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SUMMARY REPORT SKILLS FOR SMART SPECIALISATION

Rivne, Ukraine

THE EU AGENCY SUPPORTING COUNTRIES TO DEVELOP THROUGH LEARNING

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1. BACKGROUND

Smart specialisation is an innovative policy approach that aims to boost jobs and growth by enabling countries and regions to better exploit their competitive advantage. Smart specialisation strategies are a means to deal with the uncertainty and reshape regional development policy to mitigate the effects of the crisis brought on by the COVID-19 pandemic. The approach can help regions and countries to anticipate, plan and implement their economic modernisation processes (EC, 2017) by prioritising public investments for economic transformation and by facilitating market opportunities in value chains. Smart specialisation is a place-based method that encourages meaningful dialogue among various stakeholders – business, research, innovation, education and employment. It supports evidence-based prioritisation of public investment that fosters growth and competitiveness.

In the European Union and its Neighbourhood region, smart specialisation is closely linked to the EU's financial framework and cohesion policy priorities as a strategy to support countries and regions in their drive for innovation-led economic transformation. As part of the European Commission's 2021-2027 Multiannual Financial Framework, the 'Interregional Innovative Investments' component prioritises building pan-European clusters based on complementarities and synergies. Human capital is a crucial element of any developmental strategy. Beyond the tertiary education and research sector, vocational education and training and medium-level qualifications play a significant role in driving forward the smart specialisation agenda in the EU Neighbourhood region as countries prioritise economic clusters that include occupational areas relevant for both tertiary and upper secondary education.

In spite of vocational education and training (VET) and skills development having been recognised as framework conditions for innovation ecosystems, they are not fully reflected in the tools and methodologies that currently guide the design of smart specialisation strategies in the EU Neighbourhood. To address the challenge of connecting VET to the broader drive for innovation, growth and competitiveness, in 2019 the European Training Foundation (ETF) started to develop and test a practical guide for analysing the skills implications of smart specialisation strategies. Based on lessons learnt from the two pilot studies on Montenegro (ETF, 2020) and Moldova (ETF, 2021a), in 2020 the ETF strengthened and added to the methodology with a view to adapting it to regional contexts. A fully fledged methodological approach is due to be completed in 2021 and will take into consideration results from the research and partnerships implemented at regional level in Rivne, Ukraine.

This paper provides a summary of findings that emerged from implementing the ETF's 'Skills for smart specialisation' methodological approach in Rivne, Ukraine. The paper sheds light on the implications that smart specialisation has on the demand for skills and on what changes are needed from education and training to respond to this demand – in order to realise the productivity gains from smart specialisation that, if distributed, have the potential to increase wages, raise the attractiveness of jobs in the region and, eventually, generate wider well-being in Rivne.

Partners from Estonia and the Netherlands played a pivotal role in the success of the ETF's initiative in Rivne, Ukraine.

Box 1: HMC, school for wood, furniture and interior professionals Rotterdam, Netherlands

Website: https://hmcollege.nl/

HMC is engaged with the ETF in Rivne, Ukraine, to share their experience on understanding trends and possible future developments in the furniture manufacturing and woodworking sector, and ensuring that the students have the right skills at the right time - in support of regional competitiveness.
HMC is an independent post-secondary vocational college where students are trained for a profession in woodworking, furniture or interior design sectors in the Netherlands. Established in 1929, HMC focuses on creativity, craftsmanship and entrepreneurship. HMC has teaching locations in Amsterdam and Rotterdam. The school is a relatively small college (3000 students). Many teachers previously worked in the field or still do part time.
Over the years, extensive contacts have been built up with the industry, so the education fits well with the working practice and their students have a wide choice of work placements. HMC offers mainstream education (school-based as well as work-based learning programmes), pursuant to the Act on education and vocational training (WEB Act). In addition, HMC offers courses and training for employees and employers in the sectors.

Box 10: Võru County Vocational Training Centre in Estonia
Võru, Estonia

VÕRUMAA KUTSEHARIDUSKESKUS

Website: www.vkhk.ee

The Võru County Vocational Training Centre is the best internationally known and recognised education institution in Estonia, offering attractive involving and flexible teaching and supporting personal growth. The Centre was established in 1999 and has about 570 students and 80 employees.
Võru County Vocational Training Centre offer vocational education to students who just graduated 9th grade as well as those who finished high school. On some vocations, it is possible to study without having basic education and in sessional teaching as well as work-based teaching. The school actively organizes different complementary trainings to adult learners.
In addition to the main buildings the school has a campus, Tech House and a Centre of Competence for Wood Processing and Furniture Manufacturing - TSENTER (http://tsenter.ee/en/). TSENTER is a network linking the public sector, private industry, and educational and research institutions, providing knowledge, skills, and best practices in materials and technologies to advance production, management, and product development in wood processing and furniture manufacturing. Focus areas for TSENTER in woodworking and furniture manufacturing are product development, finishing and production management.

2. SMART SPECIALISATION IN RIVNE

A resolution by the Cabinet of Ministers of Ukraine (5 August 2020, No 695) approved by the State Strategy for Regional Development for 2021-2027, Operational goal 5 'Sustainable industry development', states the following priorities[1]:

- develop and implement a mechanism for state financial support for regional development projects, which provide for the development of priority types of economic activities determined on the basis of smart specialisation (including regional and Kyiv city state administrations in accordance with the EU smart specialisation methodology) and the smart specialisation projects envisaged in regional development strategies (hereinafter 'smart specialisation projects');
- introduce tools to support the participation of small and medium-sized enterprises in smart specialisation projects;
- ensure the accession of all regions of Ukraine to the European Smart Specialisation Platform (S3 Platform) in order to open access to the platform tools for the regions of Ukraine;
- create and implement a mechanism for providing priority support for the development of production facilities that create new jobs based on the use of local resources and resource-saving technologies, and provide for the placement of industrial capacities in the regions to produce energy-efficient equipment and building materials;
- determine and offset up the relevant infrastructure for the territories within which business entities can conduct production activities.

