organizations are present - Aviation cluster from Silesia and innovative agency 4CF from Warsaw.

There is no exact information about the results, but it is also known about numerous exchanges of partners from Ukrainian universities, in particular, Kharkiv, Lviv and Zaporizhzhya polytechnics, which had many exchanges with Polish universities.

4. The main conclusions regarding the potential of cooperation between Ukraine and Poland in the field of Industry 4.0.

The year 2023 became a breakthrough in the sphere of relations between ecosystem actors of both countries. The number of exchanges and joint actions performed in 2023 is more significant than in the entire past decade. These exchanges clearly showed and proved the great potential of cooperation of both countries in this field, but also many challenges, among which the urgent need to coordinate the actions of ecosystem actors is in the first place.

The achievement of cooperation in 2023 is also the fact that both parties managed to find sources of financing for exchanges in 2023, which seems even better for 2024.

4.1 Potential cooperation between ecosystems of Industry 4.0 - the main directions of action.

The uncertainty regarding the end of the war in Ukraine, the turbulence of the external environment, and the complexity of the general geo-political situation are the main factors affecting the planning of the actions of all partners of Ukraine in 2024.

The authors of the document adhere to the following several main assumptions regarding the external environment:

- The war will be protracted and will not end in 2024
- The economic situation in Ukraine will deteriorate, the military-political situation will remain relatively stable within the existing front line
- External, international aid to subjects of economic activity will remain at a high level
- Poland will remain a main economic and military-political partner of Ukraine.

In turn, for the participants of the Industry 4.0 ecosystem, this situation strengthens integration processes in all areas, including the spheres of Smart Industries. Ukraine's Recovery projects will not yet start in 2024. Still, the parties will continue preparations both at the level of processing large investment projects and deepening cooperation in the integration of value-added chains, strengthening their resilience in the war period and the integration and innovation of ecosystems.

The main sectors where there is significant potential and the development of cooperation between existing and new actors of Industry 4.0 is foreseen:

44 44For more information see https://www.clusters.org.ua/blog-single/cluster-meet-regions-zvit/

1. **Development of Industry 4.0 - 5.0 policies and programs, transfer of best experience to Ukraine from Polish partners**. Poland has better chances for the Central and Eastern European benchmarking, which is necessary for Ukrainian policy-makers, and the subsequent transfer of the experience of its implementation of Industry 4.0 - 5.0. This advantage is due to the following factors:
   - The presence of the State Industry 4.0 agency in Poland and against the background of the growing need to create a similar agency in Ukraine
   - Indicators of growth of industrial development and digitization of sectors
   - The existing level of support programs for Smart industries in Poland, similar to what Ukraine needs today (at the government level in Ukraine, there are practically no such programs with real budgets and action plans).
   - Strong positions of Polish policy-makers in the EU, including on issues of future aid and involvement in Recovery programs
   - Developments and results of exchanges of FPPP and UCA 2022-23

2. **The beginning of integration processes along the chains of critical industries**
   There priorities in this domain can be setup by next sectors:
   - Mechanical engineering and metalworking
   - Dual-use & MilTech sectors, including the production of drones and electronic warfare equipment
   - Sustainable Energy
   - Smart cities and infrastructure

Multilateral projects and action programs aimed at improving the innovation infrastructure and strengthening the defense sectors of Eastern Europe deserve special attention in this category. One of the initiatives for 2024 is the holding of Czech-Polish-Ukrainian events in Rzeszów (Subcarpathian startup festival), Brno (Smart.Industry - MSV exhibition) and Lviv (UCA conference), which will be focused on the development of a similar agenda in the areas of Industry 4.0 / Dual-Use / Miltech and strengthening cooperation at the C2C (Cluster-2-Cluster) and B2B level.

Potentially, this cooperation can be extended to other sectors and countries, and where Polish institutions can in some cases be the leaders of these processes.

