



EU4Digital

EU4Digital: supporting digital economy
and society in the Eastern Partnership

**Digitising industry (digital
transformation of SMEs in
traditional sectors): policy
recommendations:
Belarus**

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1 Background

The EU4Digital Facility (a programme under the umbrella of the EU4Digital Initiative) was launched by the European Commission in January 2019. The EU4Digital Facility aims to extend the benefits of the European Union's Digital Single Market to the Eastern partner states – Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova (hereinafter – Moldova) and Ukraine. The Facility focuses its support across six key policy areas, including ICT innovation. The activities in the ICT Innovation policy area are aimed to support reforms and actions favouring the development of ICT research, start-ups & innovation ecosystems across the Eastern Partnership region, drawing from the EU experience and best practices.

In 2019 - the first half of 2020, the Facility focused its work to identify and share at the regional level the best EU practices for regulation in the policy areas pre-selected by the Eastern partner countries:

- Intellectual property rights management for digital innovations (Armenia);
- New organisational forms for supporting ICT Innovation (Azerbaijan);
- Digital innovation SMEs' access to finance (Georgia, Ukraine);
- ICT innovation ecosystems for start-ups and scale-ups (Moldova);
- Digitising industry (digital transformation of SMEs in traditional sectors) (Belarus).

This report provides the results of the gap analysis related to the policy area 'Digitising industry (digital transformation of SMEs in traditional sectors)' in Belarus, and the recommendations for the development of relevant innovation policy. The recommendations formed the basis for elaboration of the national policy implementation action plan for Belarus.

2 Results

The scope and the information type sought during the gap analysis is explained by the scope of the EU4Digital Facility, as well as by the intervention logic of the Facility. Being one of the first endeavours of the EU assistance to the Eastern partner countries in harmonising digital market, the objectives of the EU4Digital Facility at this stage are to **identify the major gaps between the EU and the Eastern partners** and to reveal the directions in which the interested stakeholders can take further active steps to overcome the gaps.

Based on the gap analysis and in tight cooperation with stakeholders, the **recommendations were developed** and can be used as the basis for further activities and possible joint projects. The EU4Digital Facility aims to keep the recommendations as practical and implementable as possible.

These recommendations formed the basis for elaboration of the **national policy implementation action plans** for each Eastern partner country. The action plans identified specific stakeholders in the Eastern partner countries, specific EU tools, platforms, practices that can be mastered by Eastern partner country stakeholders and possible counterparts in the EU countries.

The other activities of the Facility (training, study visit, networking events, promotion activities, etc.) will **support the interested stakeholders in their further activities** on overcoming the gaps.

3 Methodological note

The EU4Digital Facility identified the best EU practices for regulation in the policy areas selected by the Eastern partner countries. These best practices were systematised and formed the basis for analysis of the progress and gaps in the Eastern partner countries.

The gap analysis was performed by comparing the best EU practices and tools with those existing in the Eastern partner country, within the framework of the policy area selected by the country. The national experts in each Eastern partner country collected the field data by means of desk research (study of existing reports and documents), field research (collecting and analysing raw data in Internet space) and interviews with national experts from state bodies and relevant digital innovation ecosystem organisations (see Annex 1. List of organisations and experts consulted during verification process).

Further analysis of the gaps and development of the recommendations was performed by the EU4Digital Facility expert team and aligned through consultations with national stakeholders.



4 Introduction to a framework supporting SMEs in digital transformation

This policy area addresses the needs of existing small and medium-sized enterprises in traditional industries ('traditional SMEs') (with focus on manufacturing industries in Belarus) on their path of mastering digital technologies and digital innovations to increase the efficiency of their operations and make their business model more competitive.

Digital transformation is understood by the EC as "a fusion of advanced technologies and the integration of physical and digital systems, the predominance of innovative business models and new processes, and the creation of smart products and services" [EC]. Relevant EU industry-related policy is called 'Digitising European Industry'; its objective is to ensure that businesses of all sizes, location and sectors in Europe can draw the full benefits from digital innovation.

Digital transformation differs from automatisisation and informatisation due to the systemic nature of changes required, including the change of business process, business model, and economic relations within and around the enterprise. Because of this, the funding to support SMEs in this complex endeavour should account for specifics of the expenditures and envisage inevitable knowledge transfer and trainings.

The EU best practice analysis shows that creating an environment for the digital transformation of small and medium-sized enterprises operating in traditional sectors of the economy requires a systematic approach, including the formation of a palette of entities that provide advisory support and are centres of specialised competencies, as well as state trust to the private sector, providing it with self-regulatory functions and undertaking of joint projects as public-private partnerships.

This all leads to the vision of a special organisational setting and toolkit of a policy on digital transformation, including collaborative mechanisms of public and private sector.

This explains the logic and the structure of this report of the EU4Digital Facility study on this topic.

Section 5 contains an **overview of recommendations** that are further elaborated in detail.

Section 6 makes an **introduction into the sector of small and medium enterprises** in Belarus as the target sector for support in digital transformation.

Section 7 focuses on **policy and organisational setup for digital transformation in the country**. Subsections 7.1 and 7.2 check whether the recognition of the need for digitising of enterprises in traditional industries is supported in the country by policy documents and availability of policy bodies to implement the relevant policy. Subsection 7.3 looks for organisational mechanisms and practices for networking of diverse stakeholders involved in digital transformation.

Section 8 looks at the **resource base for digital transformation**. It checks which funding is available for different activities needed for digital transformation as well as whether the funding rules are open for state-owned and private SMEs. Next subsections ask about the availability of special competence and training enabling companies in digital transformation. Last subsection checks the availability of technologies via platforms facilitating digital transformation in the country.

Section 9 looks whether **mapping of successful digitalised companies** is done (outcomes).

While the conclusions are based on the careful study of primary data, which was validated with the national stakeholders, in the current report the discourse is presented in a summarised way, for the reasons of brevity and efficiency of reading.

The structure of the policy recommendations within this report is a framework of four elements:

- the suggested actions are listed and elaborated where needed (answering the question what is to be done (*What?*));
- the reason why these actions are important is explained in terms of a broader context of the innovation ecosystem development (*Why?*);
- relevant EU organisations are suggested as potential partners exercising the good practice in the considered area;
- possible counterparts in the Eastern partner country are indicated as the parties potentially interested in taking over of the suggested EU best practices and in performing the recommended actions.



5 Summary of recommendations

Following the status and gap analysis, the recommendations were developed, linked to the EU best practices, on how to establish the framework to support SMEs in traditional industries in Belarus on their path to digital transformation. The summarised recommendations in Table 1 are further elaborated in sections 6-9. The order of the recommendations in the below summary corresponds to the recommendations numbering in the sections.

Table 1. Summary of recommendations

Summary of recommendations
1. A set of conceptual and implementation documents adopted at the national/regional level on the digitising of enterprises in traditional industries
1.1. Develop a separate 'Strategy of digitising SMEs' in Belarus, taking into account the Concept developed for EAEU and similar EU documents (Germany, France, Netherlands, UK, Italy – Smart Industry and l'industrie du future), reflecting its challenges and specific economic, resource, ownership structure; political goals, assets, strategic competitive advantages and limitations.
1.2. Develop an action plan of Strategy implementation.
1.3. Plan and facilitate the development of a wider range of targeted national strategies for digital transformation (including a list of issues important for further development) (based on German experience).
1.4. Develop, in close cooperation with industry experts and decision-makers in government bodies, and in extensive consultations with representatives of SMEs of target industries, a specific (organisational and co-ordinational) mechanism for digital transformation of the productive sector of the economy in Belarus, including a detailed account of the structure of industries that are affected (ownership structure, the specifics of the technological regime in it, the current technological level of the industry itself and its suppliers/consumers, the degree of integration into the global market and other factors).
2. A well-balanced and equipped set of policy bodies for digital transformation in the country
2.1. Determine a central policy making body for digital transformation with a focus on digital innovations for transformation of SMEs in traditional sectors (suggested body – Ministry for Economy).
2.2. Ensure that this body is well staffed with experts on digital transformation plus establishes balanced complementary mechanisms for elaboration and implementation of policy toolkit for digital transformation.
2.3. Ensure that this body has enough budget to implement the programme on digital transformation.
2.4. Ensure that this body collaborates with other policy bodies that can contribute to policy development and implementation.
2.5. Ensure that other policy bodies have a clear understanding of their contribution domain and have human and financial resources to do so.
2.6. Consider establishing of/delegation to a separate legal entity to coordinate the implementation of the initiatives in support of a central policy body.
3. A platform and well-established organisational mechanisms and practices for discussions and joint work on digital transformation of industries of diverse stakeholders
3.1. Establish a national organisational and technological platform 'Smart industry of Belarus' as an organisational mechanism for coordination of efforts of diverse stakeholders, equipped with economic and technological instruments, facilitating the digital transformation of industries.
3.2. Consider establishment of a separate legal entity to maintain the online platform or delegating the mandate of the platform operator to an existing legal entity that can fulfil the selected functions.
3.3. Study the toolbox of existing Industry 4.0 initiatives and platforms in Europe and in the world; select the tools relevant for Belarus and negotiate with platform owners about their transfer.
3.4. Consider diverse mechanisms of consolidation of wider experts from various sectors of economy and composing the working groups.
3.5. Involve business experts in the development of the regulatory framework for innovative digital technologies, as they have the most practical understanding of the possible risks and consequences, for the purpose to maintain the legal framework in line with technological development.



Summary of recommendations	
3.6.	Use the organisational and technological platform 'Smart industry of Belarus' for discussions of strategic directions of development and joint work of diverse stakeholders, public consultations with expert communities and business associations (assessment of impact of potential policies), taking into account best practices from the EU countries.
3.7.	Perform structured consultations based on detailed empirical data, when developing the organisational and coordination mechanism for the digital transformation of industry in Belarus.
4. Funding for activities needed for digital transformation for state-owned and private SMEs	
4.1.	Map the sources of funding from state, international financial organisations, etc., available to SMEs, covering various types of digital transformation activities, and publish this map at the website of the organisational and technological platform 'Smart Industry of Belarus'.
4.2.	Identify the gaps not covered by existing funding sources for SMEs and fill the gaps by introducing of public support mechanisms (grants, innovation vouchers, state guarantees, tax incentives) and negotiated instruments of support from international (financial) organisations and private financial sector.
4.3.	Extend the usage of innovation vouchers to a much wider audience of SMEs that now (see EU innovation vouchers practice).
4.4.	Consider using the approach used by COSME Loan Guarantee Facility as well as country-level approaches (including classification of activities and rules of allocating loans) when revising the framework for digital transformation in the Eastern partner countries.
4.5.	Negotiate the instruments of support from the EU and international organisations regarding the development of competence centres for priority sectors and equipment of testing centres (digital demo factories) for pilot innovative projects of digitalisation of SMEs.
4.6.	Launch the special fund for piloting and deployment of innovative solutions for the wide market.
4.7.	Add a functionality of online submission of applications by SMEs.
4.8.	Add a functionality of applying for expertise simultaneously with applying for funds.
4.9.	Add a functionality of automatic redirection of rejected applications of SMEs for public support to the banks and non-banking financial organisations, including venture capital funds, for their consideration and offering alternative funding opportunities on competitive base (UK experience).
5. Diversified network of specialised competence centres enabling companies in digital transformation (deep tech knowledge, consulting services)	
5.1.	Map and publish in form of database the existing specialised competence centres enabling companies in digital transformation (deep tech knowledge, consulting services), up to direct contacts to experts. Open the universities' infrastructure supported by public funds to wider users in the countries (open access centres).
5.2.	Allow usage of innovation vouchers for obtaining of consultations and attracting experts from the listed competence centres.
5.3.	Develop an international training programme with advanced international competence centres for competence areas that are not or poorly covered by the existing competence centres.
5.4.	Consider establishing a (network of) competence centres in support of digital transformation of SMEs (SMEs 4.0/Smart SMEs) or identify the existing competence centres to serve for overall consultation of SMEs about the strategic approach to digital transformation, on the example of Mittelstand 4.0 competence centres.
5.5.	Study the toolboxes of Mittelstand 4.0 competence centres (Germany) or similar centres in other EU countries and negotiate the transfer of their to Belarusian competence centres. Equip these competence centres for performing of demonstration functions and serving as a testbed for innovative solutions. Promote their services across SMEs. The tool ' Reference Architectural Model Industry 4.0 ' (RAMI 4.0) employed by German competence centres is especially recommended.
5.6.	Equip facilities to perform as demonstration fabric, with specialisation in certain technological areas or certain industries (addressing the specifics of their business processes). Negotiate with leading corporations about possible equipment of these fabrics. Organise regular free of charge excursions for any interested visitors (SMEs, universities, students, public authorities) to raise interest and achieve the effect of transfer of the Industry 4.0 concept from the neglected one to the one perceived as a normal routine that a business needs to master for its competitiveness.
6. Specialised digital innovation and entrepreneurial education organisation in the country (Bachelor, Master, PhD level)	



Summary of recommendations
6.1. Train the group of consultants for the competence centres internationally. Retrain senior and engineering workers who already have professional experience and are employed in the relevant areas of production.
6.2. Establish partnership among leading educational establishment in Belarus with foreign education and training organisations in the EU for joint master's programmes for the future preparation of students onsite.
6.3. Link all educational and training processes related to digital transformation of industry with the practical training (agree with existing digitalised companies in traditional industries and digital solutions developers about internships or, better, dual education).
6.4. Negotiate with corporations about equipping of demonstration facilities for VET.
6.5. Consider using the existing digital competence frameworks for development of a consistent and common language for professions and competencies needed for implementation of digital transformation (European Entrepreneurship Competence Framework; European e-Competence framework; DigiComp, etc.).
7. Digital platforms and digital industrial (sectoral) platforms facilitating digital transformation in the country
7.1. Promote and allow a descriptive comparison of the platforms available to enterprises for digital transformation on the website of the organisational and technological platform 'Smart Industry of Belarus'.
7.2. Develop a national marketplace of technological solutions (applications) equipped with a similar search mechanism (classification of IOTA Industry Marketplace (RAMI-based) may be used as an example of industrial IoT solutions and GetApp marketplace may be used as an example for solutions like CRM, ERP, BI).
7.3. Consider dynamic linking of the national marketplace with GetApp and possible national marketplaces for Industry 4.0 of other countries.
7.4. Consider introduction of a voluntary certification of these solutions, including the issues of IT security and data protection. Check the experience of Trusted Cloud certification scheme in Germany for possible organisational mechanism.
8. Mapping the outcomes of digital transformation
8.1. Perform the mapping of successful cases of digital transformation of enterprises in traditional industries by describing the positive stories at the website of organisational and technological platform 'Smart Industry of Belarus'. A publication of at least short profile should be obligatory for those SMEs that received the state support in introduction of digital technologies.
8.2. Elaborate the online calculator of potential effects and propose it at the website of organisational and technological platform 'Smart Industry of Belarus' or competence centres 'Smart SMEs', to tease the SMEs that think about digitising.
8.3. Map and publish the number of consultations rendered by competence centres.

Source: Developed by EU4Digital Facility



6 Sector of small and medium enterprises in Belarus

For the purpose of better understanding of the size and specific needs of the target sector for support in digital transformation, this section makes an overview of the available statistics of small and medium enterprises in Belarus. It should be noted that the available statistics is scarce and does not allow for analysis on the lower level of aggregation. Also, the collection and analysis of microdata about the current level of enterprises digitalisation in correlation to their specialisation is needed for the specification of support package up to the level of solutions/vendors, which was beyond the scope of current study due to resource' and time limitations.

The number of small and medium enterprises in Belarus amounted to 111,214 at the end of 2018. Of these, there were 108,977 small and micro-organisations (increased from 28,310 in 2000), totally employing 790,400 employees; and 2,237 medium-sized enterprises, totally employing 367,700 people.

575 of medium-sized enterprises (25%) and 1,037 (1%) small and micro-enterprises are in state ownership ([Belstat, 2020](#)). The contribution of small and medium enterprises to the main economic indicators is shown below.