The initial analysis of the economic potential according to the smart specialisation approach of the Rivne region included 131 industries, 60 of which met at least one of the four selection criteria: employment, average wage, change in average wage and change in employment. Based on the analysis – both static and dynamic – of key indicators related to the four criteria[2], wood processing and furniture manufacturing were identified as key[3].

The ETF analysis, including the analysis of existing evidence, interviews and focus groups with key stakeholders, as well as a foresight exercise, all build on the regional smart specialisation strategy. The ETF analysis identifies what the regional smart specialisation strategy means for skills in the priority area of wood processing and furniture manufacturing.

The vision for skills in the Rivne smart specialisation priority area of wood processing and furniture manufacturing, as identified during the foresight process, implemented in the first half of 2021 involving key representatives of regional administration, employers, education and training providers and sectoral associations through expert panels and Delphi surveys, is as follows:

> Rivne is **a knowledge-intensive player** in the global wood processing and furniture manufacturing value chain. Rivne's wood processing and furniture manufacturing sector is **innovative, highly competitive and export-oriented** with unique suppliers and specialised human capital that

[1] Resolution on the approval of the State Regional Development Strategy for 2021/2027| 5 August 2020 No 695 (rada.gov.ua)

[2] Rivne development strategy 2021-2027, p. 117 (https://www.minregion.gov.ua/napryamki-diyalnosti/derzhavna-rehional-na-polityka/strategichne-planuvannya-regionalnogo-rozvitku/regionalni-strategiyi-rozvytku-na-period-do-2027-roku/strategiya-rozvytku-rivnenskoyi-oblasti-na-period-do-2027-roku/)

[3] The methodology for defining smart specialisation incorporates an evaluation of sectors' economic potential both by criteria relating to the sector's actual value in the economy (static criteria) and by criteria relating to development rates and dynamics (dynamic criteria).

leverage cutting-edge technology and build on **sustainable regional natural resources** (renewable sources, circular economy) that provide crucial inputs.

The sector is strongly anchored in regional human and natural resources, but with a diversified supply chain to reduce vulnerabilities, making **moving production outside the regional ecosystem costly**, and therefore unlikely. The wood processing and furniture manufacturing sector is contributing to rising prosperity in the region and in Ukraine. VET provision builds on an **intensive cooperation with local businesses and regional administration** and provides various training for different target groups (e.g. learners, employees), integrating design, entrepreneurship, sustainable production, technology transfer and applied research.

3. WOOD PROCESSING AND FURNITURE MANUFACTURING IN RIVNE

The wood processing sector plays an important role in the economy of Rivne and accounted for 7.2% of the value of sold production and 3.3% of employment in the region in 2019, while the furniture manufacturing sector accounted for 1.6% of the value of sold production and 1% of employment in the region[4].

Since 2016, there has been a steady growth in the number of enterprises in wood processing, with a significant number of individual entrepreneurs. In 2019, there were 1 large, 13 medium, 166 small and micro-enterprises, and 724 individual entrepreneurs working in the region[5]. In 2019, in the furniture manufacturing sector there were 4 medium, 20 small and micro-enterprises, and 226 individual entrepreneurs.

In 2019, the share of furniture industry exports was 9.6% of the region's total exports, ending an upward trend since 2015[6]. The share of woodworking industry exports is higher, standing at 32.4% of the region's total exports in 2019[7].

The operations of wood processing enterprises in Rivne consist mainly of manufacturing plywood, sanded and laminated chipboards, while production in the furniture manufacturing sector is broader and includes the serial production of soft and cabinet furniture (including furniture and equipment for the food industry, retail, bathrooms, etc.); custom and bespoke furniture manufacturing projects and related decorative elements (stairs, railings, fences); and the manufacture of other wood products and furniture (installation of doors, windows, metal accessories and decorative elements, mirrors, lighting elements, etc).

[4] Rivne Regional Statistics Committee.

[5] Rivne Regional Statistics Committee – Regional statistics include only enterprises registered in a specific region. A certain number of larger enterprises are established in Rivne. However, these enterprises are registered in other regions, therefore they are not accounted for in the regional statistics.

[6] Rivne Regional Statistics Committee – idem.

[7] Rivne Regional Statistics Committee, 2019 (http://www.gusrv.gov.ua/)

3.1 Employment characteristics of wood processing and furniture manufacturing

The number of people employed in the wood processing and furniture manufacturing has been growing. Between 2014 and 2020, this number grew by 33.6%. The positive trend is mostly driven by growth in the number of small enterprises.