3. **Preparation of construction plans for new processing plants in Ukrainee**, which will integrate with GVC and Poland's industrial ecosystems. Similar plans already exist in the Ukrainian government. In particular, separate expert groups blame and lobby for the program of building 500 new factories. A deeper acquaintance with them and the involvement of Polish agencies and investors can result in better preparation of these projects with further involvement of Polish firms and contractors.

4. **4.Cooperation in developing infrastructure elements of the Industry 4.0 ecosystem** – as DIHs, a network of certified experts, accelerators, and incubators. Similar projects (e- DIHs) are already starting in Ukraine with the funds of European funds, and which also involve integration processes with EU countries. Poland has fresh and extensive experience in creating similar structures, which will be in great demand in Ukraine in the 1st quarter of 2024.

5. **Staff training in Manufacturing - entry into projects and reskilling / upskilling programs** by specific market segments. Whether these programs can be joint or synergistic is an open question, but similar proposals are already being heard from Polish clusters. In particular, the Polish metalworking cluster offers Ukrainian specialists training of workers and trainers in the relevant technologies of Industry 4.0.
6. **Common entry into innovative programs and projects** financed in the EU (Horizon/ Digital Europe, SMP, Interreg, etc.). Here, the potential for cooperation is very high - many actors from scientific and research structures are already cooperating, but there are still many opportunities.

All these opportunities and areas of cooperation have great potential for development and conversion into development and business projects. At the same time, their potential should be explored and prioritized in more detail. The „APPAU Export Alliance" project plans corresponding research in some areas. Also supported by the Polish side, this will give a much clearer perspective on the directions of action plans in 2024-25.

4.2 The main challenges of cooperation for 2024

Cooperation between partners showed achievements and areas of growth and challenges. These include:

1. **Ad-hoc approaches from both sides**, such as insufficient planning, coordination, and synchronization of actions in the development of bilateral relations. The consequence is insufficient efficiency of actions. For example, on the Polish side, a growth zone can be seen in better coordination of initiatives from FPPP and Polish clusters (by PCA) related to Industries 4.0. In Ukraine, there is a big gap between the UCA and government institutions - actions are generally not coordinated in practice. Therefore, the partners of both countries should better plan and coordinate activities. A potential solution is the creation of an Industry 4.0 committee, which includes leading actors from both sides, and which conducts its activities on a regular, quarterly basis..

2. **Insufficient funding of cooperation projects from both sides**. Given the great potential for cooperation and the importance of these projects for the Resilience and Recovery of Ukraine, they should have much better support from both sides, as well as from the European Commission. The parties improved the general state of these exchanges in 2023- primarily thanks to the Polish side, but in general the level of financing of joint initiatives is still low.

3. **Synchronization in policy-making**. The asymmetric positions of key partners (FPPP as a government organization), and UCA (APPAU - as an association of businesses and clusters) require obvious alignment on the part of Ukraine. The UCA is already working on this, trying to better involve Central government ministries in these exchanges, but the Polish side can also take more steps through its own channels of influence on the Ukrainian government.

4. **Expanding partnerships and improving coordination and communications**. The number of partners on both sides related to the tasks of developing Industries 4.0 - 5.0 is really large. These are State structures, research institutions, regional development agencies, chambers of commerce, analytical agencies, international donors, etc. Most of them are not familiar with the activities of Ukrainian-Polish partners in the field of Industry 4.0, and, in general, do not sufficiently understand the importance of this cooperation. Therefore, the parties should significantly increase the level of their communication activities to improve awareness and involve more partners.

5. **Launch of flagship projects.**To motivate and activate the ecosystem participants of both countries, the parties need to launch 2-3 pilot, large-scale projects, each involving at least 10-15 key ecosystem actors. This is clearly not enough for better consolidation of resources, and similar approaches are a solution to the challenge of fragmentation (forces and resources), which the parties may not fully understand but, according to the document's authors, is one of the biggest challenges in international cooperation. Similar projects can be in the field of research cooperation, military-technical cooperation, or in the launch of new (cluster) productions, where the chains include participants from both countries.

5. Recommendations for the action plan Poland - Ukraine on 2024

The following recommendations are important for consideration by the parties of both countries.