Table 2. The proportion of SMEs in the main economic indicators of the development of the Republic of Belarus in 2018

Main economic indicators	Share of the contribution from small and micro organisations, %	Share of the contribution of medium-sized organisations, %
Gross domestic product	14,7	6,9
Total number of employees	19,8	9,2
The volume of industrial production, including the cost of tolling (not paid by the manufacturer) of raw materials	10,4	8,0
Investments in fixed assets	23,9	11,6
Revenue from sales of products, goods, works, services	33,2	9,0
The volume of foreign trade in goods	39,5	7,8
Export of goods	43,8	6,8
Import of goods	35,7	8,7

Source: [Belstat, 2020](#)

14% of small and microenterprises work in industry¹; 97% of the industrial production of small and micro-enterprises is concentrated in the manufacturing industry, and is concentrated within this industry in the areas of production of rubber and plastic products, other non-metallic mineral products (14%); metallurgical production; manufacture of finished metal products, except machinery and equipment (14%); production of food, beverages and tobacco products (13%); manufacture of wood and paper products; printing activities and duplication of recorded media (13%).

Among medium-sized enterprises, 38% work in industry; 97% of the industrial production of medium-sized enterprises, similar to small ones, is concentrated in the manufacturing industry, and is concentrated in the field of food, beverage and tobacco products (30%), production of rubber and plastic products, other non-metallic mineral products (15%); manufacture of wood and paper products; printing activities and duplication of recorded media (11%).

In general, 86% of industrial production is produced in the manufacturing sector in Belarus; the share of manufacturing in GDP is 21,3%. The share of the Eastern partner countries in the global value added of the manufacturing industry is, respectively: in Azerbaijan – 0,02%; Armenia – 0,01%; Belarus – 0,08%; Republic of Moldova – 0,01%; Ukraine – 0,09% ([Belstat, 2020](#)).

Among medium-sized enterprises, technological innovations in the manufacturing sector were carried out in 2018 by 73 organisations (3,3%); among them 18% – in the sphere of production of machinery and equipment not included in other groups. The largest share of shipped innovative products (works, services) in the total

¹ According to National Classification of the Republic of Belarus 005-2006 'Types of Economic Activities' (OKED), equivalent to the NACE, Rev.2 at the 4-digit level and to ISIC Rev.4 - at the 2-digit level, industry is one of types of economic activities, includes the following branches of industry: mining and quarrying; manufacturing; electricity, gas, steam, hot water and conditioning supply; water supply; waste management and remediation activities (<https://www.belstat.gov.by/en/ofitsialnaya-statistika/real-sector-of-the-economy/promyshlennost/>).



volume of shipped products (works, services), as a percentage of the total, was observed in the production of basic pharmaceutical products and pharmaceuticals (12,7%) and in the manufacture of electrical equipment (11,1%). Among small enterprises, only 48 carried out technological innovations (0,04%), 11 of them in the production of computer, electronic and optical equipment, and 6 in the production of machinery and equipment, not included in other groups.

The level of innovative activity in some sectors, such as innovative instrument-making and pharmaceuticals, exceeds the innovativeness of other sectors, which may be the rationale for shaping a support policy for digitalisation of SMEs, relying on them as pilot support sectors and as positive examples of digital transformation opportunities for other sectors.

The depreciation of fixed assets in the manufacturing industry is 40%, and the index of capital-labour ratio changes is only 103% compared to the previous year (+3%), which reflects a sharp shortage of enterprises' funds for modernisation in accordance with the pace of technological progress. The main sources of investment in fixed assets among small and micro enterprises are equal shares of own funds, budget funds and loans of banks; 58% of them are spent on construction and installation works. Among medium-sized enterprises, the own funds of organisations are the dominant source of investments, while budgetary funds account for one third, and bank loans – one fourth of the amount invested by enterprises independently. Thus, in all sectors there is a need for updating fixed assets and introducing modern technologies that increase labour productivity. More than 1 million people are employed in the SME sector in Belarus, i.e. 23,6% of those employed in the economy may be affected by an increase in labour productivity due to the digitalisation of SMEs. In general, this means the importance of shaping a targeted policy of supporting SMEs in Belarus in their modernisation.

The main conclusions from this analysis are as follows:

- For SMEs in all sectors in Belarus, there is a high need for updating fixed assets and introducing modern technologies that increase labour productivity.
- There is a big shortage of own enterprises' funds for modernisation in accordance with the pace of technological progress.
- More than 1 million people are employed in the SME sector in Belarus, which means that 23,6% of those employed in the economy may be affected by an increase in labour productivity due to the digitalisation of SMEs.
- 97% of the industrial production of medium-sized, small and micro-enterprises is concentrated in the manufacturing industry, which causes the need of special focus of the policy in Belarus on the needs of this sector.
- The level of innovative activity in some sectors, such as innovative instrument-making and pharmaceuticals, exceeds the innovativeness of other sectors, which may be the rationale for shaping a support policy for digitalisation of SMEs, relying on them as pilot support sectors and as positive examples of digital transformation opportunities for other sectors.



7 Policy and organisational setup for digital transformation in the country

7.1 A set of conceptual and implementation documents adopted at the national/regional level on the digitising of enterprises in traditional industries

Status

This section investigates the contents of the existing and drafted policy documents in Belarus as for addressing the needs of digitising SMEs.

The section starts from reviewing the most practically oriented *programmes* with concrete KPIs and budgets, next it reviews relevant *strategies* with the sequential action plan, and finally it checks the existing policy documents of the most conceptual level (*concepts*) that summarise the challenges and outline the critical elements of their resolution.

❖ Programmes

The [State programme for Information Society and Digital Economy Development for 2016-2020](#) consists of three sub-programmes containing system-forming activities of a national scale in the field of ICT:

- information and communication infrastructure;
- informatisation infrastructure;
- digital transformation.

Digital transformation is the biggest part of the strategy (contains 52 of total 71 activities of the Programme). However, all these sub-activities aim at the informatisation of public sector and state-owned corporations. Few activities implemented under this Programme can be effectively used by SMEs – such as simplifying administrative procedures and creating digital access to billing and identification services.

In 2020, the [State Programme for Innovation Development for 2016-2020](#) is in force. Within the framework of solving the task 1 'Formation and accelerated development of high-tech sectors of the national economy, based on the production of fifth and sixth technological structures, consolidating the position of the country in the markets of high-tech products', the Programme envisages to concentrate efforts on the *number of technologies backing up the industry digitalisation*, including development of network technologies and radio frequency identification technologies in accordance with the 'Internet of Things' concept; development of services based on cloud computing technologies; development and implementation of digital modelling and design technologies, additive technologies, etc.

The [State Programme of Development of the Machine building Complex of the Republic of Belarus for 2017-2020](#) sets as its purpose to develop, increase the efficiency and competitiveness of the machine-building complex of the Republic of Belarus. Though this programme envisages some measures on increasing the technological level and even create the innovative infrastructure, these are pointing at specific subindustries and as a total are *not oriented at digital transformation of Belarusian machine building sector as an industry*.

A number of [State Scientific and Technical Programmes](#) (SSTP) are established for implementation of the Strategy of innovation development. This instrument of the scientific and technological policy allows for an *open contest of scientific-technical project tasks* to achieve the Programme goals, where also SMEs can apply. One of programmes is SSTP 'Robotic Complexes and Aerospace Technologies' (2016-2020).

The *State Informatisation Programme for 2021-2025* with high probability will include the issues of digitising industry. United Institute of Informatics Problems of the National Academy of Sciences of Belarus [proposed](#) the main directions of scientific and methodological support for digital transformation in the Republic of Belarus. If this programme will only focus on large-scale technological solutions and infrastructure, then a separate SMEs-oriented state programme of digitising industry would be required to include the measures of economic nature.

The draft *State Programme of Innovative Development of Belarus for 2021-2025* [is planned to be submitted](#) to the Council of Ministers in the fourth quarter of 2020. The [Decision of the Council of Ministers of 29 January 2020 №53](#) is planning that by the fourth quarter of 2020 the Ministry of Economy will have developed a set of measures providing for the digital transformation of specific types of economic activity to be included in the state programmes for 2021-2025. The State Committee for Standardisation is expected to develop draft technical regulatory legal acts for state standards aimed at ensuring the implementation of the concept of digital transformation of the industrial sector.



Thus, none of the existing practically oriented *programmes* set concrete KPIs and budgets related to support of SMEs in digital transformation.

❖ Strategies

The [Strategy for the Development of Informatisation in the Republic of Belarus for 2016 – 2022](#) (of 3 November 2015 № 26) announced a series of activities, including, among the others, modernisation of traditional industries based on the implementation of world quality standards, digital marketing and production technologies. However, this strategy prioritises (places at the forefront) the transparency of public administration systems, the public sector and infrastructure rather than digitising SME's. Implementing ICT in the real sector² of economy is just one of nine areas included in the Strategy. Its main tasks are set as:

- “increasing the efficiency of production management through the large-scale introduction of automated planning and management systems for the full cycle of production;
- introduction of modern digital marketing methods based on the use of social networks and modern technologies;
- increasing the share of the ICT component in the finished product by creating incentives for business to participate in solving the problems of modernisation of traditional sectors of the Belarusian industry;
- consolidation of the potential of the resident organisations of the High-Tech Park, the country's business associations to create engineering companies based on them that can provide all sectors of the national economy with ICT services;
- creating a system of outsourcing services for optimising business processes on the basis of modern enterprise resource management systems and product life cycles for Belarusian enterprises.”

Additionally, some relevant tasks are set in the area of development of digital business infrastructure, online market, banking services, e.g.:

- assisting small and medium-sized businesses in the use of ICTs and the Internet for manufacturing activities and electronic commerce;
- widespread adoption of the Internet of Things technology in production, transport and logistics, and housing and communal processes.”

Unfortunately, the systemic realisation of these activities is pending because they have not been included in the [State programme for Information Society and Digital Economy Development for 2016-2020](#), and thus *have not received any common implementation framework and budgets*.

In 2020 the new National Strategy of Sustainable Development – 2035 is to be approved. First drafts of Strategy are now discussed; in the draft document presented to the public the biggest part of the strategy refers to digitalisation of national economy, including traditional sector and SMEs. Attention in the [draft document](#) is paid to the “formation of digital platforms for the interaction of industrial organisations, the creation of smart factories, the digitalisation of traditional activities, the development of consulting in the field of digital transformation”.

To conclude, though the existing *strategies* outline the building blocks of the digitising industry policy, they until now did not result into a specific implementation framework dedicated to digitising SMEs and supported as a systemic initiative by the state funds.

❖ Concepts

On the conceptual level, the understanding of the activities needed for digitising industry is elaborated and fixed in the '[Concept of creating conditions for digital transformation of industrial cooperation in Eurasian Economic Union and digital transformation of industry of the Members](#)' (Concept) approved on 7 December 2018. This document is primarily aimed at digitalising industrial cooperation in the EAEU, but also is promoting digitalisation of industries, manufacturing, management and supporting processes, supporting the use of digital platforms. Member countries are recommended to implement this Concept with account of their priorities and resources.

Further steps to bring this concept to realisation are made by the Ministry of Economy through practically oriented projects; work is done to embed into the state programmes for 2021-2025 the elements of the Concept that suit the logical frames of these programmes; however, no dedicated strategy, action plan, or programme have been elaborated so far to cover the needs of digitising SMEs specifically in Belarus.

² Real sector is the term originating from the Soviet tradition, applied to all industries that produce material products, contrary to the industries creating non-material products, like education, medicine, tourism, services, etc.



The [Concept for digital transformation of system of education processes](#) on 2019-2025 approved by the Minister of Education on 15 March 2019 does not directly focus on SMEs and digitising industry, but should be mentioned as the one underpinning the training needs of SMEs related to digital transformation.

Gaps

The gaps can be summarised as follows:

- There is no dedicated digital agenda developed for Belarus, reflecting the challenges of digital transformation for SMEs, as well no dedicated strategy and action plan of its implementation yet.
- While separate elements related to digitising enterprises are presented in different strategies and programmes, these elements are not covering the full spectrum of activities needed to support digitising and are technocratic rather than economic.
- At the moment, there is no single vertical set of documents (concept-strategy-programme), that are focused on digitising industry or SMEs in Belarus.

Recommendations

❖ What?

1. Develop a separate 'Strategy of digitising SMEs' in Belarus, taking into account the Concept developed for EAEU and similar EU documents (Germany, France, Netherlands, UK, Italy – Smart Industry and l'industrie du future, reflecting its challenges and specific economic, resource, ownership structure, political goals, assets, strategic competitive advantages and limitations.
2. Develop an action plan for digital agenda implementation including the following principles:
 - a. priorities to include both infrastructure and technology as well as development of skills;
 - b. technologies to be taken into account including IoT, Big Data and data analytics, robotics and automated machinery (incl. autonomous vehicles), AR/VR, blockchain, advanced materials, 3D printing (additive manufacturing), cloud technologies, mobile services, cybersecurity, Artificial Intelligence (AI);
 - c. design and implementation including stakeholders from industry and research, allowing a bottom-up approach to designing, initiating and implementing the initiatives;
 - d. involve stakeholders to in-depth consultations to define policy priorities in line with the needs of domestic industries;
 - e. ensure the involvement of business and civil society representatives in the process of digital transformation initiatives development and implementation;
 - f. organise working groups on specific technologies or cross-cutting issues;
 - g. envisage support programmes, e.g. by involving companies to re-educate or requalify employees (upskilling);
 - h. foresee the diverse funding options for industry digitisation initiatives:
 - i. to be financed through public means in case of country-wide solutions and market failures;
 - ii. be supported by equal share state and sectoral funding of digital transformation processes at the sectoral level, in various forms;
 - iii. provide political and administrative support for initiatives funded by private and international funds within the digital agenda;
 - iv. envisage tax incentives;
 - v. envisage funding of both supporting the development of new technologies (R&D dimension) and supporting the deployment and use of existing technologies in industry (deployment dimension) (more focus on deployment at this stage is recommended for Belarus).
3. plan and facilitate the development of a wider list of targeted national strategies empowering digital transformation (including the list of issues important for further elaboration) (based on German experience);
4. develop, in close cooperation with industry experts and decision-makers in government bodies, and in extensive consultations with representatives of SMEs of target industries, **a specific** (organisational and co-ordinational) **mechanism for digital transformation** of the productive sector of the economy



in Belarus, including a detailed account of the structure of industries that are affected (ownership structure, the specifics of the technological regime in it, the current technological level of the industry itself and its suppliers/consumers, the degree of integration into the global market and other factors).

❖ Why?

Strategic and systemic vision is needed to build the toolbox of industrial and innovation policy in a pragmatic way – not only endorsing the digital opportunities, but also seeing the country-specific restrictions, goals, peculiarities of implementation mechanism.

❖ Relevant EU practices (non-exhaustive list):

Annex 3. National Platforms for Industry 4.0 in the EU countries – List of national strategies on Industry 4.0 in the EU countries.

❖ Potential stakeholder(s) in Belarus:

- Ministry of Economy;
- Ministry of Communications and Informatisation;
- Ministry of Industry.

7.2 Policy body(ies) for digital transformation in the country

Status

This section investigates, whether there is a determined body or well-balanced set of policy bodies for governance of digital transformation processes in the country, and whether their resources are sufficient to implement the set of measures in support of digitising SMEs in Belarus.

Policy body with functions to support the digital transformation of SMEs

Currently *the responsibility for the specific domain of digitising industry is not attributed to any specific policy body.*

As of May 2020, the Government has been working on the task of *establishment of the state regulator in the field of digital transformation of the economy* of Belarus under the Ministry of Communications and Informatisation. However, a list of functions of a potential new regulator has not been established and a legal decision has not been made.

As of now, the tasks [Ministry of Communication and Informatisation](#) (MCI) most relevant to digitising industry **include** “state regulation, management of activities, the implementation of a unified state policy in the field of communications and informatisation, and the creation of conditions for the development of organisations of all forms of ownership operating in this area; organisation of the development and implementation of communication and information development programmes”. Thus, its activities related to digital transformation mainly focus on digitalisation of public sector, e-government and communication infrastructure.

Resources of the policy body to support the digital transformation of SMEs

Staff. In the structure of MCI, activity of two departments is related to digitising industry – department of strategic projects and department of coordination of industry informatisation projects, mainly covering state-owned enterprises.

Under MCI, there is the R&D institution Scientific and Engineering Republican Unitary Enterprise ‘[Institute of Applied Software Systems](#)’ which carries out functions of a competence centre for informatisation for MCI (e.g. the digital maturity indexes for the companies, sectors and country as a whole have been developed by the Institute in 2019).