Table 1. Number of people employed by size of enterprise in wood processing and furniture manufacturing in Rivne, 2014-2019

Sector	2014	2015	2016	2017	2018	2019
31 Manufacture of furniture (total number of people employed)	**1 256**	**1 212**	**1 442**	**1 647**	**1 588**	**1 595**
Including for companies as a percentage						
Large enterprises	-	-	-	-	-	
Medium enterprises	92.9	95.0	94.8	93.7	89.5	91.9
Small enterprises	3.7	2.0	2.8	3.3	7.8	6.1
Micro-enterprises	3.4	3.1	2.4	3.0	2.6	1.9
16 Manufacture of wood and wooden products (total number of people employed)	**4 390**	**4 896**	**4 989**	**5 201**	**5 520**	**5 407**
Including for companies as a percentage						
Large enterprises	*	*	*	*	*	*
Medium enterprises	*	*	*	*	*	*
Small enterprises	*	11.1	*	12.3	13.1	13.7
Micro-enterprises	3.9	5.9	5.4	6.8	5.4	4.5

*Note: * Missing data*
Source: Rivne Regional Statistics Committee

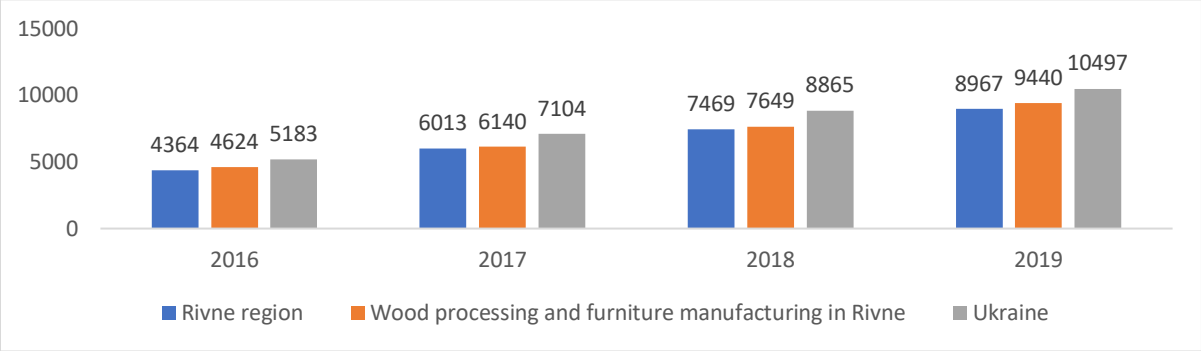
The distribution of people employed in wood processing and furniture manufacturing by their level of education shows that the majority have completed vocational education[8]. Only a small share of workers have completed higher education.

An increase in wages can be observed in the wood processing and furniture manufacturing sector in Rivne. Wages in the sector are higher than average in the Rivne region, however, they remain below the overall national average. Between 2013 and 2017, labour costs increased threefold. The most significant growth was observed in the sub-sector of the manufacture of products of wood, cork, straw and plaiting materials[9].

[8] The level corresponding to ISCED 3.
[9] Rivne Regional Statistics Committee, 2019 (http://www.gusrv.gov.ua/).

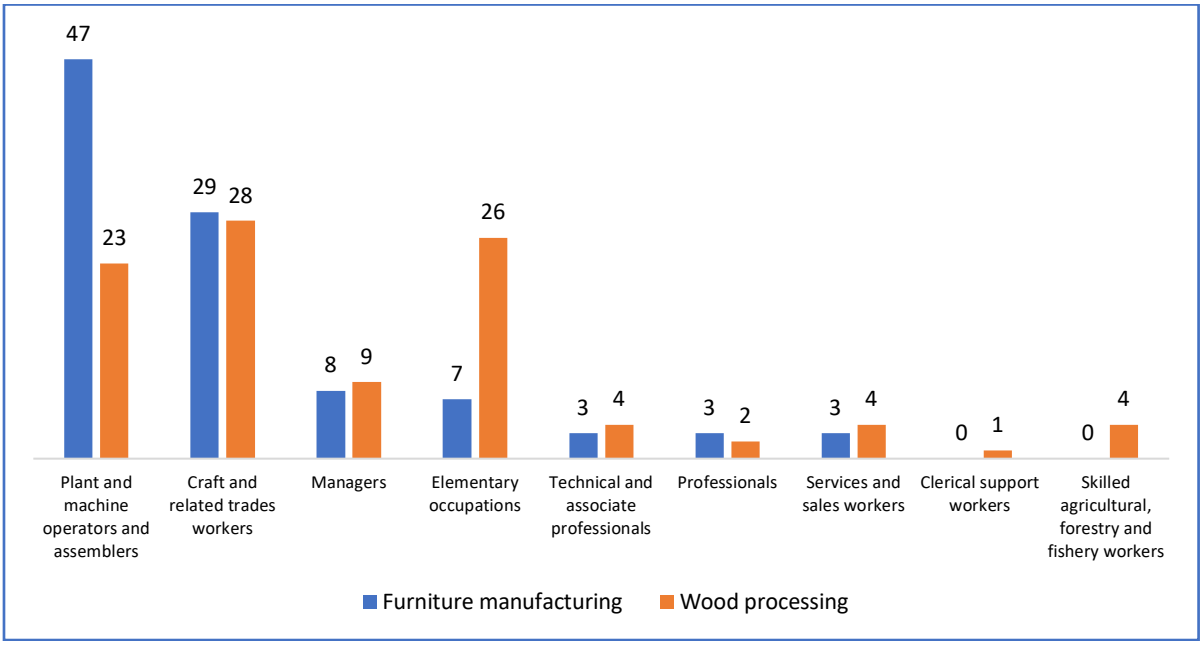
Figure 1. Average wages (UAH)

(Wages across all sectors in Rivne, wages in the wood processing and furniture manufacturing sector in Rivne, and wages across all sectors in Ukraine)



Source: Rivne Regional Statistics Committee

Figure 2. Occupational structure of the wood processing and furniture manufacturing sector in the Rivne region, 2020 (%)



Source: Pension Fund of Ukraine

There are variations in the occupational structure of people employed in the wood processing and furniture sector. For both, most of employees belong to the occupational groups of 'craft and related trades workers' and 'plant and machine operators and assemblers'. However, in the wood processing sector, the share of of elementary occupations is higher, while the share of mechanics and assemblers is significantly lower.