1. **Get political support at the highest level**. After its approval by the FPPP, this report is recommended to be communicated by appropriate letters to the level of the relevant ministries (economy, innovation, digitalization) of both countries to obtain political support.

2. **Launch of the intergovernmental committee for bilateral cooperation of Industry 4.0**. This committee may have monitoring, communication and advocacy roles and functions, will require some resource and financial support, and is currently seen as a key tool for addressing all five challenges outlined above.

3. **Begin preparations for actions already planned for 2024** (Appendix 3). Thanks to the cooperation of the FPPP and the Ukrainian Cluster Alliance in 2023, the parties already have some confirmed plans and proposals for 2024. Ukrainian clusters also have certain resource support (EAA and Professionals4Ukraine projects, see Appendix 4), which bring cooperation to a more systemic level. At the same time, preparing these measures should begin as early as possible and requires good coordination from the Polish side as well. Coordinators should be identified for each segment of activities and plans, and general monitoring of the plan is the subject of consideration by the Bilateral Collaboration Committee.

4. **Expand the circle of partners, including international ones** - and get their support. The involvement of strong international partners, including the European Commission, is an obvious direction for the committee's actions. This direction requires a separate detailed action plan.

5. **Continue the "analytical cycle" with a more complete report in late 2024.** This report is a small contribution to the development of bilateral relations between Poland and Ukraine in the field of Industry 4.0. It will continue in the 1st quarter of 2024 as part of the „APPAU Export Alliance" project, which is supported by USAID. It seems logical to take steps to continue and complete these analytical works, according to the priorities that will be determined by the Committee, supplemented and strengthened by Industry 4.0 experts from both countries.