Though on 5 February 2020 Vice Prime Minister [mentioned](#) that the Ministry of Communications and Informatisation is the only Ministry that has performed all the indicators in 2019, in general it feels the lack of specialists under pressure of fast growing labour market in digital sphere and no possibility to provide competitive salaries to IT specialists, as well as lack of tools.

Funds. There is a special Republican Fund for Communications and Informatisation that is managed by the Ministry of Communications and Informatisation. According to the [Decree of the President of the Republic of Belarus](#) dated 16 January 2020 No. 13, in 2020 the republican fund for universal communications and informatisation services is formed in the amount of 45,000,000 roubles (ca. \$22 million). Its covered areas are:

- capital investments related to the provision and development of universal public telecommunication services and directed to new construction, reconstruction, expansion and technical re-equipment of



telecommunication facilities (including the development of project documentation), as well as for the purchase of equipment not included in the construction estimates” (7,500,000 roubles);

- state informatisation programmes (their subprogrammes), including scientific research, experimental design and experimental technological work, capital investments allocated for the construction, including reconstruction, of technical equipment used to generate, process and store information (including the development of project documentation, purchase of software and special equipment” (37,500,000 roubles).

This fund is managed by MCI and government agencies that are the customers of state-owned informatisation programmes (their subprogrammes). The recipients of the funds can include telecommunication operators that are granted the right to provide universal services; as well as the organisations that act as customers of state-owned informatisation programmes (subprogrammes), are responsible for completing tasks and implementing activities of these programmes (subprogrammes), and (or) their subordinate organisations performing the activities of the programmes.

Thus, this fund can only be considered as a *potential source of infrastructure development for digital factories, provided they are included in government informatisation programmes, but not for financial support of digitalisation directly for SMEs*. At the same time, its size, given the large number of main areas of use, is not enough to form the infrastructure of demonstration factories at the quality level similar to the EU.

Beyond this fund, there are no funds foreseen in Belarus and in particular at MCI specifically for supporting digitising industry with focus on digital transformation of SMEs in traditional sectors.

Other policy bodies for collaboration on digital transformation processes in the country

The policy of digitising industry also might be implemented via the model of collaboration of multiple policy bodies that contribute expertise and efforts within their domains. This would need the understanding by each ministry of its relevant contribution, and coordination of efforts among the ministries.

The government agencies beyond MCI, whose activities are directly related to the digitalisation of industry include the Ministry of Economy, the Ministry of Industry, the State Committee for Science and Technology, the Ministry of Education, the Ministry of Labour and Social Protection. Some of their functional areas are intersecting with the digitising industry policy challenges:

- The tasks of the **State Committee on Science and Technologies (SCST)** [include](#) “the implementation of state policy in the field of scientific, technical and innovative activities, as well as the protection of intellectual property rights; organisational and economic regulation of issues of development of scientific, technical and innovative activity and protection of rights to intellectual property; the development of innovative infrastructure, the creation of mechanisms to support the subjects of innovation, ensuring the creation and development of industries based on new and high technologies”.
- The scope of the tasks of the **Ministry of Economy** [includes](#) “state regulation of entrepreneurial activity of small and medium-sized enterprises”; “state cluster policy and the creation of conditions for increasing the competitiveness of the national economy through the introduction of a cluster development model”. The Ministry of Economy also “participates in the development of mechanisms to increase the effectiveness of innovation and state support for science, implements the state policy to support the development of entrepreneurship, implements the state cluster policy”.
- The tasks of the **Ministry of Industry** [include](#) “pursuing scientific, technical, economic and social policies aimed at creating conditions for the effective work of state organisations subordinate to the Ministry of Industry (hereinafter referred to as state organisations) in order to meet the needs of the national economy and the population of the republic for industrial and technical products, consumer goods and services”.
- The tasks of the **Ministry of Education** [include](#) “ensuring the functioning of the education system of the Republic of Belarus, the creation of a continuing education system.
- The tasks of **Ministry of Labour and Social Protection of the Population** include “developing proposals and implementing the main directions and priorities of state policy on the promotion of employment”.

This overview justifies that the *existing distribution of tasks between these regulators necessitates interaction and coordination of their efforts in the digital transformation strategy development and implementation*.

MCI is responsible for [coordination](#) of the other ministries’ activities in digital development of the sectors of economy. It collects all applications from different bodies to include them in the funded state informatisation programmes. All respondents mentioned that this procedure is efficient – all initiatives and suggestions of



implementation from other bodies are collected and discussed in transparent workgroup on Council of Ministers level. However, the process can be prolonged – up to half a year, which may delay some solutions.

The obstacles for the comprehensive involvement of multiple ministries in the joint work on the digital transformation strategy development and implementation are that:

- all the ministries have insufficient human and financial resources to contribute deeply and specifically to digitising industry policy development and implementation;
- industry-specific state bodies do not always have a clear understanding of the organisation of the digital transformation of SMEs and, hence, of their potential contribution.

At the same time, the decision-makers at many ministries are increasingly interested in the issues of digitalisation and express their interest via mentioning these issues in separate documents and strategies.

Gaps

The gaps can be summarised as follows:

- Central policy making body for digitising industry with specific focus on digital transformation of SMEs in traditional sectors is not determined by the government.
- No funds are foreseen specifically for supporting digitising industry with focus on digital transformation of SMEs in traditional sectors. This leads to a shortage of financial and organisational assets for digital transformation of SMEs in Belarus.
- There is a need for all relevant ministries to enhance their human and financial resources to be able to contribute deeply and specifically to digitising industry policy development and implementation.

Recommendations

❖ What?

1. Determine a central policy making body for digital transformation with a focus on digital innovations for transformation of SMEs in traditional sectors (suggested body – Ministry of Economy). This recommendation takes into account that the Government is currently working on the task of creating a state regulator in the field of digital transformation of the Belarusian economy on the basis of the Ministry of Communications and Informatisation, as well as a separate organisation under its framework that is responsible for interaction with state bodies in the implementation of digital transformation projects (creation of state information systems and resources). Nevertheless, the Ministry of Economy is considered to be the relevant central authority for the development of policies for digital transformation with a focus on digital innovation for transforming SMEs, due to the following arguments:
 - a. Digital transformation of SMEs is significantly different in nature from the creation of state information systems and resources – it involves the development of existing solutions and products (technological innovations), the introduction on this basis of more competitive innovative products, as well as organisational innovations within themselves and in relations with other economic entities.
 - b. The system of incentives and tools to ensure this innovative process of SMEs is also significantly different from the creation of a nationwide informatisation infrastructure, and an economic policy equipped with such tools for SMEs is fully within the competence of the Ministry of Economy.
 - c. Direct support for the digitalisation of SMEs from the state budget may consist of tax incentives and funds from existing innovative funds, while soft loans and infrastructure can be largely provided from international donors.
2. Ensure that this body is well staffed with experts on digital transformation plus establishes balanced complementary mechanisms for elaboration and implementation of policy toolkit for digital transformation.
3. Ensure that this body has enough budget to implement the programme on digital transformation.
4. Ensure that this body collaborates with the other policy bodies that can contribute to policy development and implementation.
5. Ensure that other policy bodies have a clear understanding of their contribution domain and have human and financial resources to do so.
6. Consider establishing of/delegation to a separate legal entity to coordinate the implementation of the initiatives in support of a central policy body.



❖ Why?

While digital transformation concerns all industries and aspects of state regulation and governance, and hence all governance structures need to resolve the relevant issues in their competence area, determination of central policy body is needed to ensure the understanding by all the country stakeholders of the main gateway that accepts suggestions and coordinates the implementation of initiatives. For business, the distributed and unfocused nature of governance hinders the initiatives as they 'don't understand with whom to talk'.

❖ Relevant EU counterpart (non-exhaustive list):

Annex 3. National Platforms for Industry 4.0 in the EU countries – List of national strategies on Industry 4.0 in the EU countries.

❖ Potential stakeholder(s) in Belarus:

- Ministry of Economy;
- Ministry of Communications and Informatisation;
- Ministry of Industry.

7.3 A platform and well-established organisational mechanisms and practices for discussions and joint work on digital transformation of industries of diverse stakeholders

Status

In 2019 Ministry of Economy (MoE) presented its strategic view on [‘The role and strategy of the state in the development of digital transformation of the national economy of Belarus’](#), which publicly announced the initiative of the MoE on establishment of the **organisational and technological platform (OTP) ‘Smart industry of Belarus’**, and welcomed to join the state bodies, high technology business associations, enterprises, academia in order to establish the necessary legislative base, standards, organisational mechanisms for Industry 4.0 development in Belarus. By order of the Minister of Economics dated 04.04.2020 No. 39, an organising committee was established to form the OTP ‘Smart Industry of Belarus’.

At present, the organising committee of OTP ‘Smart Industry of Belarus’ faces the task of forming a membership base for the Platform in the amount of 80-100 participants.

As for existing institutional rules and practices for discussions and joint work on digital transformation of industries of diverse stakeholders, there is a procedure of public consultations for *new acts, concepts, action plans* fixed in the legislation in Belarus.

According to the Law [17 July 2018 №130-3](#) the draft normative legal act draft can be submitted for public (public or professional) discussion in the Internet on the website of the Legal Forum of Belarus, as well as through parliamentary hearings, in media or other ways that are not contrary to law.

In practice, the procedure of public consultations for new acts, concepts, action plans is used by regulators most often in a passive way (website publication). Some regulators use this procedure in a proactive way (approaching the knowledgeable organisations, including private business associations).

On expert view, though the procedure of discussion of Laws and Decrees is established in legislation, widespread practice is still developing. There is no sustainable algorithm of discussions for policy documents – some of them are widely discussed, others are debated at special Councils that are not open for the public. The practice of public consultations strongly depends on different types of documents, positions of heads of the bodies, etc.

Though the institutional background for discussions of strategic directions of development and joint work of diverse stakeholders is available, the practice of application of public consultations mechanism is used to an insufficient extent. Often the existing cross-departmental working groups operate in the rather formalised way and do not provide a lot of place for presenting and discussion of confronting views. There is no possibility for experts of self-nomination into specialised working groups.

The main institutional stakeholders from non-governmental side, that can be involved into discussions and joint work on digital transformation of industries, are listed in Table 3.



Table 3. Institutional stakeholders and communities for joint work on digital transformation of industries

Operating organisation	Scope of participants	Functionality	Clarification
The council for digital development of the economy by the Prime minister, established in 2019.	Representatives of policy bodies.	To determine the goals and objectives of the digital transformation of the national economy and to set priorities for the introduction of digital technologies for manufacturing industries, trade and services considering the latest achievements in the field of information, communication technologies and the development of a global digital space. The Council will also stimulate the transition to advanced digital technologies in various fields of economy and public relations. Its competencies include the creation and development of modern digital infrastructure and the creation of digital platforms for various purposes.	Council has not been active at public for the last 1,5 years. On 05.02.2020 Curator of profile Ministry of Communications and Informatisation prioritised reinstatement of the Council.
Association 'Robotechnics and Artificial Intelligence'	Legal entities and commercial organisations in the area of robotics and AI	The association was established in the fall of 2017 and registered in the Sino-Belarusian Great Stone Industrial Park to promote widespread key digital technologies adoption in the industrial sector.	The association initiated and supports a number of country-wide activities for digital transformation, like Smart Industry forum, monitoring of digital maturity of enterprises, Robotics training for children, etc.
Confederation of Digital Business , including Belinfocom Infopark Association GS1Bel	Legal entities, commercial organisations and individual entrepreneurs engaged in entrepreneurial activities in the field of information and communication technologies.	Digital transformation of business, economy, public relations; promoting the development of digital business entities; formation of infrastructure and services that support the functioning of the digital business; creating an optimal regulatory environment conducive to the development and effective conduct of digital businesses.	The confederation includes the oldest associations working on the development of digital business in Belarus.
Belarusian Association of Management Consultants	Individual management consultants and consulting force of relevant companies.	Focuses on developing and maintaining standards in management consulting and digital transformation as part of them.	In 2019 committee for digital transformation assistance was established.
Association of Innovation Manufacturers	Manufacturers of innovative high-tech products in the Republic of Belarus.	Developing the instrument-making industry in cooperation with the State Committee for Science and Technology, the Ministry of Economics and the High-Tech Park; holding public events for this purpose.	Association stimulates sharing of experience and cases on successful automation and transformation.
IoT Minsk Community	Developers and Engineers.	Sharing competence in the sphere of Internet of Things, implementing it in industries, developing software and hardware collaboration for business and social applications.	Community is an example of new forms of free networks/hubs working without special registration, etc.

Source: Developed by EU4Digital Facility



Gaps

The gaps can be summarised as follows:

- There is no website representing the currently being established organisational and technological platform 'Smart industry of Belarus'.
- The organisational mechanism of the operation of the organisational and technological platform 'Smart industry of Belarus' platform is still unclear.
- Though the institutional background for discussions of strategic directions of development and joint work of diverse stakeholders is available, the mechanisms of public consultations and working groups involving private stakeholders are used to an insufficient extent.

Recommendations

❖ What?

1. Establish a national organisational and technological platform 'Smart industry of Belarus' as an organisational mechanism for coordination of efforts of diverse stakeholders, equipped with economic and technological instruments, facilitating the digital transformation of industries.
2. Consider establishment of a separate legal entity to maintain the online platform or delegating the mandate of the platform operator to an existing legal entity that can fulfil the selected functions including but not limited to:
 - a. to assist the national actors, especially SMEs, in understanding of the I4.0 paradigm;
 - b. to increase awareness and assist SMEs in selection of relevant digitisation technologies, including necessary security and data protection issues;
 - c. to facilitate the development of the digital competencies of various types of stakeholders touched by digital transformation of industries;
 - d. to facilitate discussion and coordination of issues related to digital transformation of industries, including issues of standardisation, licensing and certification requirements, infrastructure for industrial IoT, traceability, EDI, interaction with logistical operators, etc.;
 - e. to collect and consolidate the opinions of experts on significant issues, inform and advise the government in decision making related to digital transformation of SMEs;
 - f. to facilitate the establishment of pilot laboratories, networks and consortia for pilot projects;
 - g. to monitor, adapt and implement the best world practices in the area of digitalising industry;
 - h. to assist the public authorities in defining the conditions and rules of public support of R&D, innovation projects and SMEs in the area of digital transformation (recommend the methodology for assessing the 4.0 maturity of industrial companies that would qualify them when applying for state grants, loans, tax incentives, etc.);
 - i. to contribute to the adaptation of education and VET system to the new needs of the industry;
 - j. to provide other services in their expertise areas.
3. Study the toolbox of existing Industry 4.0 initiatives and platforms in Europe and in the world; select the tools relevant for Belarus and negotiate with platform owners about their transfer.
4. Consider diverse mechanisms of consolidation of wider experts from various sectors of economy and composing the working groups:
 - a. delegation by organisations;
 - b. self-nomination (open call).
5. Involve business experts in the development of the regulatory framework for innovative digital technologies, as they have the most practical understanding of the possible risks and consequences, for the purpose to maintain the legal framework in line with technological development.
6. Use the organisational and technological platform 'Smart industry of Belarus' for discussions of strategic directions of development and joint work of diverse stakeholders, public consultations with expert communities and business associations (assessment of impact of potential policies), taking into account the best practices from the EU countries:
 - a. Industry and research stakeholders play an important role in the design and implementation of industry digitalisation initiatives.



