HEROES
European University Alliance

2025

SKILLS AND COMPETENCE NEED MAP

Final version 2025-09-16

Co-funded by
the European Union

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Note to the Reader

This report has been produced as inspirational material for the HEROES partners as they work together to create new educational content to be offered as joint modules, minors, degree programmes, micro-credential offerings and staff training.

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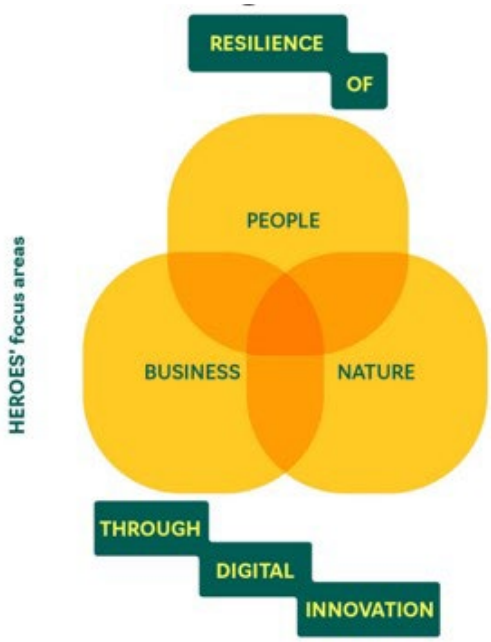
Executive summary

This report explores future skills needs across nine European regions, focusing on strengthening resilience for people, businesses, and nature. The findings highlight that adaptability, lifelong learning, and digital competence are fundamental *for individuals* to thrive amid rapid technological change and labour market transformation. Equally important are green awareness, critical thinking, and strong collaboration skills to navigate complex challenges and support sustainability. *For businesses*, competitiveness depends on advanced digital expertise (AI, data science, cybersecurity), sustainability knowledge, and the integration of circular economy practices. Innovation, entrepreneurship, and strategic skills management are essential to lead green and digital transitions, while strong leadership and collaborative networks will underpin resilient ecosystems. *Nature-related* resilience requires expertise in environmental science, sustainable production, water management, and climate adaptation, alongside innovation in green solutions. Overall, the report concludes that digitalisation, sustainability, and workforce transformation drive the most pressing skills demands. Building resilience will require close cooperation between education, industry, and policymakers.

Summary

This report provides a comprehensive and multifaceted picture of future skills and competence needs in nine European regions, with a clear focus on building smart regional resilience for people, businesses, and nature. This resilience refers to the regions' ability to adapt to and recover from economic, social, technological, and environmental disruptions through innovation, collaboration, and sustainable practices.

These skills and competence needs are primarily driven by the digital transformation, the green transition, and changing expectations within the workforce (the workers' agenda). The report consistently underlines that a skilled and adaptable workforce is crucial to managing these major changes. The information is based on a combination of official EU documents, national/regional documents (including regional work force documents) and expert interviews conducted by the nine partner institutions, which both confirm and deepen the insights into the skills and competences that will be most in demand. The future skills and competence needs can be summarised under three overarching areas, people, business and nature:

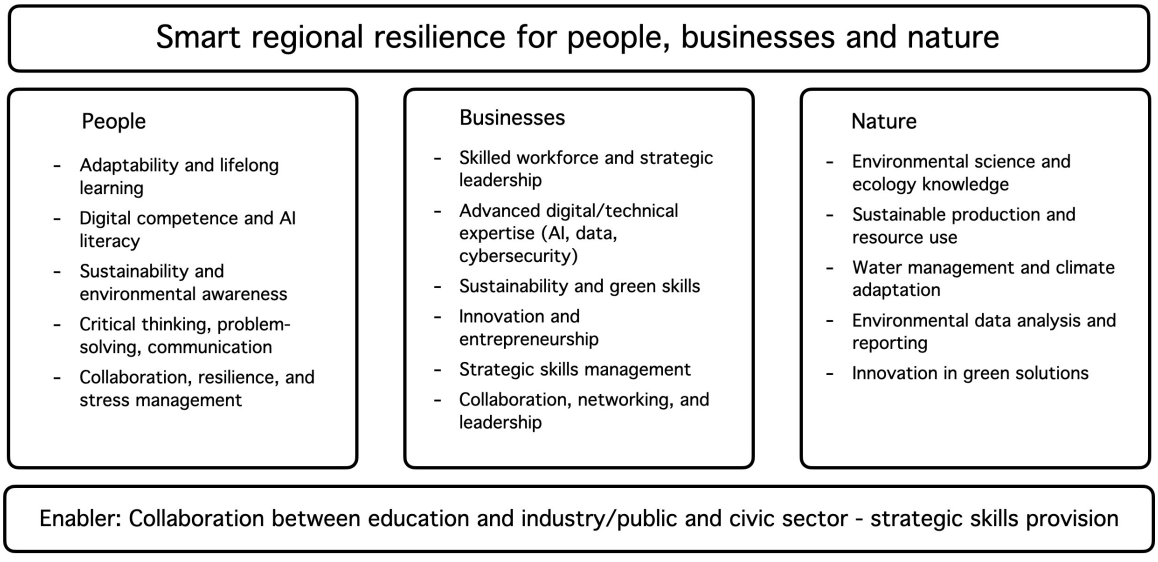


For *people* to cope and thrive in a changing world, a range of personal and professional skills and competences are emphasised. Adaptability and a strong commitment to lifelong learning are fundamental, as rapid technological development and labour market transformation require the continuous acquisition of new knowledge and the ability to reorient oneself. Digital competence is essential at all levels, from basic digital literacy for handling tools and platforms to more advanced skills such as data analysis and an understanding of AI's capabilities and limitations. A green mindset and environmental awareness are also becoming increasingly important, with individuals needing a basic understanding of sustainability and the ability to act in an environmentally responsible way. In

addition, critical thinking, problem-solving ability, and communication and collaboration skills are central to navigating complex information flows, tackling unexpected challenges, and working effectively in multicultural and interdisciplinary environments. Psychological resilience and the ability to handle stress are also highlighted as important for individual well-being.

The ability of *businesses* to withstand disruptions, adapt, and maintain sustainable operations is built on a competent workforce and strategic leadership. There is a strong focus on advanced digital and technical expertise, including AI, data science, programming, and cybersecurity, to modernise processes and develop new digital business models. Sustainability expertise and green skills are also essential, encompassing knowledge of the circular economy, energy efficiency, sustainable materials, and the ability to integrate sustainability into business strategies. Innovation capability and entrepreneurship are key to developing new products and services and leading transformation processes. A strategic approach to skills and competence management is becoming increasingly important for businesses, including the ability to analyse future skills needs and plan for long-term recruitment and development. Finally, collaboration and networking skills, as well as leadership and management competences, are central to building strong ecosystems and guiding organisations through green and digital transitions.

Although *natural resilience* is not always a direct skills area for individuals and businesses, specific competences are required to support environmental sustainability and protect ecosystems. These include knowledge in environmental science and ecology, as well as skills in sustainable production and resource use, such as circular economy and waste management. Water management and climate adaptation are particularly important, including expertise in sustainable water use, preventative measures against extreme weather events, and the ability to implement green solutions. The ability to collect and analyse environmental monitoring data and to report on sustainability performance is also becoming increasingly relevant. Innovation in sustainable solutions is an underlying competence that cuts across this area.



The task and the methodology

According to the Heroes application, the partners should conduct a comprehensive assessment of the current and future skills and competence requirements within their respective regions. With a dedicated emphasis on *smart regional resilience*, this analysis aims to align joint educational offerings with the evolving needs of these regions in our three interdisciplinary focus areas and their intersections:

1) peoples' resilience
2) businesses' resilience
3) nature's resilience

The 3.1 team conducted *desk research* and *expert interviews*. Desk research included collecting and analysing official documents on two levels: 1) On an overall EU-level and 2) on national/regional level. The regional documents were provided by the respective partner and consisted of both files (Word and PDF) and web pages. Many of the collected documents were very extensive. It was decided to analyse them with support of various AI-tools. The methodology and a list of the analysed national/regional documents are presented in Appendix 1.

Five expert interviews in each region were conducted. They were transcribed and then analysed with AI-tools in a manner similar to the analyses of the documents. A short version of the interview framework is presented in appendix 2.

Drafts of all analyses presented in this report have been shared with all Heroes partners (through communication in WP 3). All partners have had the opportunity to comment and provide feedback, which has been used to refine both the analysis and its presentation.

Structure of the report and its limitations

This report is structured such that it first presents the final results of the analysis of the overarching EU documents. Next, a summarised analysis of what the national/regional documents revealed is presented, along with analyses of each region individually. For each region – the result from the expert interviews compliments the findings from the desk research. This is presented under a separate heading. Finally, a concise summary of all analyses is provided, accompanied by graphical illustrations.