For reference questions, contact
yurchak.alexandre@clusters.org.ua

6. Bibliography

1. Emergen Research (2023) 10 wiodących firm oferujących rozwiązania Przemysłu 4.0, online: https://www.emergenresearch.com/blog/top-10-leading-companies-offering-industry-4-0-solutions (dostęp: 19.12.2023).
2. Agenda cyfrowa Ukrainy (2018). online: https://www.slideshare.net/APPAU_Ukraine/digital-agenda-ukraine (w języku ukraińskim) (dostęp: 24.12.2023).
3. Yurchak, O. (2019) Ukrainska Stratehiya Industry 4.0 - 7 Napryamiv Rozvytku, online:https://industry4-0-ukraine.com.ua/2019/01/02/ukrainska-strategiya-industrii-4-0-7-napriankiv-rozvutku/ (w języku ukraińskim) (dostęp: 20.12.2023).
4. APPAU (2019) Strategia Przemysłu 4.0, online: https://mautic.appau.org.ua/asset/42:strategia-rozvitku-4-0-v3pdf (w języku ukraińskim) (dostęp: 24.12.2023)
5. APPAU (2020) Projekt krajowego programu rozwoju klastrów do 2027 roku, online: https://mautic.appau.org.ua/asset/166:proekt-nacprogrami-klasternogo-rozvitku-do-2025-v1pdf (w języku ukraińskim) (dostęp: 24.12.2023).
6. Schroeder Wolfgang (2016). Niemiecka strategia Przemysłu 4.0., online: https://uk.fes.de/fileadmin/user_upload/publications/files/FES-London_Schroeder_Germanys-Industrie-40-Strategy.pdf (dostęp: 20.12.2023).
7. UE (2015). Strategia jednolitego rynku cyfrowego dla Europy, online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52015DC0192 (dostęp: 20.12.2023).
8. UE (2021). Kompas cyfrowy 2030: europejska droga do cyfrowej dekady, online: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021DC0118 (dostęp: 22.12.2023).
9. KE (2021) Horyzont Europa, online: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en (dostęp: 22.12.2023).
10. Monitor Transformacji Cyfrowej (2017). Kluczowe wnioski z krajowych inicjatyw w zakresie polityki przemysłu 4.0 w Europie., online: https://es.sistematica.it/docs/379/DTM_Policy_initiative_comparison_v1.pdf (dostęp: 20.12.2023).
11. Industry4Ukraine (2020). Smart-spetsializatsiya ta klasternyy rukh - proekt ‚INTEGRATSIYA 4.0', online: https://www.industry4ukraine.net/publications/smart-speczializacziya-ta-klasternyj-ruh-proekt-integracziya/ (w języku ukraińskim) (dostęp: 20.12.2023).
12. Land 4 Developers (2023). Network of Centers 4.0 in Ukraine, online: https://land4developers.com/company/network-of-centers-4-0-in-ukraine/ (w języku ukraińskim)
(dostęp: 20.12.2023)
13. APPAU (2019). TK 185, online: https://appau.org.ua/category/tk-185/ (w języku ukraińskim) (dostęp: 20.12.2023).
14. APPAU (2023). Budowanie mapy drogowej transformacji cyfrowej w sektorze rolno-spożywczym. Online: https://agri-food.appau.org.ua/en/home-page/ (dostęp: 21.12.2023)
15. APPAU (2022) Pidsumki 1-ho roku programi EIF - vid ad hoc do systemnoyi roboty.
Online: https://appau.org.ua/ (w języku ukraińskim) (dostęp: 20.12.2023)
16. CMU (2021) Postanova Schodo spriyannya vprovadzhennyu tekhnolohichnoho pidkhodu ‚Industriya 4.0' v Ukrayini, online: https://zakon.rada.gov.ua/laws/show/750-2021-%D0%BF#Text (w języku ukraińskim) (dostęp: 21.12.2023)
17. VRU (2021). Krajowa strategia gospodarcza 2030, online: https://zakon.rada.gov.ua/laws/show/179-2021-%D0%BF#Text (w języku ukraińskim) (dostęp: 23.12.2023).
18. Horizon Dashboard, online: https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/1213b8cd-3ebe-4730-b0f5-fa4e326df2e2/sheet/62509062-153c-48c2-9716-afdc498336c8/state/analysis (dostęp: 23.12.2023).
19. Fedak, M. (2019). Ukraiński przemysł krajobrazowy 4.0 - druga wersja., online: https://industry4-0-ukraine.com.ua/2019/05/27/ukrainian-landscape-industry4-0-druga-vers%D1%96ya/ (w języku ukraińskim) (dostęp: 20.12.2023).
20. APPAU (2020). Przemysł krajobrazowy 4.0 na Ukrainie., online: https://land4developers.com/the-landscape-industry-4-0-in-ukraine/ (dostęp: 20.12.2023).
21. Jurczak, O. (2021), Przemysł 4.0. Wartość zachęt podatkowych., online: https://industry4-0-ukraine.

com.ua/2021/12/05/regulatory-incentives-to-implement-industry40/ (w języku ukraińskim) (dostęp: 23.12.2023).
22. UNIDO (2020). Raport o rozwoju przemysłowym 2020. Industrializacja w erze cyfrowej, online: https://www.unido.org/sites/default/files/files/2019-11/UNIDO_IDR2020-MainReport_overview.pdf (dostęp: 23.12.2023).
23. Industry4Ukraine (2020). Smart-spettsializatsiya v Ukrayini - yakoyu maie buty tsilova model., online: https://www.industry4ukraine.net/publications/smart-speczializacziya-v-ukrayini-yakoyu-maye-buty-czilova-model/ (w języku ukraińskim) (dostęp: 22.12.2023).
24. UCA (2023). Manifest Przemysł 5.0., online: https://www.clusters.org.ua/en/blog-about-clusters/manifesto-industry-5-0/ (dostęp: 24.12.2023).
25. UCA (2023). Rezolucja pierwszej konferencji „Przemysł 5.0 na Ukrainie", online: https://www.clusters.org.ua/en/blog-about-clusters/resolution-of-the-first-international-conference-industry-5-0/ (dostęp: 23.12.2023).
26. Plan odbudowy Ukrainy, online: https://recovery.gov.ua/ (w języku ukraińskim) (dostęp: 24.12.2023).
27. Industry4Ukraine (2021). Najbardziej priorytetowy instrument i instytucje Przemysłu 4.0: aktualny stan wdrożenia, online: https://www.industry4ukraine.net/bez-kategoriyi-uk/priorytetni-instrumenty-ta-instytucziyi-industriyi-4-0/ (w języku ukraińskim) (dostęp: 24.12.2023).