- b. More than 70% of the national policies of Industry 4.0 take a bottom-up approach to developing, initiating and implementing initiatives. The methods and tools used in stakeholder engagement initiatives included in-depth consultations to determine policy priorities in accordance with the needs of domestic industry.
 - c. The extent of public intervention in the initiative platform varies. While the government is the engine in some initiatives, industry and academia tend to play an important role in other, often making up the majority of members in governance structures, such as steering committees. For example, out of eight members of the Board of Directors of the Danish Academy of Production (MADE), five are industry representatives and three are academics.
 - d. A separate legal entity has been created in Austria and Denmark to coordinate the implementation of initiatives. This allowed the creation of a special group working full time and a large degree of neutrality on the part of political parties. So, in Austria Industrie 4.0 Oesterreich is created as an association that includes universities, digital business, telecom operators, etc. The founding members of the platform are the Bundesministerium of Communications, Innovation and Technology (BMVIT); Bundesarbeitskammer (LHC); Association of Electrical and Electronics Industry (FEEI); Association of Engineering, Metalworking and Foundry Industry (FMFI); Association of Industrialists (IV); Production Association (PRO-GE).
 - e. In Portugal, the development of the Indústria 4.0 initiative and strategy was based on the full participation of industry, science and education stakeholders to determine the needs and potential of domestic industry. Meanwhile, the management of the platform and monitoring of its 62 public and private measures is led by the private association COTEC. In addition, a strategic committee composed of multinational companies and relevant stakeholders directs and advises the government council on the development of the content of the strategy.
 - f. The German initiative Industrie 4.0 was originally developed and implemented by the German government in collaboration with industry. Policy development was led by the German Ministry of Education and Science and the German Ministry of Economy through strategy and financing, and practical implementation was carried out by industry players who recently took full control of the platform. The platform is headed by ministers, as well as industry, scientific and trade union directors. Platform Industrie 4.0 consists of academics, businesses, policy makers, chambers of commerce and business representatives. While the industry governing council is responsible for developing the strategy, the Scientific Advisory Committee advises on scientific and programme issues.
7. Perform structured consultations based on detailed empirical data, when developing the organisational and coordination mechanism for the digital transformation of industry in Belarus. This is needed, since the practice of organising initiatives may vary among the EU countries, in order to facilitate a better study of the EU best practices in terms of the organisational mechanism for consolidating state and business efforts.

❖ Why?

SMEs that make the supply chain of market leader international manufacturing companies, play a fundamental role in strengthening the competitiveness of the country. Ensuring their digitising is in line with international standards and practices, increase of competences of related stakeholders, coordination of multiple stakeholders in the systemic challenge of digitising industry needs to be undertaken by an actor that is efficient in identification of experts, drivers of change, their consolidation and coordination.

❖ Relevant EU practices (non-exhaustive list):

- Annex 3. National Platforms for Industry 4.0 in the EU countries – List of national platforms for Industry 4.0 from the EU countries.
- Austrian Platform [Industrie 4.0 Österreich](#) (PI4.0) provides ample opportunities for research in strategic areas related to I4.0. Thematically, the platform is currently organised into working groups that bring together members of the association and experts of the highest level, for example, from ministries, funding agencies, standardisation organisations, etc.). In addition to research on relevant and relevant topics of I4.0, the platform's activities include experimental activities for members, as well as the dissemination of case studies and best practices. This platform supports a number of working groups on the following topics:
 - security and protection;
 - new business models;



- smart logistics;
 - pilot factory;
 - norms and standards;
 - R&D and innovation;
 - man in a digital factory;
 - qualifications and competencies;
 - regional strategies.
- The Belgian [Made Different](#) initiative specialises in implementing technology solutions in local companies. It supports and guides the business during its transformation into Factories of the Future (FoF). The detailed concept identifies seven key areas covering technological, manufacturing, environmental and human aspects. All of these areas are interconnected, and companies must adopt a comprehensive transformation strategy in order to successfully qualify as FoF. About 265 Belgian manufacturing companies are actively involved and have implemented or started to implement one of the seven key transformations.
 - The [Danish Production Academy](#) (MADE) specialises in both research and deployment. In addition to its diverse industrial research activities, MADE provides access to the latest knowledge and practical experience for manufacturing companies that are not directly involved in research projects, for example, through innovative conferences, seminars, research laboratories and company visits. Visits to the Open Lab allow companies and research scientists to gain insight into modern technology in a particular field. Typically, an open lab includes short presentations, case studies, and technology demonstrations.
 - A [Working group](#) on Digital Innovation Hubs within the Digitising European Industry initiative. Working Groups are key instruments to rapidly find information, collect best practices and formulate recommendations to the next high-level governance meeting.
 - ICT Innovation for Manufacturing SMEs ([I4MS](#)) – the EU initiative to digitalise the manufacturing industry. I4MS is a programme promoted by the European Commission to expand the digital innovation of manufacturing SMEs in Europe. An SME or a mid-cap can apply for technological and financial support to experiment with different technologies and services to improve the innovation skills of your staff and the technologies and services your company provides.
 - Smart Anything Everywhere ([SAE](#)) – the initiative of the European Commission that offers funding and support especially SME's to upgrade their products and services to the digital age.
- ❖ **Potential stakeholder(s) in Belarus:**
- Ministry of Economy;
 - Ministry of Communications and Informatisation;
 - Ministry of Industry;
 - Republican Association of Industrial Enterprises 'BelAPP';
 - Belarusian Chamber of Commerce and Industry;
 - United Institute of Informatics Problems;
 - Digital Business Confederation;
 - Association of Robotics and AI;
 - Association of Blockchain.

8 Resource base for digital transformation

8.1 Funding for activities needed for digital transformation for state-owned and private SMEs

Status

The available funding related to needs of digital transformation of state-owned and private SMEs in Belarus is listed in Table 4.



Table 4. Funding for different activities in digital transformation of SMEs

Source of funding	Type of funding	Funding programme	Eligible for funding	Size of funds available	Comments/Clarification
European Union	Grants	Business Advisory Services covers from 25 to 90 per cent of the total net cost of a consulting project.	Private SMEs	€10,000 usually per case. Irrevocable.	Decision-making process is up to EBRD staff.
	Loans	Women in Business helps women leaders to access finance through dedicated credit lines provided to local banks.	Women-led SMEs	\$135 million for the region, loans with lower interest rates than in general programme.	Business Advisory Services grants can be used not only for digital transformation.
	Loans	EBRD General Portfolio. Current portfolio – €874 million, 65 active projects.	Private and state businesses of all sizes	Loans from 4 to 10 years. Deferred payment up to two years. Interest rate – from 6.4% in EUR, from 8% in USD.	For Women in Business and EBRD General Portfolio digital transformation is not in focus.
	Loans	European Fund for Southeast Europe (EFSE) .	Private SMEs	€22,161 (average loan).	Support is available to micro (fewer than 10 employees) and small (fewer than 50 employees) enterprises (MSEs), as well as to low-income private households in sectors such as agriculture, industry, trade and services.
State Budget	Grants, Loans, Guarantees	On a return basis: State Council on Science and technology via Belarusian innovation fund provides funding for organisation and development of the production of scientific and technical products resulting from the implementation of innovative projects and assignments of state scientific and technical programmes and venture projects. On an irrevocable basis: Innovation vouchers are provided to enterprises by the Republican Centralized Innovation Fund and local innovation funds, which are state targeted budget funds, through grants and innovative vouchers.	State and private enterprises, developers and inventors, enterprises without subordination (including SMEs).	Innovation vouchers up to \$25,000 at preparatory stage. Grants up to \$100, 000 at design and technological phase.	Primarily focused on R&D projects and innovative investment. Digital transformation could be the part of research project or investment activity, but in fact little of funding is spent on digital purposes. The competitive selection procedure was approved by Decree of the Council of Ministers of the Republic of Belarus on 10 January 2017 No. 14 'Regulation on the procedure for conducting open competitive selection of projects (events) financed from the funds of the republican centralised innovation fund'.



Source of funding	Type of funding	Funding programme	Eligible for funding	Size of funds available	Comments/Clarification
	Loan, Leasing, Reduced interest rates	Bank of Development . The priority objectives of providing financial support to SMEs operating in the manufacturing and services sectors.			This programme is not focused on innovative platforms but aims at SMEs. These funds can be used for driving transformation of small and medium companies only as a part of financing equipment or franchise buying.
State (Belarus, China)	Loan, Direct investments	' Spark ' programme of Innovative Centre 'Great Stone'.			Primarily financing projects for establishing mass manufacturing but digital assets in projects can also be funded.
State (formed from loans of international financial organisations) ³	Loan, Leasing, Reducing interests	Belarusian fund of financial support of entrepreneurs			Primarily financing of tangible assets.

Source: Developed by EU4Digital Facility

Out of them, the funding opportunities that are most relevant to cover SMEs' needs in digital transformation, include:

- flexible grants from European Bank of Reconstruction and Development;
- 'Bank of Development' SMEs programme;
- irrevocable financial assistance.

Flexible grants from European Bank of Reconstruction and Development (EBRD)

Flexible grants are provided from EBRD at the size of 25 to 90 per cent of the total net cost of a consulting project up to a maximum of €10,000. Business Advisory Services Programme assists enterprises to define their business needs and to identify services provided by professional consultants to assist them to improve their performance. With these grants, such advisory services can be supported as:

- feasibility studies;
- partner search: supplier, investor, customer search, procurement management;
- reorganisation/restructuring: organisational development, HR management, sales/distribution system, logistics management;
- computerised financial/management information systems: financial management information system, customer relationship management system (CRM), enterprise resource planning system (ERP);
- computerised manufacturing systems: computer aided design (CAD), computer-aided manufacturing (CAM) packages, modelling, optimisation and simulation;
- engineering studies: architectural planning/design, space optimisation, IT infrastructure design, machinery/equipment selection, installation, training;
- energy efficiency and environment: energy audit, Clean Development Mechanism (CDM), renewable energy, environmental impact assessment, integrated pollution prevention control (IPPC), ISO 14000 implementation.

Thus, *this financial support may cover the sourcing of technological expertise and consultancy, yet it does not include modernisation of fixed assets and introduction of technologies.*

'Bank of Development' SMEs programme

'*Bank of Development*' SMEs programme renders support to SMEs not constantly; its offer changes depending on the priority government goals. At the end of 2016 the Development Bank differentiated the product range in line with priority areas of SMEs development in the Republic of Belarus (support to start-up companies, innovations, exporting enterprises, etc.); together with funding of manufacturing and service areas, financing of trading enterprises also became possible.

³ The Fund accumulates funds received in the form of voluntary donations from legal entities and individuals, loans from international financial organisations, attracted by issuing (issuing) securities, as well as from other sources of financing. The fund's property is owned by the Republic of Belarus.



Practical implementation of the programme is carried out with the participation of commercial partner banks and a leasing company ('Promagroleasing' JSC) that have experience in cooperation with small and medium enterprises. There are 11 partner banks participating in the programme: (['Belgazprombank' JSC](#), ['Belarusky Narodny Bank' JSC](#), ['Belinvestbank' JSC](#), ['Belarusbank' JSC](#), ['MTBank' CJSC](#), ['Alfa-Bank' CJSC](#), ['Priorbank' JSC](#), ['Bank Dabrabyt' JSC](#), ['Belagroprombank' JSC](#), ['Paritetbank' OJSC](#), ['BTA Bank' CJSC](#)) and leasing companies ['Promagroleasing' JSC](#), ['Raiffeisen-Leasing' JLLC](#) and ['ASB-Leasing' LLC](#).

The partner banks and a leasing company select borrowers under the criteria agreed upon with the Development Bank, evaluate their financial condition and proposed projects, as well as decide on granting loans at a specified marginal rate.

Financial support to SMEs operating in the manufacturing and service sectors is provided for the purposes of:

- financing the costs of SMEs for the acquisition (reconstruction, modernisation, construction, overhaul) of fixed assets;
- financing the costs of SMEs for the purchase of intangible assets (franchises) for their production, trading or service activities.

Thus, this financial support *may cover the modernisation of fixed assets and technologies, yet it is not complemented with the technological expertise.*

Irrevocable financial assistance

Irrevocable financial assistance can be provided to legal entities of any ownership form, individual entrepreneurs or physical entities, on the contest case via *Belarusian Innovation Fund* in form of *grants* or *Innovation vouchers*, as regulated by the [Regulation on the provision of innovative vouchers and grants approved by the Council of Ministers of the Republic of Belarus \(Resolution of October 4, 2013 No. 888\)](#), up to \$25,000 at the preparatory stage of the innovation project, and up to \$100,000 at the implementation of the design and technological phase ([Procedure for the provision of innovation vouchers and grants](#)).

Innovative projects are eligible to contest in case of:

- compliance with the priority areas of scientific and technical activity in the Republic of Belarus approved in accordance with the legislation (Decree of the President of the Republic of Belarus No. 378 of 22 July 2010);
- if the project provides for the creation, production and sale of innovative and (or) high-tech goods;
- it includes inventions (selection achievements, topologies of integrated circuits) for which an entity applying for state financial support was granted a patent (certificate) or for which an application for a title of protection was filed with the patent body of the Republic of Belarus and a positive decision was made based on the results preliminary examination or production secrets (know-how) in the presence of material objects (samples of new materials, devices, installations, products for various purposes and other), confirming the technical feasibility of implementing these production secrets (know-how).

As part of the implementation of the *preparatory phase of the innovation project*, the following types of activities, including the purchase of goods necessary for their implementation, and services, including the following, can be financed through the innovation voucher:

- marketing research;
- patent research;
- patenting of industrial property rights in the Republic of Belarus and abroad, maintaining security documents in force;
- engineering consulting and design services (engineering services);
- informational promotion of industrial property rights and (or) products created using these industrial property rights (participation in conferences, forums, exhibitions, fairs, exchanges and other events, production of advertising and information products);
- development of a business plan for an innovation project;
- assessment of industrial property rights in order to add rights to these industrial property rights to the authorised capital of a legal entity implementing an innovative project;
- investor search services.

As part of the implementation of the *design and technological phase*, the following types of activities, including the purchase of goods necessary for their implementation, and services, including the following, can be financed through an innovative voucher or grant.

- engineering consulting and design services (engineering services);



- experimental design and technological work, conducting the necessary technical and other tests;
- assessment of industrial property rights in order to add rights to these industrial property rights to the authorised capital of a legal entity implementing an innovative project, as well as upon conclusion of a license agreement;
- informational promotion of industrial property rights and (or) goods, the creation of which is provided by an innovative project (participation in conferences, forums, exhibitions, fairs, exchanges and other events, the creation and production of advertising materials, the organisation and conduct of advertising campaigns);
- investor search services;
- certification services.

Thus, *this financial support is oriented at the enterprises or individual entrepreneurs wishing to establish a creation, production and sale of innovative and (or) high-tech goods leaning on patents and does not address the needs of existing SMEs on adopting digital technologies for their restructuring and modernisation.*

As a total, the existing funding opportunities in Belarus may be useful for SMEs on their way to digitalisation, especially when used in a bunch, complementing the expertise, equipment, technologies and infrastructure.

Future opportunities

The Ministry of Economy proposed in the draft Decree the following tools for supporting digital transformation at the micro level:

- pilot innovation projects;
- assignment of the status of a “digital factory” with the right to partially compensate for the costs of digital transformation activities at the expense of innovative funds.

At the moment, however, there is no source of funding identified for the implementation of these instruments.

Gaps

The gaps can be summarised as follows:

- *None of the identified sources is suited to cover the full bunch of SME’s needs on their way to digital transformation*, including the analysis of existing business processes and their optimisation; introducing supply chain management; developing and testing on market of product/service innovations; inventorising and digitising customer relationships; business development to expand into new markets in terms of geography and/or in terms of target customers; development and introduction of innovative business models; cybersecurity; improving digital skills and supporting the training of employees in digital technologies.
- *The transaction costs of SMEs on searching for these opportunities and servicing them as separate sources are too high.*
- The available fund providers *do not include specialised technological and innovation expertise on digital transformation*; do not guide SMEs to structure their business plan of digital transformation in a systemic way.
- The intangible component of digital transformation (specialised consultancy on restructuring of business processes, development of innovative business models, training, intellectual property, know how, networking internationally) that is indispensable for digital transformation and may require even higher investments that those needed for purchase of equipment, are not covered by the existing funding opportunities, or the too small.

Recommendations

❖ What?

1. Map the sources of funding from state, international financial organisations, etc., available to SMEs, covering various types of digital transformation activities, and publish this map at the website of the organisational and technological platform ‘Smart Industry of Belarus’.
2. Identify the gaps not covered by existing funding sources for SMEs and fill the gaps by introducing public support mechanisms (grants, innovation vouchers, state guarantees, tax incentives) and negotiated instruments of support from international (financial) organisations and private financial sector.