The results of interviews with employers, training providers and the regional administration point to shortages of workers caused largely by difficult working conditions, low attractiveness, low wages, and migration outflow, especially among young people.

According to the data from the regional employment service, in 2019, 947 unemployed persons were registered with the regional employment service for occupations relevant to the two sectors (see Table 2). During this period, employers in Rivne reported 1 626 vacancies in the wood processing and furniture manufacturing sector.

Table 2. Number of unemployed people and vacancies in Rivne region (2019)[10]

Occupation	January-December 2019		
	Number of unemployed	Number of vacancies	Shortage of workers
Seamstress	306	647	341
Machine operator of woodworking machines	140	319	179
Woodcutter	190	222	32
Forklift driver	55	114	59
Joiner	67	80	13
Sorter of materials and wood products	38	76	38
Operator on automatic and semi-automatic lines in woodworking	24	47	23
Drying plant operator	22	28	6
Other	105	93	-

Source: Rivne Regional Employment Service

According to employers[11], new employees do not fully meet employers' requirements. Employers' main concerns relate to a lack of professional knowledge and skills, more specifically:

- Hard skills, e.g. practical training and skills to work with modern equipment and tools:
  - working with technical documentation, flow charts and diagrams;
    - digital skills such as computer programming and modelling, debugging of machines, and operating with CAD/CAM tools.
- Soft skills:
  - self-organisation;
  - communication skills;
  - creativity;
  - teamwork;
  - computer skills;
  - conflict resolution;
  - time management;
  - English language skills.

[10] Data refers to the overall numbers of vacancies.

[11] Specific questions were asked to employers during interviews in October 2020.

3.2 Education and training provision in wood processing and furniture manufacturing

There are currently 15 educational institutions in Rivne that provide education and training in the field of wood processing and furniture manufacturing in eight occupations relevant for the sector:

- (7124) Construction carpenter;
- (7124) Carpenter;
- (7422) Woodworker;
- (7331) Manufacturer of artistic products from a rod;
- (7331) Manufacturer of artistic products from a wood;
- (7241) Wood and birch carver;
- (7132) Parquet layer;
- (7423) Woodworking machine operator.

The number of students is the highest for specialisations in wood processing such as construction carpenter, carpenter and woodworker. In the specialisation of parquet installation, no students were enrolled in the 2019/2020 academic year. In general, the number of available training places is higher than the number of students enrolled across all occupations. On average, only one third of training places are filled.

Table 3. VET institutions' training capacity and real enrolment in Rivne (2019-2020)

	Occupations				
	Institution	Construction carpenter Carpenter Woodworker	Wood and birch carver Manufacturer of artistic products from a wood/rod	Parquet layer	Machine operator of woodworking machines
1	Higher Vocational School #1, Rivne city	Available training places: 120 Enrolment: 52			Available training places: 60 Enrolment: 14
2	Vocational and Technical School of Rivne Nuclear Power Plant	Available training places: 30 Enrolment: 14	Available training places: 30 Enrolment: 14		
3	Higher Vocational School of arts, Dubno	Available training places: 30 Enrolment: 59	Available training places: 30 Enrolment: 3		
4	Higher Vocational School #29, Volodymyrets				
5	Training centre of Rivne VET centre at state employment centre, Hoshcha		Available training places: 30 Enrolment: 0		
6	Higher Vocational School #25, Demydivka	Available training places: 30 Enrolment: 0			Available training places: 30 Enrolment: 0
7	Dubrovytsia Professional Lyceum	Available training places: 30 Enrolment: 0			

8	Zdolbuniv Higher Vocational School of Railway Transport	Available training places: 30 Enrolment: 16			
9	Polytskiy training centre #76				Available training places: 20 Enrolment: 0[12]
10	Katerynivskiy training centre #46				Available training places: 20 Enrolment: 0[13]
11	Training centre of Rivne VET centre at state employment centre, Oleksandriia	Available training places: 30 Enrolment: 0			Available training places: 30 Enrolment: 0[14]
12	Radyvyliv Professional Lyceum	Available training places: 60 Enrolment: 27			
13	Rokytne Professional Lyceum	Available training places: 30 Enrolment: 0			
14	Higher Vocational School #22, Sarny	Available training places: 60 Enrolment: 58			
15	Sosnove Professional Lyceum	Available training places: 180 Enrolment: 0		Available training places: 180 Enrolment: 0	

Continuing vocational education and training is rather scarce in Rivne. At present, only five VET schools and two training centres under the state employment office in Oleksandriia and Hoshcha provide relevant short training programmes for adults for the specialisations of construction carpenter, operator of woodworking machines and manufacturer of artistic products from a rod.

The professional training of skilled workers in wood processing and furniture manufacturing is done according to the NQF, the State Educational VET Standards, approved by the Ministry of Education and Science, and State Nomenclature of Vocational Training professions that are trained for at VET institutions[15].

All professions fully correspond to the occupational skills and knowledge specified in the national VET standards. No occupational standards are developed for professions in the sector.