7. Attachments

Załącznik 1 - Porównanie kierunków UE (poziom ogólnoeuropejski) w zakresie Przemysłu 4.0 i propozycji ukraińskich

	The direction of the EU in I4.0	The main focus of the programs	Interests - prospects for Ukraine
1	Digital Single Market (DSM)	The EU's single digital market -> common standards, interoperability	1.Acceleration of general development in the fields of artificial intelligence, cyber security, work with data and development of digital infrastructures.. 2. Faster transition to I4.0 technical standards in .
2	EU4Digital	Development and expansion of DSM initiatives to Eastern European countries	1. Expansion of already existing projects on the subject of cyber security prom. enterprises (critical infrastructure) 2. best practices in the development of digital skills and innovations.
3	Smart specialization (S3)	Growth of innovation in the industry through better cooperation between science, business and government	More rapid and industry-oriented deployment of this project in Ukraine (already underway since 2017).
4	ICT innovations for SMEs from industrial sectors (I4MS)	Development of I4.0 in SMEs. Now the project is already in the 4th, last phase, it is not very clear what the perspective is	Since 2013, the project has gone through 3 phases, in which Ukraine has not even entered yet: therefore, the transfer of best experience in the creation of Centers 4.0, Competence Centers, and other tools for the development of SMEs is very important.

5	Network of DIHs (and- https://www.midih.e u/)	Creation of examination centers I4.0	1. Integration of Ukrainian 4.0 centers into the DIH/MiDIH network 2. transfer of best practices (including with individual countries - for example 4.0 centers in Germany)
6	Horizon Europe	Growth of innovation in key sectors of the EU	Participation in all relevant programs is very important given the scope of the program and its start in 2021
7	InterReg Europe projects	Regional and inter-regional initiatives I4.0	Launch of similar projects in Ukraine
8	The Digital Europe Programme	Accelerated development of digital programs (including DIHs)	Similarly to item 5.
9	New industrial strategy of the EU	Double green and digital industry	Better integration into relevant programs - industry and technological. In particular, positioning us as a significant actor in the European supply chain & Digital supply chain system

	IT	Industry 4.0	Dynamic last 5 years	Comments / stats and facts
A. Innovation Management Area				
Clusters	20	10	Significant growth with appeance of UCA	APPAU + Eng-Automation-Machinary (EAM) clusters in Kyiv, Kharkiv, Vinnytsia, Zaporizhzhia, Lviv, Mykolaiv, Poltava, Sumy
Associations	8	3-5	No progress	There are 50+ industrial associations, but few of them have hi-tech priorities in their agenda
Specialized Public Agencies	Ministry of digital transformation	0	No progress	There were several tentatives to launch the governance of I4.0 in the Ministry of economy and Ministry of strategic industries, but without any significant results
Agency of Regional Development, or similar	Diya.Business	0	No progress	No regional agency is today in real support of Industry 4.0, or industrial cluster. First progress is fixed in Lviv and Volyn regions (partners of UCA)
B. Innovation Zone				
Startups	(300–500 annually) 1600 (total)	100-150	Some progress is fixed with activities of Ukrainian startup fund (USF)	there is no accurate accounting of industrial or I4.0 startups. The approximate part of deep-tech and industrial startups in the total volume is less of 10%, more info: https://techukraine.org and https://usf.com.ua/
Universities	208	30	Tens of Universities set-up new student programs	the most active and known in I4.0 ecosystems are Polytechnic Universities from Kyiv, Lviv, Dnipro, Kharkiv, Zaporizhzhia, Odessa
R&D centers	100	N/A	Brak postępów	A good example Yuzhnoye Design Office
Scientific Institutes	N/A	1	Weak progress (by KAU)	among 110+ scientific institutions there is only Kyiv Academic University who is active in promotion of some techno 4.0