3. Extend the usage of innovation vouchers to a much wider audience of SMEs than now (see [EU innovation vouchers](#) practice).
4. Consider using the approach used by COSME Loan Guarantee Facility as well as country-level approaches (including classification of activities and rules of allocating loans), when revising the framework for digital transformation support in the Eastern partner countries. In particular, the following areas of digital transformation are to be covered:
 - a. Internal processes: the digitalisation of existing business processes leading to significant improvements of the processes.
 - b. Supply chain management: e.g. in terms of interaction with suppliers, inventory management, and participation in integrated supply chains of larger businesses.
 - c. Product/service innovations: making use of or by integrating digital technologies into products and services and/or leading to the development of products and services which are new to the business.
 - d. Customer relationships: enhancing the marketing, customer experience, delivery of products and service to customers.
 - e. Business development: preparing the business to expand into new markets in terms of geography and/or in terms of target customers.
 - f. Innovative business models: enabling the business to develop new business models, e.g. servitisation (adding services to products or even replacing a product with a service).
 - g. Security: improving the digital security of business, notably against cyberattacks.
 - h. Digital skills and training: supporting the training of employees and/or management in digital technologies.
5. Negotiate the instruments of support from the international (financial) organisations and private finance sector regarding the development of competence centre for priority sectors and equipment of testing centres (digital demo factories) for pilot innovative projects of digitalisation of SMEs.
6. Launch a special fund for piloting and deployment of innovative solutions for the wide market.
7. Add a functionality of online submission of applications by SMEs.
8. Add a functionality of applying for consulting services with thematic expertise simultaneously with applying for funds.
9. Add a functionality of automatic redirection of rejected applications of SMEs for public support to the banks and non-banking financial organisations, including venture capital funds, for their consideration and offering alternative funding opportunities on competitive base (UK experience).

❖ Why?

Digital transformation is differing from informatisation because it implies systemic changes, including the revision of a business model because this is enabled by new technologies. A systemic approach to digital transformation is much more cost-efficient than fragmented introduction of new technological tools. All the changes consume time, expertise and hence resources. For traditional industries that are far away from IT, this expertise is very rare. Thus, public and private financial support for digital transformation should be per se structured in a way helping the traditional enterprises to understand, that they need to take care not only about, for example, CRM introduction, but also about, for example, cybersecurity and supply chain management.

❖ Relevant EU counterpart(s) (non-exhaustive list):

- [EU Blending facilities](#) (shared funds), in particular, [Neighbourhood Investment Platform](#) – a regional blending facility that mobilises additional investment for critical infrastructure projects and supports private sector development in the EU's neighbourhood.
- [COSME Loan Guarantee Facility](#) (LGF) within [COSME \(2014-2020\)](#) (the EU programme to raise SME competitiveness) supports the financing of digital transformation projects by SMEs in all sectors of the economy, regardless of their current level of digitalisation⁴. SMEs from [COSME Associated Countries](#), including Moldova, Armenia and Ukraine are eligible. For Azerbaijan, Belarus and Georgia, the possibility of extension is to be negotiated.
- On the country level of the EU countries, the examples of Germany and Spain are recommended to be studied in detail when developing the financial support mechanisms for digitalising industry.

⁴ SMEs from Ukraine and Moldova are eligible for COSME digitalisation support.



- The UK government adopted [The Small and Medium Sized Business \(Finance Platforms\) Regulations \(2015\)](#) which provide for the establishment of private sector finance platforms, designated to match SMEs to a range of finance providers, both traditional and alternative. From 2016, the UK's biggest SME lending banks (by market share and geographical coverage) are obliged to offer to SMEs rejected for finance the opportunity for their details to be referred to these designated platforms (upon agreement from the applicants). Once information is referred to finance platforms, SMEs are no longer required to actively search for finance alternatives yet keeping control of the process via consent requirements: further initiative rests with the finance platform and its lenders. This helps SMEs to mitigate their lack of experience in the funding market or in approaching alternative finance providers and lack of time and effort in finance options.
- ❖ Potential stakeholder(s) in Belarus:
 - [Ministry of Economy](#);
 - [State Committee on Science and Technologies](#);
 - [Belarusian innovation fund](#);
 - Bank of Development;
 - [‘Spark’ programme](#) of Innovative Centre ‘Great Stone’;
 - [Belarusian fund of financial support of entrepreneurs](#).

8.2 Diversified network of specialised competence centres enabling companies in digital transformation (deep tech knowledge, consulting services)

Status

Beyond access to funding, SMEs need to have access to specialised competences to support them in digital transformation. These competences should embrace both deep tech knowledge (from robotics and sensors to AI, Big Data analytics) and the economic competences (business processes, business models, marketing, etc.). The specifics of production processes (manufacturing, materials processing, utilisation, etc.) and business processes in particular industries (logistics, tourism, healthcare) needs to be understood as well.

This expertise needs to be visible to SMEs in a structured, systematised way, in order to decrease the transaction costs of SMEs in searching for particular expertise and comparing the options.

The efforts on mapping particular competences also are helpful for revealing the gaps and addressing them on the state policy level, the level of educational system or innovation ecosystem.

Finally, the specialised competence centres need to exist in the country, that serve as demonstration, prototyping, testing, piloting the solutions on the possibilities of digitising for SMEs, and consultations nodes that advise SMEs on the bunch of changes required for a systemic digital transformation.

Following this need, the current section investigates, what are the existing organisations in Belarus that can serve as the competence centres on digital transformation, and whether there are the databases available that can help SMEs to identify the necessary competences in the country.

- ❖ [Ecosystem of specialised competence centres enabling companies in digital transformation](#)

The ecosystem of specialised competence centres enabling companies in digital transformation (deep tech knowledge, consulting services) is not very much developed in Belarus. The most significant are listed below.

Table 5. List of competence centres

Role of competence centre	Organisation name	Terms of service	Clarification
Competence Centres	Technology centre ‘Smart Industry’	Paid and free	Created by Association ‘Robotechnics and Artificial Intelligence’ with the support of UNIDIO for development of digital technologies market and implementing LEAN in industrial sector.
	Competence Centre of digital transformation of construction industry in Belarus	Paid and free	The Competence Centre was created under the Ministry of Architecture and Construction and Softline company to support activities for creating integrated information systems in construction.



Role of competence centre	Organisation name	Terms of service	Clarification
Accelerators	Bridgio	For equity and paid	Created by Electronic Design House 'Promwad' and Consulting group 'Key Decisions' accelerator is focused on helping companies to create innovative spin-offs and products, to promote them on the EU market.
Digital transformation suppliers (examples)	EPAM	Paid	One of the largest digital transformation suppliers in the region; does not focus on Belarusian market and Belarusian SMEs.
	IBA	Paid	Develops digital solutions for national transport, agriculture, education, etc.
Centre of collective usage	Encata	Paid	MakeIT is an automated prototyping platform with all the necessary equipment.
Learning Centres	Certified Learning Centre Festo (FACT) Industry 4.0.	Free and paid	Primarily available for college students and small businesses.
Consulting Services	Vint-Consult Key Decisions Consulting Rules of Business	Paid	Most of consulting services in Belarus help with automation of existing business-processes or changing management in transformation. Pure digital transformation services are hardly defined.

Source: Developed by EU4Digital Facility

Three business associations also can be considered the distributed hubs of competences relevant to digital transformation of industry in Belarus:

1. [Association of blockchain \(distributed ledgers technologies\)](#) includes 18 member companies specialised on implementation of blockchain technologies in the fintech, industrial, science area.
2. [Association of innovative machine tools](#) unites six big companies:
 - a. *Izovak* – manufacturer of vacuum evaporation equipment;
 - b. *Polymaster* – equipment for monitoring and measuring radiation: electronic dosimeters, x-ray dosimeters;
 - c. *Technotone* – development, production and implementation of fuel consumption monitoring and vehicle monitoring systems;
 - d. *Regula* – spectroscopic microscopes; instruments for the control of authenticity of documents;
 - e. *Promwad* – development and production of electronics, full cycle;
 - f. *Solar LS* – lasers and spectral devices for science, technology and medicine.
3. [Association of robotics and AI](#) has recently started its activities and unites several enthusiastic companies.

None of them acts as digital innovation hub providing both the demonstration, testing, prototyping, R&D and economic consultancy to SMEs for a full cycle support of SMEs in digital transformation. There are very few open demonstration facilities on Industry 4.0.

❖ Digital competencies of ICT companies

Finding a relevant counterpart among the IT companies is crucial in case if the SMEs selects to not apply the packaged solution but needs special software tailored to their needs. Mapping the competencies of ICT companies via database helps not only customers to find a vendor but also the government to have an overview of potential executors for large-scale innovative digitising projects (complementary to tenders). Finally, for ICT companies themselves such mapping helps to identify the gaps and market niches.

In Belarus, there are two databases of ICT companies: database of High-Tech Park member companies (HTP) and the leading web resource for IT specialists dev.by.

None of these databases is suited to find a list of relevant IT companies ready to service industry/manufacturing sector in the available two most widespread databases: Dev.by and HTP database of IT companies.

Currently, these databases allow assessing the number of companies acting at Belarusian market on some aspects of digitising.



Table 6. Number of companies per types of activities relevant to digitising SMEs at Dev.by database

Type of activity	Number of companies	Total amount of their employees
Custom software development	388	65,271
Own products	621	123,587
Embedded Software	86	39,814
Hardware	46	5,963
ERP systems development and implementation	99	15,761
SaaS	100	12,104
Information security	34	6,142
Big Data	88	55,061
ECommerce	110	34,395
System integration	57	9,816
IOT	58	35,537
Analytical software	65	7,378
VR	27	28,886
Machine learning	85	42,249

Source: Developed by EU4Digital Facility based on search at [Dev.by database](#), 2020

Table 7. Number of companies per types of activities relevant to digitising SMEs at HTP database

Type of activity	Number of companies
Activities with tokens.	6
Application development and deployment market	133
Applications	477
Application Software	443
Box Products/Licensed Software	79
Business Process Outsourcing	16
Custom software development	176
Embedded Software Development	40
Information Security	55
IT services, ASP, SaaS,	381
Services and solutions	96
Software Ready for SaaS Development	20
System infrastructure software	119
System software	120
Testing	41

Source: Developed by EU4Digital Facility based on search at [HTP database](#), 2020

The **conclusions** from this analysis is that:

- There is no common approach to defining the ICT services.
- The terms that are used by ICT companies to describe their activities are of little use to SMEs that look for solutions of particular practical challenges, but in most cases do not staff IT professionals who could help in selection of a relevant IT company.
- These databases do not exhibit most of categories that constitute the framework of digital transformation:



- information security and protection of sensitive data (protection of objects, processes, communication channels, organisational protection of information objects);
- means and systems (technologies) of electronic identification and tracking of elements of the production process (RFID systems, barcodes, smart sensors);
- cyber-physical systems, including:
 - robotic complexes (autonomous robots);
 - sensors and sensors that track and monitor production and process processes in real time;
- Service Oriented Architecture;
- network infrastructure (data exchange environment);
- real-time application and monitoring software;
- additive production;
- technologies of industrial Internet of things:
 - industrial IoT platforms – IoT operating systems connecting machinery, physical infrastructure and devices;
 - machine-to-machine communication (M2M);
- Digital Technologies Amplifying the Potential of Industry 4.0:
 - 3D modelling and prototyping;
 - cloud computing and cloud infrastructure;
 - smart contracts;
 - big data and their analytics;
 - Augmented and Virtual Reality;
 - artificial intelligence.

❖ Research capacity on informatics and digital technologies

Availability of R&D capacities within the country is important for enabling the innovative technological solutions. The main research capacities on **informatics** in Belarus are concentrated at the:

- [State Scientific Institution 'United Institute of Informatics Problems of the National Academy of Sciences of Belarus'](#).
- [Belarusian State University for Informatics and Radioelectronics](#).

[United Institute of Informatics Problems \(UIIP\)](#) is the leading organisation in Belarus in fundamental and applied research on information technologies, including CAD/CAM/CAE systems, applied mathematics, high performance parallel computing, bioinformatics and medical informatics, geoinformation systems, digital cartographic systems, Space informatics, GRID-technologies. The Institute is the provider of scientific and educational Internet networks in Belarus. It takes part in development of state recommendations on information technologies implementation, scientific support of informatisation processes, prognosis in related science and technology fields in Belarus, high skill specialists training.

[Belarusian State University for Informatics and Radioelectronics](#) maintains 49 research laboratories and research groups, 5 centres, in which research is conducted in the following areas related to digitising industry:

- radio devices and systems;
- information transmission and processing systems;
- new information technologies and management systems;
- micro and nanoelectronics;
- new promising materials, energy and resource saving technologies;
- certification, diagnostics and testing of elements, devices and systems;
- modelling and optimisation methods in electronic systems and devices;
- socio-economic problems of social development;
- information and educational technologies in education;
- beam technologies and equipment;
- automation of industrial processes and energy.



Besides, SMEs can source from **industry-specific research capacities** of the wider variety of scientific research organisations, mostly concentrated under the National Academy of Sciences (NAS), including 15 research institutes and centres of the National Academy of Sciences ([The Institute of Applied Physics](#); [A.V. Luikov Heat and Mass Transfer Institute](#); [The Institute of Mathematics](#); [The Institute of Metal Technology](#); [The Institute of Physics](#); [The Institute of Power](#); [The Institute of System Research in Agrarian-Industrial Complex](#); [The Institute of Technical Acoustics](#); [The Joint Institute of Mechanical Engineering](#); [The Joint Institute of Power and Nuclear Research 'Sosny'](#); [V.A. Belyi Metal Polymer Research Institute](#); [The Physical-Technical Institute](#); [The Powder Metallurgy Institute](#); [The Scientific-Engineering Enterprise 'Geoinformation Systems'](#); [The Scientific-Production Enterprise 'Centre of LED and optoelectronic technologies'](#)); State Scientific and Production Amalgamation [SSPA 'Optics, Optoelectronics and Laser Technology'](#); 2 Scientific and Practical Centres ([The Scientific and Practical Materials Research Centre](#); [The Inter-branch Scientific and Practical Centre for Identification Systems and E-business Operations](#)); 14 state [design organisations](#) and production organisations (Annex 4. Design and production basis for industry in Belarus).

These organisations publish the information about their specialisation on the websites; periodically the catalogues and [databases](#) are developed by NAS to list the profiles of organisations on one place.

However, the following *difficulties* are identifiable:

- The catalogues are difficult to be used by SMEs because of unstructured information about specialisation of organisations.
- There is no database that would provide the quick search opportunity for particular competencies or application areas existing in the country and the contact persons, in particular, related to digitising challenges, neither within NAS, nor in the country generally.

A task of development of such a database logically needs to select a logical framework (classifier) of competences related to digital industry, which optimally should be an international standard.

Gaps

As a result of analysis, the following gaps have been identified:

- None of the existing competence centres acts as digital innovation hub providing both the demonstration, testing, prototyping, R&D and economic consultancy to SMEs for a full cycle support of SMEs in digital transformation. There are very few open demonstration facilities on Industry 4.0.
- None of the available databases (Dev.by and HTP database of IT companies) is suited to find a list of relevant IT companies ready to service industry/manufacturing sector:
 - These databases do not exhibit most of categories that constitute the framework of digital transformation. SMEs cannot search for suppliers, number of employees, level of technology in the field of key technologies related to digitising industry such as CPS, Energy saving, Smart sensor, 3D printing, IoT, Cloud, Big data, AR/VR for smart manufacturing. Similarly, for potential customer it is not possible to analyse the market in terms of companies, their sales, the number of employees, and technology level in the sector of enterprise software such as ERP, SCM, CRM, MES, PLM, EMS, etc.
 - The terms that are used by ICT companies to describe their activities are of little use to SMEs that look for solutions of particular practical challenges, but in most cases do not staff IT professionals who could help in selection of a relevant IT company.
- The catalogues are difficult to be used by SMEs because of unstructured information about specialisation of organisations.
- There is no database that would provide the quick search opportunity for particular competencies or application areas existing in the country and the contact persons, in particular, related to digitising challenges.

Recommendations

❖ What?