Based on the interviews with VET providers, there is growing awareness on the importance of partnerships for exchange and transfer within the regional innovation ecosystem through technology transfer or applied research. However, to date, VET schools and centres in Rivne do not have a mandate to add value to businesses and society based on regional development priorities. Direct and continuous collaboration with businesses, other education and training providers, including higher education, is not a mission of VET schools and centres, nor is the provision of services or research to

[12] No information on the number of students present in the state database on education.
[13] No information on the number of students present in the state database on education.
[14] No information on the number of students present in the state database on education.
[15] Про затвердження Державного пер... | від 11.09.2007 № 1117 (rada.gov.ua)

businesses. Cooperation between business and vocational schools and centres rarely goes beyond the provision of practical experiences for students, and collaborative projects are exceptional. Interviews with VET providers and employers showed that enterprises with modern equipment rarely cooperated with vocational (professional-technical) education institutions, which would help make education and training more practically relevant and foster knowledge transfer to more traditional enterprises.

The analysis shows that existing training programmes focus on the provision of technical skills but lag behind in the integration of soft skills, which are not listed among the competences in the relevant educational standards.

The extent to which digital technologies are embedded in the curricula and standards is rather low, and the equipment is insufficient. At the same time, teachers need continuous support to effectively integrate new technologies in teaching and to leverage them to develop the skills needed by the regional economy.

4. SKILLS RESPONSES FOR THE VISION IN WOOD PROCESSING AND FURNITURE MANUFACTURING

Wood processing and furniture manufacturing is a mature sector based on renewable natural resources of raw wood. The sector can be a source of sustainable growth; however, innovation is crucial to sustain market growth and competitive ability. Innovation in the production processes in the furniture industry are generally focused around competitiveness and reducing costs, or specialisation in terms of quality and product differentiation.

The innovation required by competitiveness and the reduction of costs includes the automation of business processes, integration with business partners, the use of computer-aided design or manufacturing (CAD-CAM), and the introduction of new materials that are more resistant, cheaper or more sustainable than the ones previously used. Use of the internet and the development of e-business are also important means to expand sales to new markets.

Skills shortages are a major barrier to technology adoption by businesses, particularly SMEs. Moreover, businesses are being hindered by a fragmented skills system and a lack of systematic engagement between education and industry. A comprehensive analysis of specific skills requirements and competences required by sector developments already exists at European level.[16]

Three key areas of skills shortages and gaps have been identified through the foresight process in Rivne, which aimed to build a shared vision of key stakeholders for skills and policy responses needed to support the regional vision for smart specialisation in wood processing and furniture manufacturing: (1) digital skills; (2) design and wood composites; and (3) green skills and the circular economy.

4.1 Digital skills

Digitisation is at the heart of Rivne's smart specialisation in wood processing and furniture manufacturing. While VET schools and centres are still preparing workers with mainly analogue skills, they are acutely aware that design, manufacturing and logistics capabilities in the industry are becoming increasingly digital. The priority in driving smart specialisation forward is to update training provision to include intermediate and advanced skills in additive manufacturing.

Additive manufacturing is a manufacturing process that supports all aspects of the product development cycle, from prototype to end-use production parts. Additive manufacturing, commonly referred to as 3D printing, is a process used to create a physical (or 3D) object by layering materials one by one based on a digital model. 3D printing relies on CAD drawings and is commonly used in the furniture manufacturing industry to produce individual components or even entire pieces of furniture, in particular components and bespoke furniture. CAD enables companies to produce cost-effective and precise illustrations of physical systems. Industrial designers utilise 3D software and CAD programmes to move from concept to production.

[16] Final Report on technology trends and technology adoption | Advanced Technologies for Industry (europa.eu)

Manufacturing processes, too, are increasingly computer-aided (CAM). CAD/CAM software solutions are used by companies to manage the entire manufacturing process efficiently, such as design, 3D design, calculation, variant configuration, data transfer via CAD/CAM interfaces, sales, and route planning.

Additive manufacturing is particularly desirable in producing bespoke pieces. In the years to come, the speed of 3D printing, which is already rapidly increasing, is likely to make it faster than some of the more conventional production processes. This is likely to increase its use, in particular in the production of individual components. Additive manufacturing leverages hands-on learning and adds another dimension to teachers in their classroom practice to illustrate complex concepts, make abstract and inaccessible objects tangible, improve learners' spatial abilities and create a richer, more engaging learning environment[17].

The future of the wood processing and furniture manufacturing industry is looking even more digital with the ordering and scheduling of materials – interactions with suppliers, storage facilities and across the production chain will take place on digital, contract-independent collaboration platforms that have access to central databases and are supported by technologies such as robotics[18].

Intermediate skills in additive manufacturing should be made part of all curricula in wood processing and furniture manufacturing in Rivne. This includes topics such as manufacturing safety (e.g. protocols and personal protective equipment (PPE) and ventilation to work with moving and hot components, hazardous materials, and radiation), the basics of manufacturing processes and additive manufacturing methods (e.g. material extrusion, directed energy deposition (DED), material jetting, binder jetting, powder bed fusion (PBF), vat photopolymerisation and sheet lamination and materials required through this method.

Advanced skills in additive manufacturing such as materials science (materials that can be used with additive manufacturing processes e.g. a variety of polymers, metals, composites and ceramics), integrating additive manufacturing with traditional manufacturing, and additive manufacturing as a secondary process (e.g. moulds and patterns) are in high demand but not covered by the curricula of VET schools and centres in Rivne.

Another area not yet covered by training provision and not requiring significant infrastructure investment is digital marketing. There are numerous online training programmes available on digital marketing, however VET schools and centres do not generally sponsor access for learners to online training and learning tools.