C. Incubation area				
Incubators	12	2	No progress	Sikorsky Challenge / EO. EO stopped operation in Kharkiv in 2022
Corporate Accelerators	Not less than 8	3	No progress	DTEK / MHP / Metinvest (big holding)
HUBs as coworking / networking spaces	50	N/A	Weak progress (by regional HUBs)	Unit.city, HUB 4.0 and other
Venture funds	19	2-3	No progress	Noosphera, Sikorsky Challenge, USF
EU grant programs	N/A	10+	Significant progress in Universities and SMEs	Unit.city, HUB 4.0 and other
Other funds	9	3	Significant progress with donor's program and USF	At least 3 donors (USAID, GIZ, UNDP) periodicall support some projects oriented to Industry 4.0. USF also support SMEs and startups (mainly in category of deep-tech)
D. Testing / Demonstration and Experience area				
Techno parks	4	1	No progress	Unit.city is 1st innovation park but with low orientation to industrial applications
Industrial parks	-	3	There is progress only at the legislation level	Bila Tserkva, Vinnytsia, Gorodok
Centers of applied (industry) expertise	N/A	N/A	No progress	Paton's scientific institute was a good example / There is no developped Prototyping Center, even the necessity is crucial
R&D labs and testing	the same 100 R&D centers	N/A	No progress?	
Digital Innovation Hubs	N/A	2	Good progress in Kyiv (2)	There are 4 DIHs registered on S3 platform / 2 are active

	Activities	Category	Description	Main objectives	Date	Current status	Budget*	Contact person PL	Contact person UA
A	**POLICY-MAKING IN INDUSTRY 4.0-5.0**								
1	Set-up the regular Bilateral Committee work	Policy - making	Every quater meeting with consideration plans & projects	1. Setup common agenda, 2. Prioritize right projects, 3. Facilitae exchanges, 4. Improve effectiveness in multi-stakeholders environment.	every quater	planning	UA: project P4U (2 people) PL: TBD	Adrian Jasik	Alex Yurchak
2	Inter-gov exchanges	Policy - making	2 study-tours with involvement of key persons from both sides	1. transfer of policies and best practices to Ukraine, 2. agreement about (smart) recovery projects	TBD	planning	UA: projekt P4U (do ustalenia) / do ustalenia	Adrian Jasik	Alex Yurchak
B	**PROGRAMY ODPORNOŚCI I ODBUDOWY UKRAINY**								
1	Round table in Warsow		RT with key stakeholders of smart Industries. Presentation of 1st results of study 'Potential of collaboration'	to define priority projects and program with regard to UA Gov plans (prepared for package 50 bln euro)	March	planning	UA: EAA / TBD	Adrian Jasik	Alex Yurchak
C	**DEVELOPMENT OF COLLABORATION IN B2B - C2C EXCHANGES IN SMART.INDUSTRIES**								
1	B2B exchanges Ind 4.0	EAA	Visit of 10 Ind Automation companies of Ukraine to Poland	B2B exchanges with Polish Main Automation contractors and End users	połowa marca	in preparation	EAA	Adrian Jasik	Alex Yurchak
2	Round table in Lviv	P4U	Round table of ambassadors Professionals4Ukraine in Lviv	Set regional collaboration UA - PL. CZ, RO	September	in preparation	P4U	TBD	Alex Yurchak
3	Mini-conference in Kyiv	P4U	Final meeting of ambassadors P4U	Alignment / exchanges	September	in preparation	P4U	TBD	Alex Yurchak