A report of this kind neither is nor can be comprehensive. It is strictly limited by the information contained in the sources (documents and interview transcripts) analysed. There may be significant skills and competence needs that are important to be aware of, yet which are not mentioned in the sources. Furthermore, the report is limited by the manner in which the analyses of these sources have been carried out.

This report can be seen as a list of more or less central skills and competences need related to smart regional resilience at various levels. It is more of a catalogue than a coherent account of the exact needs that exist now or will arise in the future. As the report describes both overarching and regional needs, it contains many repetitions. There are many clear similarities in how the needs are described at the overarching EU level and in the regions where the Heroes partners operate. This may partly reflect that the needs are indeed very similar across different regions. However, it is also likely that this reflects the fact that the analyses conducted refer to a shared discourse in which policy discussions take on a life of their own, and a number of buzzwords are repeatedly reused.

Across several sections, the report outlines future skills and competence needs in relation to the key areas defined in Heroes: people, business and nature. These areas are interlinked, and certain skills and competences may apply to more than one. For ease of overview, however, they are generally presented under a single category, partly reflecting how they were positioned in the underlying source material.

The task was to identify future skills and competences. The source material underpinning this report employs these terms, but also a wide range of others to describe future knowledge requirements. In the report, we have primarily used the terms *skills* and *competences*, while also allowing the terminology from the sources to be reflected where relevant – for example, knowledge, abilities, understanding, expertise, insights, capabilities, capacity, and mindset.

Skills and competences need: Official EU documents

The EU's evolving labour market, shaped by digitalization, green transitions, and global competitiveness, requires a dynamic set of future skills. These competencies are crucial for fostering *smart regional resilience*—the ability of regions to adapt to economic, social, and environmental changes.

Sources: European Skills Agenda (2020): ec.europa.eu, Pact for Skills (2020): ec.europa.eu, European Green Deal (2019): ec.europa.eu, Digital Education Action Plan (2021–2027): ec.europa.eu, Skills for Industry Strategy 2030: europa.eu, Smart Specialisation Strategies (S3): s3platform.jrc.ec.europa.eu, Skills for Resilience (ILO, 2024): ilo.org, PISA and CEDEFOP Reports on Skills Measurement: cedefop.europa.eu

Digital and Technological Skills, such as
- *Advanced IT & Programming:* Coding, cloud computing, and software development.
- *Data Science & Analytics***:** Big data management, machine learning, and visualization.
- *Cybersecurity:* Data protection, risk assessment, and ethical hacking.
- *AI & Automation:* Robotics, process automation (RPA), and AI ethics.
- *IoT & Blockchain:* Smart infrastructure, connected devices, and secure digital transactions.

Green and Sustainable Skills, such as
- *Renewable Energy Technologies:* Solar, wind, and bioenergy systems.
- *Circular Economy:* Sustainable resource management and eco-design.
- *Climate Adaptation:* Environmental impact assessment and resilient urban planning.

Industry-Specific Skills, such as
- *Advanced Manufacturing:* Industry 4.0, additive manufacturing (3D printing).
- *Healthcare & Biotechnology:* Digital health solutions and biomedical engineering.
- *FinTech:* Blockchain applications, digital currencies, and algorithmic trading.

Cognitive Skills, such as
- *Problem-Solving:* Analysing complex issues and innovative decision-making.
- *Creativity & Innovation:* Design thinking and adapting to new challenges.
- *Resilience & Adaptability:* Managing uncertainty and navigating change.

Social and Emotional Skills, such as
- *Leadership:* Strategic thinking and guiding teams through transitions.
- *Communication & Collaboration:* Cross-cultural competence and virtual teamwork.
- *Emotional Intelligence:* Self-awareness, empathy, and conflict resolution.

Entrepreneurial Skills, such as
- *Business Acumen:* Understanding market trends and strategic growth.
- *Agility:* Rapid learning and role adaptability.

- *Negotiation:* Persuasion and stakeholder management.

Meta-Competencies for Lifelong Learning, such as
- *Learning-to-Learn:* Adapting quickly to new knowledge and technologies.
- *Digital Literacy:* Staying updated with evolving digital tools.
- *Self-Management:* Goal setting, time management, and independent problem-solving.