At present, the training offer in woodworking and furniture manufacturing in Rivne is not aligned with employers' needs. Curriculum reforms not aligned with technological and market improvements or the skills needs in the labour market. This is reflected in outdated sectoral qualifications and curricula. To respond to employers' demand for beginner- and intermediate-level skills in additive manufacturing, the chronic public underinvestment in terms of ICT infrastructure in VET schools and centres in wood processing and furniture manufacturing needs to be addressed.

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[17] Curriculum on 3D Printing | EPALE (europa.eu)

[18] European Social Partners joint statement on Digital Transformation in workplaces of the European Furniture Industry, Joint Statement EFBWW EFIC on Digitalisation.pdf

Table 4: Priority actions identified by stakeholders during the foresight process – digital skills

DIGITAL SKILLS • Strengthening intermediate and advanced skills in additive manufacturing among VET graduates, incl. mastering essential technologies of computer-aided design and manufacturing (CAD-CAM) • Developing digital marketing skills and knowledge	
Identified actions: regional	***Identified actions: national***
✓ Support access to relevant IT equipment for learners and VET providers (incl. CAD/CAM software) ✓ Maintain close cooperation between VET providers and local employers to have up-to-date knowledge on technology development and skills needs ✓ Mediate access to available and relevant online training and certification in the area of digital skills for teachers, learners, employees and businesses ✓ Introduce changes in curricula, incl. 3D and CAD/CAM modules, and increase the number of learning hours for digital skills ✓ Increase the number of learning hours for English in relevant study programmes, incl. professional vocabulary; conduct training with English native speakers ✓ Introduce new lessons or support access to (online) training on (digital) marketing strategies	✓ Amend educational standards for relevant specialisations ✓ Support training of teachers (in digital and language skills in particular)

4.2 Design and wood composites

The furniture industry is undergoing a profound transformation. Rivne's vision is to support wood-oriented furniture manufacturers in moving from a rich tradition of designing traditional interior design elements and furniture from wood to more contemporary goods. The lever of competitive advantage to achieve this is to use innovative design in terms of both materials and final goods. This requires a strong knowledge base of design technologies (manual, technical and digital), materials, production processes and the ability to add value.

Traditional wood-oriented furniture design and manufacturing techniques focus on hand and power tools, while advanced wood-oriented furniture design and manufacturing techniques entail acquiring skills to utilise a range of woodworking machinery, CNC technology (subtractive manufacturing), large-scale woodworking machinery, laser equipment and 3D printers. Advanced design and manufacturing skills also include intelligent design that is based on market analysis, competitiveness analysis, cost analysis, and an analysis of the environmental impact. In both traditional and advanced design and manufacturing, the design process flows from concept through to fully finished furniture projects.

An important element of wood-oriented furniture design is the ability to use different material options and composites in the design. Composite materials are in general made up of different natural and synthetic materials, which are combined into fibre-based particle-based or sheet-based composites to improve their properties. Composite materials can be shaped into virtually anything. Due to their physical-mechanical properties that allow structural applications in various fields, the use of composite materials in industrial and non-industrial fields is expanding and increasingly replacing wood materials. Composite materials enable the design of lightweight, resistant and energy-efficient and durable goods that can be used in a wide variety of components and final products in the wood processing and furniture manufacturing sector. Integrating composites into furniture design (e.g. fibreglass) has allowed for the creation of products that are both cost-effective and unique in terms of design. The latest-generation composites provide for the application of natural fibres and biomatrices, to be increasingly eco-compatible.

With consumer preferences changing at an unprecedented pace, eco-design is emerging as an area of considerable innovation and is incentivising producers of wooden furniture to design more sustainable products. To reduce the environmental impact of furniture manufacturing, the focus is on more resource-efficient ways of using and reusing wood, and managing and reducing waste. By using waste as a resource, the actual amount of waste is minimised while simultaneously addressing resource constraints, consumer value and profitability challenges. Key aspects to overcome in circular design are the availability of substitution materials and parts, and the lack of information on substances of concern (e.g. flame retardants). This means that all biological and technical components of a product must fit within a materials cycle, designed for disassembly and repurposing.

Advanced design skills both for volume production and for creating one-off bespoke designs should be made part of all design curricula in wood processing and furniture manufacturing in Rivne. This entails equipping learners with knowledge of advanced manufacturing, such as design principles (e.g. sketching; furniture history; and functional, structural, aesthetic and qualitative demands of contemporary furniture design), computer-aided design (technical drawing for furniture, 3D modelling, scale models using mock-ups and CAD), different techniques used to manipulate wood and related materials, presentation skills (e.g. reports, presentations and portfolios), and the translation of a design concept into a finished prototype on a high technical level. Advanced furniture design also entails strong knowledge of combining creative strengths with manufacturing technology and the ability to work in collaboration with an industrial partner. To move towards more innovative use of materials, practical chemistry and techniques to combine the design of wooden furniture with other materials that are more resistant or cheaper such as plastic, stone or natural materials such as wood, cork, natural fibres, branches, and even waste, should be made part of the curricula.

Advanced skills in wood composite manufacturing and repair are in high demand and a prerequisite to using innovative materials to achieve a lever of competitive advantage in furniture design. Basic knowledge of material properties (different types of fibres, matrices and fabrics), traditional and advanced composites, processes to create products from wood composite materials, manufacturing and processing technologies of wood composite materials, and the creation of articles from wood composites should be made part of the wood processing curricula in Rivne. At present, the use of wood composites in furniture design is limited in Rivne.