1. Map and publish in form of database the existing specialised competence centres enabling companies in digital transformation (deep tech knowledge, consulting services), up to direct contacts to experts. Use a framework with several dimensions referring to technological specialisation, potential industry application area, type of problem, etc. grouped in a database allowing SMEs to find the competence centres relevant to their challenge with the minimal transaction costs and time waste. Suggested basic framework to map the competence centres is provided in Annex 5. Suggested basic framework for data



collection during inventurisation of the existing competence centres. Open the universities' infrastructure supported by public funds to wider users in the country (open access centres). Identify the contact persons with specific expertise to directly interact with SMEs (not publishing the contact to director of the organisation who will never talk with SMEs).

2. Allow usage of innovation vouchers for obtaining of consultations and attracting experts from the listed competence centres.
3. Develop an international training programme with advanced international competence centres for competence areas that are not or poorly covered by the existing competence centres.
4. Consider establishing a (network of) competence centres in support of digital transformation of SMEs (SMEs 4.0/Smart SMEs) or identify the existing competence centres to serve for overall consultation of SMEs about the strategic approach to digital transformation, on the example of [Mittelstand 4.0](#) competence centres.
5. Study the toolboxes of [Mittelstand 4.0](#) competence centres (Germany) or similar centres in other EU countries and negotiate the transfer of their to Belarusian competence centres. Equip these competence centres for performing of demonstration functions and serving as a testbed for innovative solutions. Promote their services across SMEs. The tool '[Reference Architectural Model Industry 4.0](#)' (RAMI 4.0) employed by German competence centres is especially recommended.
6. Equip facilities to perform as demonstration fabric, with specialisation in certain technological areas or certain industries (addressing the specifics of their business processes). Negotiate with leading corporations about possible equipment of these fabrics. Organise regular free of charge excursions for any interested visitors (SMEs, universities, students, public authorities) to raise interest and achieve the effect of transfer of the Industry 4.0 concept from the neglected one to the one perceived as a normal routine that business needs to master for its competitiveness.

❖ Why?

Specific expertise is required for implementation of the digital transformation, linking the deep tech knowledge, the knowledge of specifics of production and business processes in different industries, and the knowledge of innovation management and business transformation. For a traditional enterprise, it is difficult to understand which technologies, information systems and solutions are relevant to their challenges, how to formulate the request for digital solutions (technical specification), how to modify the model of operation of the enterprise using the opportunities of digital technologies, and how to select the reliable suppliers. SMEs need a simple mechanism of finding the renowned expertise in the country and a single point where they can receive the overall advice on cost efficient approach to their digital transformation.

❖ Relevant EU practices (non-exhaustive list):

- Competence networks assisting SMEs in the area of Robotics:
 - European Coordination Hub for Open Robotics Development ([ECHORD++](#));
 - Robot technology transfer network [ROBOTT-NET](#);
 - Robotics Digital Innovation Network ([RODINE](#)), Coordination and Support Action.
- [Cluster Collaboration Platform](#) has an extensive database of cluster organisations assisting SMEs in diverse areas classified per sectoral industries, emerging industries, technology fields, smart specialisation priority areas, etc. Generally, 440 organisations are mapped in digital industries.
- [Demonstration facilities in Germany](#) – a list and a [map](#) of Industry 4.0 demonstration and test facilities across Germany with references to their specialisation topics, industries they are servicing, constituting organisations and contact person.
- [R&D facilities map on Industry 4.0](#) in Germany, including small and medium-sized companies, university research, non-university research, large corporations, other across the following topics: embedded and cyber-physical systems, internet of things; virtual and augmented reality; research on the company hall floor; intelligent networking in production; innovative SMEs; production plants for growth markets; top cluster “intelligent technical systems”; further education.
- [Mittelstand 4.0](#) – a list of Industry 4.0 competence centres across Germany with references to their specialisation topics, industries they are servicing, constituting organisations and contact person.
- [Map Industrie du Futur](#), France – Industry 4.0 digitalisation cases with filtering across dimensions of transformation, size of company and the range of competitiveness levers.
- [DIH catalogue](#) is a comprehensive database of digital innovation hubs across the EU, that allows search across the technical competences (listed in Annex 5. Suggested basic framework for data collection



during inventorisation of the existing competence centres) and the services provided; with a search possibilities across technology readiness levels and market sectors (industries of economy). For example, there are 254 organisations listed, possessing competence in the area of ‘Sensors, actuators, MEMS, NEMS, RF’; among them 107 organisations possessing this competence at the highest level TRL9 – Actual system proven through successful mission operations.

❖ **Potential stakeholder(s) in Belarus:**

Belarusian Institute of System Analysis and Information Support for Scientific and Technical Sphere; Technology centre ‘Smart Industry’; United Institute of Informatics Problems; Competence Centre of digital transformation of construction industry in Belarus; Educational-methodical association for education in the field of computer science and radio electronics; Robotics & AI Association; Bridgio; EPAM; IBA; Encata; Certified Learning Centre Festo (FACT) Industry 4.0.

8.3 Specialised digital innovation and entrepreneurial education organisation in the country (Bachelor, Master, PhD level)

Status and gaps

The experts for actual analysis of business process and advising enterprises in the selection of a constellation of digital technologies started to be trained in Belarus only a few years ago. The most relevant programmes run by two leading universities include the ones listed in the Table 8.

Table 8. The most relevant programmes run by two leading universities

Organisations	List of, and reference to training programmes
Belarusian State Economical University, Faculty of Digital Economy	<ul style="list-style-type: none"> Bachelor’s programme Economic informatics. The programme trains personnel with competencies in the field of economics, management and information technology and systems capable of applying information technology at a high level for the preparation and decision-making in management, economics and business. Economic cybernetics (specialisation ‘Optimal planning and management in the economy’). The graduates get deep knowledge of the theoretical foundations of economics, information technology and programming, mathematical methods of planning and economic management.
Belarusian State University	<ul style="list-style-type: none"> Bachelor’s programme Information resources management. The professional activities of an Information Resources Management specialist are at the junction of management, economics and information technology. Such specialist manages the information resources of the company for its successful work in the market economy. Bachelor’s programme Industrial management. The Industrial Management programme prepares middle managers in industry, services and government. Thanks to the interdisciplinarity of the curriculum, graduates can work in the national and global labour market in the following areas of activity: management, controlling, marketing, logistics, project management and quality management, financial analysis and accounting, technical support and service and many others. <p>MBA programme Management of digital business transformation. The programme covers the issues of:</p> <ul style="list-style-type: none"> organisation of management of an electronic enterprise and its units; e-business in digital economy; studying the current state and best practices of using breakthrough technologies; digitalisation in business (artificial intelligence, blockchain, Internet of things, etc.); development of corporate strategies, key business models and cases of digital transformation; the use of modern methods of modelling transformation processes;



Organisations	List of, and reference to training programmes
	<ul style="list-style-type: none"> • digital transformation project management based on modern competencies – Agile, Lean Startup, DevOps; • management of the implementation and development of digital and intelligent enterprise platforms; • assessment of business opportunities and resources for successful digitalisation; • managing the development and sale of a digital product; • the creation and evaluation of sources of digital value of the enterprise; • improving digital literacy of staff.

Source: Developed by EU4Digital Facility

There are some examples of bachelor and master programmes (see Annex 6. Training basis for digitising industry in Belarus: selected programmes of Belarusian State University for Informatics and Radioelectronics), but these specialities are not directly focused on digital transformation. Over recent years the digital part of these programmes has increased. The good practices, that are still seldom, are that the IT companies start to contribute software for practical learning of students. However, there are still no demonstration and testing facilities open to students, as in Germany, to get a hands-on understanding and practice of work with IoT, M2M, cyberphysical systems and other components of the digitising manufacture.

The descriptions of digital competencies, knowledge, skills that are lectured to students, are not unified across programmes.

Gaps

The existing spectrum of educational programmes provides good technical competencies but need further significant improvements by enhancement of practical component of training as well as develop professionals with systemic economic knowledge combined with the understanding of digital technologies specifics, to support SMEs in various traditional sectors in digital transformation.

Recommendations

❖ What?

1. Train the group of consultants for the competence centres internationally. Retrain senior and engineering workers who already have professional experience and are employed in the relevant areas of production.
2. Establish partnership among leading educational establishment in Belarus with foreign education and training organisations in the EU for joint master's programmes for the future preparation of students onsite.
3. Link all educational and training processes related to digital transformation of industry with the practical training (agree with existing digitalised companies in traditional industries and digital solutions developers about internships or, better, dual education).
4. Negotiate with corporations about equipping of demonstration facilities for VET.
5. Consider using the existing digital competence frameworks for development of a consistent and common language for professions and competencies needed for implementation of digital transformation (European Entrepreneurship Competence Framework; European e-Competence framework; DigiComp, etc.).

❖ Why?

Without experts that can understand and combine the dimensions of digital transformation (technological, economic, educational), there will be a risk of digitising for the sake of digitising with negative economic effects. The knowledge shared by leading vendors on Industry 4.0 needs to be mastered in order to be able to master their technologies and to understand their peculiarities and complementarity.



❖ Relevant EU counterparts (non-exhaustive list):

- European's Institute of Innovation & Technology [EIT Digital](#) – leading European digital innovation and entrepreneurial education organisation driving Europe's digital transformation. Its [Summer school](#) 2020 includes topics [IoT Platforms For Industry 4.0](#) and [Big Data For Industry 4.0](#).
- The new phase of [ICT Innovation for Manufacturing SMEs \(I4MS\)](#), launched in 2017, also offers new actions to foster collaboration and address new challenges:
 - [I4MS online community](#) to bring together all the actors involved in digital transformation;
 - [Disruptors Awards](#): to select the best experiments illustrating the benefits of implementing ICT technologies.
- To help the regions not well covered by DIHs yet, the European Commission has launched [training programmes for new DIHs](#):
 - [Skills Observatory](#) – overview of all digital skills and training materials focused on robotics, HPC, IoT, additive manufacturing and Cyber Physical Systems.
 - [KETs Tools](#) – the KETs Observatory aims to provide the EU and national policy makers, and business stakeholders with quantitative and qualitative information on the industrial deployment of Key Enabling Technologies both within the EU-28 and in comparison, to other world regions (East Asia and North America).
 - [DIHELP – DIH Enhanced-Learning Programme](#) – DIHELP is a programme launched by the European Commission to support Digital Innovation Hubs (DIHs) in developing and/ or scaling-up their activities. Selected DIHs in the EU are offered a coaching and mentoring programme for nine months.
 - [Smart Factories in new Member States: training for DIHs in Central and Eastern Europe](#) – the project 'Smart Factories in new EU Member States' has trained 34 organisations to become Digital Innovation Hubs in 13 Central and Eastern European countries (training materials also open for consultation).
 - [I4MS mentoring programme](#) – competence on how to develop a business plan for DIH on ICT innovation for manufacturing SMEs, identify the needs of industry in their regions and operate their services.

❖ Relevant international corporate training centres (non-exhaustive list):

- [SITRAIN – Digital Industry Academy](#) under Siemens, including [E-learning@SITRAIN](#).
- [IBM Industry Academy](#), including [Advanced technology solutions in the manufacturing industry](#):
 - [Industry 4.0 & Cognitive Manufacturing](#);
 - [Securing the Internet of Things](#);
 - [Shift to enterprise-grade AI](#).
- [Digital Transformation](#) under Microsoft Industry – sharing cases of digital transformation from automotive, defence and intelligence, financial services, government, health, manufacturing, media and entertainment, retail and telecommunications industries.
- [Google Digital Academy](#) – programmes range from bespoke workshops and high impact, face-to-face Labs, to scaled e-learning and virtual learning to maximise shared understanding. Each programme covers some or all of five interdependent pillars of transformation – each area where new tech and customer behaviour have created an urgent need for transformation.
- [IARIA](#) – International Academy, Research, and Industry Association, including tutorials from international lecturers.
- [IoT Advanced Applications and Industry 4.0](#) from [ITU Academy](#). The ITU Academy offers a wide range of general and specialised courses on all aspects of information and communication technologies. ITU is partnering with various training providers to deliver about 100 training activities per year. Partners include Centres of Excellence (CoEs), Internet Training Centres (ITCs) as well as academic institutions and the private sector.
- [GDS Academy – GOV.UK](#) – teaches digital skills to civil servants; local government employees; other public sector workers.
- [NHS Digital Academy](#) is a virtual organisation set up to develop a new generation of excellent digital leaders who can drive the information and technology transformation of the NHS. The NHS Digital Academy, through a partnership with Imperial College London, the University of Edinburgh and Harvard



Medical School, provides a year-long, world class, fully accredited learning programme ([Post Graduate Diploma in Digital Health Leadership](#)) for digital change leaders. The training on digital transformation include [Connected digital systems](#), embracing:

- [Health and care data](#);
- [Global Digital Exemplars](#);
- [Digital Maturity Assessment](#);
- [Local Digital Roadmaps](#);
- [Cyber security](#);
- [Interoperability](#);
- [NHS e-Referral Service](#).
- [Discover the IT Industry | Industry Academy Series](#) – free online courses from Tieto – a global company that provides IT and product engineering services. It's one of the largest IT service providers in Europe and has a global team of over 15,000 employees in 20 countries. They were nominated as a Global 100 Tech Leader in 2018.
- [Cross Industry Academy – Tech Allies Network](#) – a year-long programme consisting of four free evening events, based in London (Open Banking and the Rise of FinTech; Digital Disruption in Professional Services – The Future; Transforming Healthcare – a Journey through Digital, Data and Analytics; Digitalisation – Transforming the Energy Sector).
- [Deloitte 5G Next Generation Application Academy](#) – combines production, study and research, is aimed to unite China telecom operators to serve top clients and enable them an overall digital transformation by 5G technologies; moreover, strengthen the partnership with innovators in the market.
- [Locarno Industry Academy](#) from Europa International – Locarno Industry Academy is a training programme with strong European and International dimensions, created to help young professionals extend their network in the field of international sales, marketing, distribution (including the new platforms), exhibition and programming (festival, cinéclub and cinematheque).
- [Telecoms & Tech Academy](#) includes courses in the areas of:
 - Digital Transformation;
 - Innovation Mini MBA;
 - 5G, Connected Innovation, Applications & Services;
 - 4G & LTE;
 - Commercial Aspects of Telecoms;
 - Marketing, Sales & Customer Focus in Telecoms;
 - Management, Innovation & Strategy;
 - Network Technology.
- [Industry Academy](#) from OWDT – e-learning platform.
- [Digital Academy](#) (Digital Transformation and Industry Innovation Academy).
- ❖ **Potential stakeholder(s) in Belarus:**
 - Belarusian State University;
 - Belarusian State Economic University;
 - Belarusian State University for Informatics and Radioelectronics;
 - Belarusian National Technical University;
 - Academy of Management under the President of the Republic of Belarus;
 - Educational-methodical association for education in the field of computer science and radio electronics;
 - Ministry of Education;
 - Republican Institute for Vocational Education.



8.4 Digital platforms and digital industrial (sectoral) platforms facilitating digital transformation in the country

Status

Among the platforms available to enterprises for digital transformation, the following can be mentioned:

1. Software platforms (e.g. cloud-based CRM, ERP, MRP, PLM, etc.) and Sales platforms:
 - a. BeCloud provides a business with a virtual environment for storing and processing information, combining hardware, software, communication channels, as well as technical support. It is important to note that in the framework of the Decree of the President of the Republic of Belarus dated 16.12.2019 N 461 'On Amending the Decree of the President of the Republic of Belarus', the RCEA is a platform for the placement of state information resources and systems, which is part of e-government and is aimed primarily to simplify doing business by SMEs.
 - b. Salesforce (represented in Belarus by Twistellar).
2. Industrial-Internet-of-Things (IIoT) platforms:
 - a. A1 (www.a1.by), MTS (www.mts.by) and Beltelecom (<https://beltelecom.by/business>) now are ready to establish such platforms and provide separate services to connect physical objects for business needs.
 - b. Huawei announced access to its [digital platform for Enterprises](#) also for Belarusian enterprises. However, the biggest part of platform scenarios is suitable for public organisations and large enterprises rather than for SMEs.
3. Supply chain management:
 - a. [Eurasian Digital Platform Prototype](#). This platform is announced only as a prototype for driving cooperation between industrial enterprises in EAEU and doesn't work in sustainable mode.

Gaps

This overview illustrates that the palette of platforms available to Belarusian SMEs is scarce, despite a big amount of ICT companies in Belarus. This causes the need for SMEs to be better informed about the global market opportunities, and for the state - to develop the national marketplace of technological solutions enabling the digitising of SMEs.