4	I4.0 in metalworking	P4U	Presentation of Metarworking cluster: techno 4.0	Alignment / exchanges	Jan-Feb	planning	-	Sebastian Rynkiewicz	Andriy Karpenko
D	**ECOSYSTEM DEVELOPMENT / PARTNERSHIP IN EU PROGRAMS**								
1	Online conference ‚Construction materials'	Recovery	Online meetup between PL and UA clusters: composites and other costruction technologies	to establish collaboration between PL and UA companies	30th of Jan	in preparation	-	Andrzej Czulak	Born Schyrin
2	Building the corridor eDIH Mazovia - DIH KPI	Recovery	After-BOWI' stage (BOWI project ended in 2023 suggested the continuation of collaboration between the mature (Mozovia) and young (KPI) DIHs	to build true collaboration (corridor) between eDIH and DIH / make exchange regular	TBD	looking for funding	nie	Sylwia Stefaniak	Oleksandr Stepanets
3	Regional exchanges with ARD / online	Resilience	After visiting Legnice and Krakow in Dec-23, there were some agreemnt about exchanges of best experiences of Polish and Ukrainian regional actor in regional / innovation development	1. to share best practicies among UA ADR 2. to set-up the format of regular communication on the topics Smartspecialization / Industry 4.0	Jan (TBD)	planning	TBD	TBD	Anatolij Dolynnyj
AND	**Security / MilTech - DualUse**								
1	Conference ‚Quantum technologies in Defense'	Resilience	Conference unde direction DG DEFIS/ 4 coorganizers (FR, GE, PL, UA)	to forster collaboration around all dual-use techno: Quantum, Photonics, others. To discuss possibility for Ukraine to join ENDR	13-14/03	in preparation	UE / DG DEFIS	Maciej Nowakowski	Oleksa Woźniak

Annex 4 - Overview of I4.0 cooperation projects with Poland EAA and Professionals4Ukraine supported by the Ukrainian side for 2024.

„Export Alliance of APPAU" (EAA) project

Implementation period: from December 2023 to November 2024
Volumes of financing: 2 tranches x 25,000 euros
The purpose and goals of the project

The main goal of the project is to help 10 members of APPAU to start systemic activities in the development of export opportunities, to give impetus to increased sales, integration into European supply chains, job creation and, ultimately will contribute to the stability and strength of Ukrainian innovative companies.

The main tasks of the project:

1. Creation of two permanent committees on cooperation between innovation ecosystems:
   a. Poland-Ukraine,
   b. Czechia-Ukraine.
2. Conducting thorough research of the markets of Poland and the Czech Republic in the segment of industrial automation
3. Conclusion of at least three commercial agreements in the target markets, ensuring the export of products or services of alliance members.
4. Implementation of at least three agreements related to engineering outsourcing or contracting.
5. Development of bilateral relations and initiation of joint projects with external partners in recovery projects in Ukraine.

As part of the financing of the project, 2 business missions to Poland are foreseen.
Beneficiaries of the project, 10 participants of APPAU include enterprises specializing in industrial design and automation, system integration, industrial software development, additive manufacturing, industrial design, industrial marketing, etc.

The project „Strengthening the cooperation of Ukrainian and European clusters in the Professionals4Ukraine program"

Implementation period: from February 2024 to November 2024
Volumes of financing: 25 thousand euros
Prerequisites of the project.
Internationalization of Ukrainian SMEs and clusters is a key strategy of the UKA and where integration into value added chains and innovation ecosystems of the EU is component #1. During 2022-23, UKA implemented more than 20 different activities and mini- projects in the implementation of this strategy. According to the evaluations and this experience, the Professionals4Ukraine program is recognized as the best mechanism - the development of a network of foreign ambassadors who help Ukrainian clusters and enterprises in strengthening their economic stability during the war. But there is a critical lack of resources for its implementation on a larger scale.Strengthening of cooperation between UKA clusters and foreign business associations from target countries with access to specific integration projects, by creating a permanent coordination center is the main goal of this project.

Purpose and tasks. The project includes the following measures:

- how to create a separate coordination center to work with ambassadors from 7 target countries (including Poland)
- specification of directions and action plans with each of them
- coordination in the implementation of their individual measures
- launch of bilateral cooperation committees for 3 countries (including Poland)
- organization of two final events in Lviv and Kyiv.