Intermediate-level skills in sustainable design and the circular economy should be made part of all design curricula to respond to the challenges posed by technological, social and market changes. This entails conducting a life-cycle assessment for products and optimising the sourcing and environmental impact and circulability of processes (recyclability or biodegradability), redesigning of products to

increase their sustainability, and devising new business models to facilitate innovation in the circular economy.

Advanced skills in regenerative materials (bioactive, biodegradable, biomaterials, biomimetic and bioresorbable) and biodesign (knowledge and skills required for designing and building various structures by using the most accessible, affordable, ecological, local and healthy biodegradable materials) should be made available as an optional course in design curricula in wood processing and furniture manufacturing in Rivne for an additional competitive lever in the growing and competitive furniture design industry.

Table 5: Priority actions identified by stakeholders during the foresight process – design and wood composites

DESIGN AND WOOD COMPOSITES • Strengthening the knowledge base in the area of design technologies • Ability to process non-wood materials (e.g. glass, plastic) and develop composites with wood • Supporting eco-design and sustainable products	
Identified actions: regional	***Identified actions: national***
✓ Introduce changes into curricula, integrating modules on the principles of (technical) design and computer-aided design ✓ Establish a fab-lab in cooperation with local employers with the aim of gaining knowledge on new techniques and materials ✓ Design new modules related to the practical use of chemistry in wood processing, furniture design and material properties ✓ Support cooperation with higher education and scientific institutions on the innovative use of traditional and advanced composites ✓ Introduce a module on sustainable design and the circular economy	✓ Amend educational standards for relevant specialisations ✓ Support training of teachers in the area of design and material technology ✓ Develop new manuals and tools in the area of design and material technology

4.3 Green skills and the circular economy

The wood processing and furniture manufacturing industry is facing a variety of climate and environmental challenges. Customers are increasingly environmentally aware and the demand for environmentally responsible products is growing. The challenges faced by companies include conserving raw materials, minimising waste volume, toxicity, and the increased cost and declining

quality of raw materials. New practices and out-of-the-box thinking are needed to renew the wood processing and furniture manufacturing industry and make it more environmentally responsible and sustainable. This is at the core of Rivne's smart specialisation.

For forest-based industries that rely on a natural resource, wood, as their primary input, the linear model where resources are used to produce a good that is then consumed and discarded is no longer viable. Depleting wood resources already affect the industry, and environmental concerns are changing consumer behaviours. The circular economy, on the other hand, is a model of production and consumption that involves maximising the value of products and materials for a long time, closing both their technical and biological cycles, designing out waste and pollution, and allowing nature to regenerate. The transition towards a circular model constitutes a new challenge for the entire wood processing and furniture manufacturing sector, as it has to adapt current design and manufacturing processes and equip current and future professionals with the necessary skills for this transition.

The circular economy has a strong economic case. By using waste as a resource, the actual amount of waste is minimised while simultaneously addressing resource constraints, consumer value and profitability challenges. It is in an efficient and smart way for both the environment and business. It is an important source of innovation and enables growth and job creation, while cutting greenhouse gas emissions, waste and pollution. Such innovation will be key to maintaining cost-competitiveness, which is being eroded by low-cost imports and international trade, affecting SMEs in particular. The labour cost in Rivne is already higher compared to some competitors. In the future, meeting regulatory costs in the fields of climate, energy and environment policies are also likely to diminish the industry's investment capability.

Digital tools could help make manufacturing processes more efficient (lower energy or raw material consumption, lower emissions or waste generation). Waste prevention, waste management and innovative business models, such as resource recovery (producing secondary raw materials from waste) can benefit greatly from digitally enabled solutions. Digitisation is facilitating the traceability of information on hazardous substances (via big data, blockchain and the Internet of Things). Traceability is often an impediment to increasing recycling rates, materials and products. Increasing traceability has the potential to enhance circularity through the progressive substitution of hazardous substances to better protect consumers, citizens and the environment. Such tracking would benefit both manufacturers, by allowing them to be informed about the substances of concern used along their supply chain, and consumers, by providing them with better information about the sustainable characteristics of the products they purchase.

Advanced digital skills help prevent and reduce wood waste. VET curricula in Rivne in woodworking and furniture design would benefit from including a basic understanding of the circular economy (tools and concepts), hazardous substances that pose challenges and additional costs for recyclers, and the potential offered by the circular economy and related careers in the industry.

A basic understanding of furniture design using reclaimed wood should be made part of all curricula on furniture manufacturing. This training should consist of manually working with reclaimed wood in order to restore it into its initial condition.

Once the reclaimed wood is restored, design skills are implemented. Advanced training on the circular production cycle should be made available to wood-based furniture designers, from design to manufacture, by using reclaimed wood, often with different properties and conditions. This resource versatility of reclaimed wood has resulted in the majority of companies in the circular furniture sector

focusing on bespoke goods and custom designs. Therefore, the marketing of circular products, whose uniqueness can be used e.g. to tell the customer a story on the origin of the wood used to develop the product, differs from that of traditionally sourced wood, and should be given special attention in curricula.

Incorporating the digital transformation of waste management into entrepreneurship education in wood processing as a source of new, emerging business models, such as waste e-trading platforms (building on the cascading use of the various forms of wood by-products) and waste-specific software and business analytics, would help renew the industry.