Recommendations

❖ What?

1. Promote and allow a descriptive comparison of the platforms available to enterprises for digital transformation on the website of organisational and technological platform 'Smart Industry of Belarus'.
2. Develop a national marketplace of technological solutions (applications) equipped with a similar search mechanism (classification of [IOTA Industry Marketplace](#) (RAMI-based) may be used as example of industrial IoT solutions and [GetApp](#) marketplace may be used as example for solutions like CRM, ERP, BI).
3. Consider dynamic linking of the national marketplace with [GetApp](#) and possible national marketplaces for Industry 4.0 of other countries.
4. With a growing palette of solutions, consider introduction of a voluntary certification of these solutions, including the issues of IT security and data protection. Check the experience of [Trusted Cloud certification](#) scheme in Germany for possible organisational mechanism.

❖ Why?

Such marketplace linked to international marketplaces would not only allow SMEs to better familiarise themselves with the 'available menu', but also allow to easily identify the gaps and foster the competition (incentivise the national providers of solutions to consistently care of the quality improvement and functions development).

❖ Relevant EU practices (non-exhaustive list):

- [CCSL - the Cloud Certification Schemes List](#) – is an example of diverse approaches in the EU to create trust to cloud solutions providers. The list gives an overview of different existing certification schemes which could be relevant for cloud computing customers. CCSL also shows which are the main



characteristics of each certification scheme. For example, CCSL answers questions like “which are the underlying standards?”, “who issues the certifications”, “is the cloud service provider audited?”, “who audits?”. CCSL provides links and references to each certification scheme for further reading.

❖ **Relevant international corporate platforms (non-exhaustive list):**

Beyond the EU practices, the following internationally operating corporate platforms are of practical relevance, to help Belarusian stakeholders to get an overview of platforms that might be considered for backing up the solutions for digitising of SMEs:

- [IOTA Industry Marketplace](#).
 - [GetApp](#) Marketplace.
 - [Industrial IoT Platforms Market](#) from Gartner. For manufacturing industry, the recommended platforms include:
 - [SAP Leonardo IoT](#);
 - [Oracle IoT Cloud](#);
 - [PTC ThingWorx](#);
 - [PI System](#);
 - [RootCloud](#);
 - [Software AG Cumulocity IoT](#);
 - [Siemens MindSphere](#);
 - [Azure IoT](#);
 - [NetFoundry](#);
 - For companies under \$50 million turnover, additionally the following platforms are recommended (all industries):
 - [Altizon Datonis IoT Platform](#);
 - [Axonize](#);
 - [Cloud IoT platforms](#) by Alibaba Cloud;
 - [Predix Platform](#) by GE Digital.
 - [Strategic partners of Ericsson in Industry 4.0](#).
- ❖ **Potential stakeholders in Belarus:**
- Digital business confederation;
 - Association of robotics and AI;
 - High-Tech Park.

9 Mapping the outcomes of digital transformation

Status

Some positive cases of digital transformation of industries are presented during special events (i.e. organised by Scientific and Technological Association ‘Infopark’) and presented in special publications (i.e. ‘Digital Transformation’ – peer-reviewed journal ‘**Digital Transformation**’ registered by the Ministry of Information of the Republic of Belarus).

Gaps

There are no examples of existing online platform mapping successful digitalised companies for promotion and experience sharing in Belarus.

Recommendations

❖ **What?**

1. Perform the mapping of successful cases of digital transformation of enterprises in traditional industries by describing the positive stories at the website of the organisational and technological ‘Smart Industry of Belarus’. A publication of at least short profile should be obligatory for those SMEs that received the state support in introduction of digital technologies.



2. Elaborate the online calculator of potential effects and propose it at the website of organisational and technological platform 'Smart Industry of Belarus' or competence centres 'Smart SMEs', to tease the SMEs that think about digitising.
3. Map and publish the number of consultations rendered by competence centres.

❖ Why?

Mapping of successful cases of digital transformation of enterprises in traditional industries helps to ensure the demonstrative and persuading practical background for those enterprises that are risk averse. Essential stories also help to avoid mistakes by other enterprises.

❖ Relevant EU counterpart(s) (non-exhaustive list):

- [Industry 4.0 Landkarte - Platform Industry 4.0](#) – The map shows practical examples of where Industry 4.0 is already practiced in Germany today - a "pin" for each example. Filter functions make searching easier.
- [Digital Transformation Monitor](#) - overview of the national initiatives aims to analyse the framework conditions at national level and, more specifically, the rollout of digital policies. The DTM reports provide an overview of the key national and regional public support measures, outlining the policy trends and implementation of processes and strategies, outputs and outcomes, and key policy lessons learned, including possibilities to scale-up and transfer to other countries and regions.
- [Digital Transformation Scoreboard](#) – part of the Digital Transformation Monitor (DTM). The DTM aims to foster the knowledge base on the state of play and evolution of digital transformation in Europe. The DTM web platform provides a monitoring mechanism to examine key trends in digital transformation. It offers an insight into statistics and initiatives to support digital transformation, as well as reports on key industrial and technological opportunities, challenges and policy initiatives related to digital transformation.
- [European stakeholder forum](#) – an annual event gathering about 500 delegates for consultation and discussion on the Digitising European Industry initiative. The Forum aims to raise awareness and to foster networking between all stakeholders, in particular between the various national and regional initiatives, Digital Innovation Hubs and platforms.
- [EIT Digital](#) (from the [European Institute of Innovation and Technology](#)), which contributes to the network of DIHs through its project [MIDIH](#). MIDIH "Manufacturing Industry Digital Innovation Hubs", is a "one stop shop" of services, providing industry with access to the most advanced digital solutions, the most advanced industrial experiments, pools of human and industrial competencies and access to "ICT for Manufacturing" market and financial opportunities. MIDIHs will leverage networks of local Competence Centres, each specialised in peculiar aspects of the CPPS/IIOT (Cyber Physical Production System / Industrial Internet of Things) technologies and able to attract, mentor and nurture local Manufacturing SMEs towards Industry 4.0 projects, experiments and business. A common platform of knowledge, methods and collaboration tools will be shared among the MIDIHs network and allow cross-border fertilisation, continuous improvement, open innovation.
- [DIHNET.EU](#) Coordination and Support Action coordinating the whole network of Digital Innovation Hubs in the EU.

❖ Potential stakeholder(s) in Belarus:

- Ministry of Economy;
- Ministry of Communications and Informatisation;
- Ministry of Industry;
- Digital business confederation;
- Association of robotics and AI.



Annex 1. List of organisations and experts consulted during verification process

Organisation	Expert
Ministry of Communication and Informatisation	Deputy Head of Sectoral Informatisation Department
Department of Innovation Economics, Ministry of Economy	Head of Hight-Tech Sector
Ministry of Industry	Deputy Head for Scientific and Technical Policy
UN (development programme)	Member of Public Council for development and monitoring of sustainable development strategies
Belarusian State Economic University	Dean of Faculty of Digital Economics
Association of AI and Robotics	Director
IoT Belarus Community	Coordinator
Association of Innovation Manufacturers	Member of the Board



Annex 2. National Strategies for Industry 4.0 in the EU countries

Country	Strategies
Germany	<ul style="list-style-type: none"> • Digital Strategy 2025
Austria	<ul style="list-style-type: none"> • Digital Roadmap Austria https://www.digitalroadmap.gv.at/
France	<ul style="list-style-type: none"> • Programme des Investissements d'Avenir http://www.gouvernement.fr/investissements-d-avenir-cgi
Italy	<ul style="list-style-type: none"> • Industria 4.0; • Piano Nazionale Industria 4.0 http://www.sviluppoeconomico.gov.it/index.php/it/, http://www.mise.gov.it/index.php/it/industria40.
Ireland	<ul style="list-style-type: none"> • National Digital Strategy (NDS) http://www.dccae.gov.ie/en-ie/communications/topics/Digital-Strategy/Pages/default.aspx
Latvia	<ul style="list-style-type: none"> • National Industrial Policy Guidelines 2014 - 2020 https://em.gov.lv/files/uznemejdarbiba/finl_en.pdf; • "National Industrial Policy Guidelines 2014-2020".
Romania	<ul style="list-style-type: none"> • Manifesto for Digital Romania http://gov.ro/en/news/address-by-prime-minister-dacian-ciolos-at-the-international-digital-romania-4-0-industry-forum
Slovenia	<ul style="list-style-type: none"> • Digital Slovenia 2020 strategic framework
Slovakia	<ul style="list-style-type: none"> • Konceptcia inteligentného priemyslu pre Slovensko http://www.rokovania.sk/Rokovanie.aspx/BodRokovaniaDetail?idMaterial=26016
UK	<ul style="list-style-type: none"> • Digital Strategy https://www.gov.uk/government/news/uk-digital-strategy-the-next-frontier-in-our-digital-revolution; • Green paper on Industrial Strategy https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/586626/building-our-industrial-strategy-green-paper.pdf.
Sweden	<ul style="list-style-type: none"> • Smart Industry; • Smart Industry http://www.government.se/information-material/2016/04/smart-industry---a-strategy-for-new-industrialisation-for-sweden/.



Annex 3. National Platforms for Industry 4.0 in the EU countries

Country	Platforms
Austria	<ul style="list-style-type: none"> • Industrie 4.0 Oesterreich; • Austria: Platform Industrie 4.0.
Belgium	<ul style="list-style-type: none"> • Made different – Factories of the future; • Scouting Industrie 4.0 Flanders Make; • Digital Wallonia.
Czech Republic	<ul style="list-style-type: none"> • Průmysl 4.0
Denmark	<ul style="list-style-type: none"> • Manufacturing Academy of Denmark (MADE)
Estonia	<ul style="list-style-type: none"> • Industry 4.0 Praktikas
France	<ul style="list-style-type: none"> • Alliance industrie du futur
Germany	<ul style="list-style-type: none"> • Industrie 4.0; • Mittelstand 4.0; • Autonomik for Industrie 4.0.
Hungary	<ul style="list-style-type: none"> • ‘IPAR 4.0 National Technology Platform’; • IPAR4.0 National Technology Platform; • The Industry 4.0 National Technology Platform Association (I4.0 NTP).
Lithuania	<ul style="list-style-type: none"> • Pramonė 4.0; • Pramonė 4.0 http://www.industrie40.lt/platform/; • Lithuania: ‘Pramonė 4.0’.
Luxembourg	<ul style="list-style-type: none"> • Digital For Industry Luxembourg; • Digital4Industry - D4I http://digital4industry.lu/; • Luxembourg: ‘High Performance Computing & the Digital Skills Bridge Toolbox’.
Netherlands	<ul style="list-style-type: none"> • Smart Industry - Dutch Industry fit for the Future http://www.smartindustry.nl
Poland	<ul style="list-style-type: none"> • Initiative and Platform Industry 4.0; • Platforma Przemysłu Przyszłości - PPP (Future Industry Platform) Poland: ‘Initiative for Polish Industry 4.0 – The Future Industry Platform’.
Portugal	<ul style="list-style-type: none"> • Indústria 4.0; • Indústria 4.0 www.i40.pt; • PRODUTECH – Production Technologies Cluster www.produtech.org.
Slovenia	<ul style="list-style-type: none"> • Slovenian Digital Coalition – digitalna.si http://www.digitalna.si/si/; • Slovenia: Slovenian Digital Coalition.
Slovakia	<ul style="list-style-type: none"> • Slovakia: Smart city
Sweden	<ul style="list-style-type: none"> • Produktion 2030 http://www.produktion2030.se/
Spain	<ul style="list-style-type: none"> • Industria Conectada 4.0; • Connected Industry 4.0.
UK	<ul style="list-style-type: none"> • Manufacturing Catapult https://hvm.catapult.org.uk/; • Innovate UK https://www.gov.uk/government/organisations/innovate-uk; • EPSRC Manufacturing the Future https://www.epsrc.ac.uk/research/ourportfolio/themes/manufacturingthefuture/.



Annex 4. Design and production basis for industry in Belarus

1. Republican Unitary Enterprise 'The Special Design-Technological Bureau 'Metallopolymer' under the '[Institute of Mechanics of Metal-Polymer Systems Named after V.A. Bely](#)' of the National Academy of Sciences of Belarus

Field of Activities: development of technologies and production of the following equipment: for sorting and recycling secondary polymeric materials; grading and recycling glass waste; disposal of building wastes; manufacture of non-woven fibrous-porous materials and polymer filtering materials; painting of metallic components of any shape or configuration by polymeric powder materials.

Equipment: a complete complex of metal-working machinery.

Production and Services: equipment for sorting solid domestic wastes, baling presses, crushing machines, sharpening devices, equipment for washing secondary polymeric materials, agglomerators, driers, moulding machines, granulators, production lines for polymeric pipes. Fibre shredders, film-hose aggregates, equipment for manufacture of non-woven fibrous-porous materials and polymer filtering elements, lines for breaking glass containers, equipment for application of polymeric power coatings, sections of dispatcher panels with a set of mnemonic circuits intended for on-line information display of all levels of electric supply, setups for building refuse disposal. Manufacture of off-standard metal structures; filtering elements for fine purification of diesel oil; cleaning of air and solutions for water wells; aerators for cleaning wastewater; sorbents for collecting oil and oil products; thermoplastic polymer components (from recycled materials including); pipes from polyethylene, key cases for non-departmental guard; polyethylene hose film, packets and so on; deposition of polymer powder paints on metal components.

2. Design and Production Republican Unitary Enterprise '[CKB](#)'

Field of Activities: metal-working, instrument manufacturing, optical production.

Subdivisions: pilot mechanoerecting plot, plot of optical products, production and technical bureau, a group of logistics and co-operation, laboratory of electrophysical measurements, services of technical control, metrology, standardisation and information.

Production and Services: carrying out experimental-design works in the field of instrument manufacturing; hydro instruments for the installation of 'Izoprofleks' pipelines; development and production of devices, its parts and details according to the agreements; manufacturing optical products due to customer documentation; turning, milling, grinding, boring, mechanical and other works; the examination of wirings reliability.

3. Design and Production Republican Unitary Enterprise '[OKB 'Akademichnaye](#)'

Field of activities: Experimental development and manufacturing of the energy machinery building in the field of science and scientific service; manufacturing, building and exploitation of die equipment of experimental and productive workbenches and plants, including bodies being under jurisdiction of the State Department of Supervision for safety work in the nuclear-power engineering and industry; improvement of processing technique, welding and controlling of components and assembly units made from noncorrosive steel and alloys.

Main subdivisions: machine shop, welding-assembly shop, design departments, technological division, division of the technical control and metrology, chemistry laboratory of the incoming control of the metal, laboratory of the mechanical test, gaging laboratory.

Production and Services: producing the complex installation for scientific investigations, development and producing of the non-standard equipment, including working under pressure and high temperature; equipment for production and processing spirit and alcohol productions pumps for food and chemical industry, seals; air reservoir, vessels, including working under pressure; plants and equipment testing.

4. Design Republican Unitary Enterprise '[Scientific Instrument-making](#)'

Field of activities: design, manufacturing, installation, replicating of technology equipment for the automation of production processes in various sectors of the economy; modernisation of domestic and imported equipment, which was established on the basis of computer technology; manufacturing of experimental designs and fabricating of small series (on the orders of companies) of own-producing developments; training and the necessary measures jointly with industrial enterprises to put on the production of high technology products for sale on the domestic and foreign markets.

5. Scientific and Production Republican Unitary Enterprise '[NPO Centre](#)'

Field of Activities: development and manufacture of crushing, grinding and classifying equipment to process and concentrate ore and non-metallic materials, development of technologies based on the equipment the plant produces. Development and manufacture of technological, medical and laboratory centrifuges, attractions, plasma and water jet cutting machines, manufacture of non-standardised equipment.



Subdivisions: scientific and technological, research, manufacturing, promising projects development, standardisation and certification.

Production and Services: Crushers and mills of impact-centrifugal effect of different productivity, air cascade-gravity classifiers and centrifugal classifiers to perform size-separation of the ground product into several fractions or to separate the product of a size. Milling and classifying complexes on the basis of crushing and classifying equipment, technological and medical centrifuges, plasma and waterjet cutting complexes. Technologies to concentrate and process minerals, technologies and equipment to process the screenings of crushing and sorting industry, technologies to obtain cubical shape crushed rock, technologies and equipment to obtain mineral admixtures from the black sand.