Table 6: Priority actions identified by stakeholders during the foresight process – green skills and the circular economy

GREEN SKILLS AND THE CIRCULAR ECONOMY

- Processing and reusing of reclaimed wood
- Strengthening environmental awareness with a focus on conserving raw materials and minimising waste, hazardous substances and circularity

Identified actions: regional	*Identified actions: national*
✓ Integrate the use of reclaimed wood into practical training	✓ Amend educational standards in relevant specialisations
✓ Introduce a module on the circular production cycle and waste treatment	✓ Support training of teachers on environmental sustainability and circular economy
	✓ Develop new manuals in the area of green skills and environmental sustainability

5. CONCLUSIONS

The labour market analysis revealed that Rivne has the potential to create more attractive jobs in woodworking and furniture manufacturing, expressed in higher-than-average wages and better working conditions. Digitisation is improving working conditions and making the previously unattractive sector attractive to young and female workers. However, this change is not yet reflected in career guidance, including on entrepreneurship. Productivity gains, if distributed, will increase wages.

While digitisation is solving business challenges and driving growth, it is also highlighting a digital skills gap across the sector and emphasising the need for the existing workforce to be upskilled. The mechanisation, automation and computerisation of operations increasingly requires specific skills with a high level of technical and digital skills. The circular economy is opening new career paths and business models.

Additive manufacturing has become an essential technology and a production method adopted by companies, irrespective of their size, from start-ups to multinationals. It represents a possibly significant strategic lever for fostering a company's process innovation, competitiveness and performance, especially for SMEs. The use of additive manufacturing technologies requires knowledge, whether in modelling, knowledge of the machine itself, materials, applications, software, etc. The importance of training in 3D printing, which the furniture manufacturing industry uses globally to produce individual components or even entire pieces of furniture, is underscored.

For the moment, low investments in terms of additive manufacturing and overall ICT infrastructure in VET, including higher VET, and CVT, is limiting digital take-up not just among learners, but also in companies. Systematic engagement between companies in the wood processing and furniture manufacturing sector and education and training provision would ensure that the growing demand for digitally highly skilled workers and business leaders is met. SMEs in particular are in need of workers with an understanding of digital technologies and how they can be used as tools to take their business forward. If VET schools and centres provided learners with the right digital skills, graduates could serve as in-house champions and drive technology adoption by SMEs.

Wood processing and furniture manufacturers in Rivne are in the early stages of embracing circularity and circular practices. At the same time, an increased demand for low-cost items makes it difficult for quality-focused companies to compete. However, there is a gap between VET provision and the skills that workers in Rivne have today, and the ones they will need to participate in a circular economy. The skills needed for the circular economy are mostly taught in the context of theoretical sustainability, and teaching the skills and mindsets needed to be aware and more broadly protect natural resources, overall forest protection, sourcing certified wood, reducing waste, closing material cycles, and tackling climate change rely primarily on the individual VET teacher's enthusiasm. The transition from the traditional linear model to a circular economic model requires significant changes, from innovation at business model and value chain levels to the introduction of supporting policy measures. The path to a circular economy will require the collaboration of different players at regional and national levels, ranging from policymakers, industry, experts, higher education, VET and consumers.

To capitalise on the new opportunities brought on by the twin digital and green transitions, SMEs need a flexible training offer for both managers and workers. This training needs to allow SMEs to fit training around their workload and business demands. VET schools and centres could be positioned to

provide SMEs with skilling, reskilling and upskilling on digital skills such as CAD, CAM and 3D printing, which would give SMEs practical skills to immediately implement in their business.

Many companies in the sector are likely to be started by young entrepreneurs, and their importance in driving forward smart specialisation is essential. Entrepreneurship education and entrepreneurial learning, such as the knowledge, skills and attitudes involved in entrepreneurship, and guidance on entrepreneurship as a career option, will play an important role. Although entrepreneurship is a key competence, curricula in VET schools and centres is not adapted to drive forward innovative entrepreneurship in wood processing and furniture manufacturing.

Teachers remain the catalysts to bring digitisation into VET schools and centres. Consequently, teachers should be continually trained to impart more than just textbook knowledge to learners. While teachers realise the requirement to continually upskill themselves, such routine upskilling is not part of teacher training in Rivne. The primary needs in the upskilling of teachers in Rivne are new technologies and their use, software, additive manufacturing, wood composites and the circular economy (and on how to integrate these into the classroom), and guiding learners along their future career paths. Ramping up digital activity, such as having a website, digital marketing and setting up an e-commerce platform, is an important means to reach new clients, provide services to new market segments and increase exports.

A means to enhance learners and teachers access to specialist equipment is strengthening education-business cooperation through various forms of work-based learning and upskilling of VET teachers, in a continuous rotation in and out of industry to ensure experience in the latest technological developments, notably with larger employers with modern infrastructure. Untapped opportunities from the digitisation of training is an expanding offer of web-based programmes developed in entrepreneurship, which are currently not used by any VET providers.

One of the main prerequisites for most digital learning is English language skills. At present, the number of hours dedicated to learning English is insufficient, and teachers' knowledge of professional terminology needs to be upskilled. An unexploited opportunity is the digitisation in the education industry, which makes conducting online training with native English speakers an easily accessible – but so far unexplored – opportunity. Another important but as-yet unused opportunity is to encourage English language learning and mobility among both students and teachers through Erasmus+, which would also enable social networks to be expanded.

Cross-cutting skills such as teamwork, problem-solving and interpersonal skills are in high demand by employers. More systematic efforts to strengthen experience-based learning through student competitions or mini-enterprises, as well as by contact with real entrepreneurs, ranging from visits to enterprises to guest lectures, would boost transversal skills. Introducing innovation or entrepreneurial hubs in VET schools and centres would encourage creative thinking and problem-solving. In addition, new modules on business planning, including basic knowledge on accounting and taxation, and funding mechanisms such as crowdfunding, is needed. Close cooperation with business support services would support the regular upskilling of teachers.