6. Republican Unitary Enterprise '[The Instrument Manufacturing Plant 'Optron'](#)

Field of Activities: Development and manufacturing of scientific devices and equipment, agricultural technique.

Subdivisions: associated companies '[Nuklon](#)', 'Labora', 'Optron-CYCLO'.

Production and Services: optical elements, equipment for greenhouses, greenhouse management, controlled contactless DC motors, agricultural equipment, fire barrel, galvanic coverages, welding works, metal-workingness, including high-fidelity.

7. State Scientific Institution '[The Powder Metallurgy Institute](#)

Field of Activities: Investigations and design of new materials in the field of powder metallurgy and ceramics, composite, man-size and super hard materials, protective coatings, welding, including with use of dynamic and pulse methods of load. Production of pilot sets of articles from construction, antifriction, electro-technical, friction, porous and other materials. Training, post training, attestation of workers and specialists in the field of powder metallurgy, deposition of protective coatings, welding.

Subdivisions: departments of machine-building materials; porous materials; investigation and testing of materials; standardisation and metrology; pilot plant; separated self-supporting subdivisions

8. Production Republican Unitary Enterprise '[Molodechno Powder Metallurgy Plant](#)

Production and Services: Products from antifriction and constructional materials: pinions, ratchets, cams, levels, rings, washers, gags, caps, covers, flanges, bearing bodies, collapsible friction bearings, shock-absorbers for cars and lorries, commutators and inserts of starters of different types, sheaves and naves of water pumps of cars, electrical contacts, different devices and furniture fittings, structural parts used in home appliances and motor-car industry. Friction parts for automotive units and tractor equipment, transmitting torsional force from the engine to the executive elements (safety clutches, brakes, gearbox), friction discs. Heatsinks (refrigerants) based on heat pipes for efficient cooling of power semiconductor devices (thyristors), which are elements of power installations of electric power stations, hydroelectric power stations, electric power stations of railway, starting aviation engines operation, used in electric machines for cooling the rotors and stators of motors, generators, and winding of transformer, in the welding technique for cooling moulds for casting, stamping with glass and plastic tableware, aluminium casting parts. Atomised bronze powder of different grades: with non-spherical shape for flame spraying of parts, with a high percentage of spherical particles for the manufacture of filter elements, for surfacing. Filter elements made of porous powder material for the separation of gases and liquids from impurities, to clean fuels, oils, resins, lacquers, molten salts and polymers, filtration of liquefied and compressed gases, use as a silencer, performed in the form of discs, plates, cylinders, cups, cones, etc.

9. Republican Fiscal Enterprise '[The Centre for Utilisation of Artillery and Engineer Ammunition](#)

Field of Activities: Organisation and fulfilment of works on utilisation of artillery and engineer ammunition (aviation shells) and artillery gunpowder.

Production and Services: production, realisation and storage of industrial explosives, sales of iron-and-steel and nonferrous metal scrap, obtained during the utilisation of ammunition, elaboration and realisation of technical documentation, regulating the utilisation of ordinary types of ammunition; utilisation of artillery and engineer ammunition (aviation shells), artillery gunpowder.

10. Republican Fiscal Enterprise '[The Centre for Utilisation of Aviation Means of Destruction](#)

Field of Activities: Organisation and execution of works for utilisation of aviation means of destruction (some types of artillery and engineer ammunition).

Production and Services: manufacturing, realisation and keeping of industrial explosives, realisation of scrap of ferrous and non-ferrous metals, obtained in the process of ammunitions utilisation, design and realisation of technical documentation which regulates the utilisation of usual ammunitions; utilisation of aviation means of destruction (some types of artillery and engineer ammunitions).



11. Republican Production Unitary Enterprise '[Academpharm](#)'

Field of Activities: development of ready-made forms and pilot production of proprietary pharmaceutical products, commercial production of medicines and other pharmaceutical products, vitamins, vitamin-mineral and metabolic systems; pharmaceutical research laboratory; pharmaceutical contract manufacturing; development and manufacturing of medical products and laboratory supplies.

Subdivisions: departments of marketing; logistics; technology; quality control; production of pharmaceutical products; shop plastificated products; laboratory of development; microbiology laboratory.

Production and Services: multivitamin, vitamin-mineral and metabolic systems; medicines for the treatment of gastrointestinal and metabolic disorders, diseases of the cardiovascular system, diseases of urogenital organs, diseases of the musculoskeletal system, neurological diseases and disorders of the sense organs, other medicines; pharmaceutical laboratory research; contract pharmaceutical manufacturing; production of medical devices and laboratory supplies.

12. Republican Unitary Enterprise '[The Scientific and Production Centre of Multipurpose Unmanned Systems](#)'

Field of Activities: research and development in the field of unmanned aircraft systems, robotic ground (surface) and underwater devices, small manned aircraft; production and organisation of multifunctional unmanned systems, their components, and other specialised equipment serial production; the maintenance of multifunctional unmanned systems, monitoring of the earth (water) surface, ground targets from the air.

Subdivisions: system design and mathematical modelling department, introduction of scientific and technical developments and scientific support for research and development department, organisational and planning department, production technology department, engineering department, design and installation of on-board equipment department, engineering communications and installation of ground equipment department, testing and technical support department.

Products and services: unmanned aerial vehicles, ground control stations, gyrostabilised opto-electronic systems, antenna-mast devices, hardware-software and flight and navigation systems, simulators, sources of infrared radiation; provides technical training and maintenance (warranty) service of its products.



Annex 5. Suggested basic framework for data collection during inventorisation of the existing competence centres

Axe 1: Data on organisations:

1. name of organisation;
2. legal form;
3. specialised department or body (i.e. working group) and contact person and data;
4. reference to projects.

Axe 2: List of thematic fields

Key enabling technologies	Digital technologies ⁵	Digitising economy
<ol style="list-style-type: none"> 1. Advanced manufacturing sectors; 2. Advanced materials; 3. Digital technologies; 4. Industrial biotechnology; 5. Micro-electronics; 6. Nanotechnology; 7. Photonics and photonics-based manufacturing. 	<ol style="list-style-type: none"> 1. Organic and Large Area Electronics (OLAE); 2. Micro and nano electronics, smart system integration; 3. Sensors, actuators, MEMS, NEMS, RF; 4. Photonics, electronic and optical functional materials; 5. Screens and display technologies; 6. Broadband and other communication networks (e.g. 5G); 7. Cyber physical systems (e.g. embedded systems); 8. Robotics and autonomous systems; 9. Internet of Things (e.g. connected devices, sensors and actuators networks); 10. Artificial Intelligence and cognitive systems; 11. Location based technologies (e.g. GPS, GIS, in-house localisation); 12. Interaction technologies (e.g. human-machine Interaction, motion recognition and language technologies); 13. Cyber security (including biometrics); 14. Advanced or High-performance computing; 15. Data mining, big data, database management; 16. Augmented and virtual reality, visualisation; 17. Simulation and modelling; 18. Gamification; 19. Software as a service and service architectures; 20. Cloud computing; 21. Additive manufacturing (3D printing); 22. Laser based manufacturing; 23. ICT management, logistics and business systems; 24. Internet services (e.g. web development, web production, design, networking, and e-commerce); 25. New Media technologies. 	<ol style="list-style-type: none"> 1. Autonomous logistical systems; 2. Autonomous vehicles; 3. Business process management; 4. Digital commerce; 5. Digital forensics; 6. Digital transport corridors; 7. Digital twins; 8. Distributed registry; 9. Energy efficiency; 10. Fintechs; 11. Flexible and wearable electronics; 12. Geographic information systems; 13. Marking (RFID, etc.) and traceability; 14. Open data & open science; 15. Project, programme, portfolio management; 16. Research; 17. Smart city; 18. Smart contracts; 19. Strategic planning and policies.

⁵ As in [DIH catalogue](#).



Annex 6. Training basis for digitising industry in Belarus: selected programmes of Belarusian State University for Informatics and Radioelectronics

Bachelor's degree

Engineer in IT, Computer Science, Computer Engineering, Electronics, Infocommunication, etc.

Programme	Faculty
Artificial Intelligence	Faculty of Information Technologies and Control
Automated Data Processing Systems	Faculty of Information Technologies and Control
Computer Engineering	Faculty of Computer-Aided Design
Computer Science and Software Engineering	Faculty of Computer Systems and Networks
Computers, Systems and Networks	Faculty of Computer Systems and Networks
Design and Manufacture of Software-Controlled Electronic Devices	Faculty of Computer-Aided Design
Digital Marketing	Faculty of Engineering and Economics
Economics in Electronic Business	Faculty of Engineering and Economics
Electronic Instrumentation and Control Systems of Physical Installations	Faculty of Radioengineering and Electronics
Electronic Security Systems	Faculty of Computer-Aided Design
Engineering-Psychological Maintenance of Information Technologies	Faculty of Computer-Aided Design
Industrial Electronics	Faculty of Information Technologies and Control
Infocommunication Systems	Faculty of Infocommunications
Infocommunication Technologies	Faculty of Infocommunications
Infocommunication Technologies	Military Faculty
Infocommunication Technologies	Faculty of Infocommunications
Information Security in Telecommunications	Faculty of Infocommunications
Information Systems and Technologies	Faculty of Innovative Lifelong Learning
Information Systems and Technologies	Faculty of Information Technologies and Control
Information Systems and Technologies	Faculty of Computer-Aided Design
Information Systems and Technologies	Faculty of Engineering and Economics
Information Technologies and Control in Engineering	Faculty of Information Technologies and Control
Information Technology Software	Faculty of Computer Systems and Networks
Medical Electronics	Faculty of Computer-Aided Design
Micro- and Nanoelectronic Technologies and Systems	Faculty of Radioengineering and Electronics
Modelling and Simulating and Computer Design of Radioelectronic Devices	Faculty of Computer-Aided Design



Programme	Faculty
Nanotechnologies and Nanomaterials in Electronics	Faculty of Radioengineering and Electronics
Programmable Mobile Systems	Faculty of Computer-Aided Design
Quantum Information Systems	Faculty of Radioengineering and Electronics
Radioelectronic Data Protection	Faculty of Radioengineering and Electronics
Radioelectronic Systems	Faculty of Radioengineering and Electronics
Radioengineering	Faculty of Radioengineering and Electronics
Radioengineering	Military Faculty
Radioinformatics	Faculty of Radioengineering and Electronics
Software-Controlled Digital Optical Systems	Faculty of Computer-Aided Design



Master's degree

Programme	Faculty
Antennas, Microwave Devices and their Technologies	Faculty of Radioengineering and Electronics
Applied Mathematics and Informatics	Faculty of Computer Systems and Networks
Artificial Intelligence	Faculty of Information Technologies and Control
Automation and Control of Technological Processes and Production	Faculty of Information Technologies and Control
Components and Devices of Computers and Control Systems	Faculty of Computer-Aided Design
Computers and Computer Systems	Faculty of Computer Systems and Networks
Computers, Computer Systems and Network Software	Faculty of Computer Systems and Networks
Design of Electronic Systems in Computer Technology	Faculty of Computer-Aided Design
Devices and Methods of Image and Sound Transformation	Faculty of Infocommunications
Economics and Management of National Economy	Faculty of Engineering and Economics
Economics and Production Organisation	Faculty of Engineering and Economics
Emergency Prevention and Response	Faculty of Computer-Aided Design
Geo-Ecology	Faculty of Computer-Aided Design
Infocommunication Systems and Networks	Faculty of Infocommunications
Informatics and Technology of Software Development	Faculty of Computer Systems and Networks
Information Security Hardware and Software	Faculty of Radioengineering and Electronics
Informational Radiotechnologies	Faculty of Radioengineering and Electronics
Instrument-Making Technology	Faculty of Computer-Aided Design
Instrument-Making, Metrology and Information Measuring Devices and Systems	Faculty of Infocommunications
Intelligent Computer Complexes, Systems and Computer Networks	Faculty of Computer Systems and Networks
Labour Protection	Faculty of Computer-Aided Design
Labour Psychology, Engineering Psychology, Ergonomics	Faculty of Computer-Aided Design
Management of Industrial Process Safety	Faculty of Computer-Aided Design
Mathematical and Instrumental Methods in Economics	Faculty of Engineering and Economics
Mathematical Modelling, Numerical Methods and Programme Complexes	Faculty of Computer Systems and Networks
Medical Devices, Systems and Products	Faculty of Computer-Aided Design
Methods and Systems of Information Protection, Information Security	Faculty of Infocommunications



Programme	Faculty
Nanotechnologies and Nanomaterials (in Electronics)	Faculty of Radioengineering and Electronics
Optical and Optical-Electronic Devices and Complexes	Faculty of Computer-Aided Design
Radioengineering, including Radio Navigation, Radio Location and Television Systems and Devices	Faculty of Radioengineering and Electronics
Radiophysics	Faculty of Radioengineering and Electronics
Solid-State Electronics, Radioelectronic Components, Micro- and Nanoelectronics, Quantum Effect Devices	Faculty of Radioengineering and Electronics
System Analysis, Information Control and Processing of Information	Faculty of Information Technologies and Control
Technology and Equipment for Production of Semiconductors, Materials and Electronic Devices	Faculty of Computer-Aided Design
Telecommunication Systems and Computer Networks	Faculty of Infocommunications
Telecommunication Systems, Networks and Devices	Faculty of Infocommunications
Theoretical Foundations of Informatics	Faculty of Information Technologies and Control



PHD Degree

Degrees upon graduation: Doctor of Philosophy in the respective focus area, such as Engineering, Physics and Mathematics or Economics; and additionally, a Researcher's Diploma and Candidate of Science degree (Kandidat Nauk).

Programme	Faculty
Antennas, Microwave Devices and Technologies	Faculty of Radioengineering and Electronics
Automation and Control of Technological Process and Production	Faculty of Information Technologies and Control
Computer-Aided Design Systems	Faculty of Computer Systems and Networks
Computing Machines and Complexes and Computer Networks	Faculty of Computer Systems and Networks
Condensed State Physics	Faculty of Radioengineering and Electronics
Economics and Management of National Economy	Faculty of Engineering and Economics
Elements and Devices of Computer and Controlling Systems	Faculty of Computer Systems and Networks
Labour Psychology, Engineering Psychology, Ergonomics	Faculty of Computer-Aided Design
Labour Safety	Faculty of Computer-Aided Design
Management of Social and Economic Systems	Faculty of Engineering and Economics
Mathematical and Instrumental Methods in Economics	Faculty of Engineering and Economics
Mathematical Simulation, Numerical Methods and Programme Complexes	Faculty of Computer Systems and Networks
Medical Devices, Systems and Products	Faculty of Computer-Aided Design
Methods and Systems of Information Protection, Information Security	Faculty of Infocommunications
Metrology and Metrological Assurance	Faculty of Infocommunications
Nanotechnologies and Nanomaterials in Electronics	Faculty of Radioengineering and Electronics
Optics	Faculty of Computer-Aided Design
Physical Electronics	Faculty of Radioengineering and Electronics
Radio-Measuring Devices	Faculty of Infocommunications
Radioengineering, including Television Systems and Devices	Faculty of Radioengineering and Electronics
Radiolocation and Radionavigation	Faculty of Radioengineering and Electronics
Radiophysics	Faculty of Radioengineering and Electronics
Safety in Emergency Situations	Faculty of Computer-Aided Design
Software for Computers, Computer Complexes, Systems and Networks	Faculty of Computer Systems and Networks
Solid-State Electronics, Radioelectronics Components, Micro- and Nanoelectronics, Quantum Effect Devices	Faculty of Radioengineering and Electronics
System Analysis, Control and Processing of Information	Faculty of Information Technologies and Control
Technology and Equipment for Production of Semiconductors, Materials and Electronic Devices	Faculty of Computer-Aided Design



Programme	Faculty
Technology and Equipment for Production of Semiconductors, Materials and Electronic Devices	Faculty of Computer-Aided Design
Telecommunication Systems, Networks and Devices	Faculty of Infocommunications
Theoretical Electrical Engineering	Faculty of Information Technologies and Control
Theory of Informatics	Faculty of Information Technologies and Control