Regional Innovation and Specialisation, such as
- *Cluster Management:* Coordinating regional innovation ecosystems.
- *Smart Mobility & Urban Planning:* Sustainable transport and smart city development.
- *Digital Twin Technologies:* Models for resource optimisation and disaster preparedness.

Crisis Preparedness and Adaptive Skills, such as
- *Risk Assessment:* Scenario planning and crisis management.
- *Resilience Thinking:* Designing systems that withstand economic and environmental disruptions.

Crosscutting Skills for Inclusive Growth, such as
- *Cultural Competency*: Navigating diverse, multicultural workplaces.
- *Ethical Leadership:* Integrating sustainability and social responsibility.
- *Civic Engagement:* Promoting democratic values and social cohesion.

Skills and competences need in Heroes regions - overview

The sources highlight a range of interconnected skills and competence requirements that are essential for building smart regional resilience. In the sources, the key drivers behind these needs are identified as digital transformation, the green transition, and changing expectations within the workforce.

People's Resilience

- Digital competence: Ability to utilise digital technology, analyse data, and understand digital solutions, including user skills, integrative skills, and specialist skills in programming.
- Adaptability and flexibility: Capacity to rapidly adjust and acquire new knowledge in an ever-changing environment, including openness to new working methods and technologies.
- Lifelong learning: Motivation and capacity for continuous development of knowledge and skills, particularly emphasised in relation to the green transition.
- Communication and intercultural competence: Ability to effectively communicate and collaborate with individuals from various backgrounds, essential for social cohesion and participation in regional development.
- Initiative and problem-solving: Ability to take initiative and effectively manage unexpected situations and challenges.
- Critical thinking: Ability to analyse information and formulate independent conclusions.
- Green mindset and awareness: Fundamental knowledge of sustainability and commitment to environmentally responsible actions, including understanding new green business models and sustainable production.
- Interdisciplinarity: Capacity to integrate knowledge from various fields and collaborate across disciplinary boundaries, particularly important in the green transition.
- Psychological resilience and well-being: Psychological knowledge and stress management capabilities are important aspects of individual resilience.

Businesses' Resilience

- Innovation capability: Ability to develop new products, services, and processes, including leadership and innovation generation.
- Digital competence (advanced): Requirement for specialists in AI, data science, programming, and software development. Companies also need personnel with high digital maturity to drive internal digitalisation.
- Sustainability expertise and green mind: Knowledge of the green transition, energy efficiency, sustainable materials, circular economy, and relevant regulations. Ability to integrate sustainability into business strategies and processes.
- Strategic competence management: Ability to analyse current and future skill requirements and strategically plan for long-term recruitment and competence development.
- Collaboration and networking: Ability to build and maintain relationships with other businesses, research institutions, and public actors to foster innovation and skills acquisition. Cluster formation and participation in ecosystems are highlighted as important.

- Leadership and management: Ability to guide organisations through transformation processes, particularly the green transition, and foster a supportive and innovation-promoting culture.
- Marketing and business development with a sustainability focus: Competence to identify and leverage business opportunities emerging from the green transition.
- Financial skills in sustainability: Knowledge of green investments and ESG-related economic considerations.
- Knowledge of relevant regulations and standards: Understanding environmental and digital legislation and regulations.
- Project management: Capacity to lead projects within sustainable development and digital transformation. Risk management: Ability to identify and manage risks related to economic, technological, and environmental changes.
- International business competence: Essential for regions focused on global markets and innovation.

Nature's Resilience

- Knowledge in environmental science and ecology: Basic understanding of how nature functions and human impacts on it.
- Sustainable production and resource use: Knowledge of methods and technologies to minimise environmental impact in production processes and optimise resource use.
- Water management: Expertise in sustainable water usage and protection of water systems. Energy efficiency and renewable energy: Knowledge of technologies and methods to reduce energy consumption and transition to renewable energy sources.
- Waste management and recycling: Skills in circular economy methods to reduce waste and enhance material reuse.
- Climate adaptation: Knowledge of methods to reduce vulnerability to climate change impacts and build resilient systems.
- Environmental impact assessment: Ability to assess and manage environmental impacts of projects and operations.
- Sustainable agriculture and forestry: Knowledge of practices promoting biodiversity and reducing negative environmental impacts.
- Data collection and analysis for environmental monitoring: Ability to gather and analyse environmental data to make informed decisions.
- Reporting and documenting sustainability performance: Competence to measure and communicate environmental outcomes.
- Innovation in sustainable solutions: Ability to develop new technologies and methods contributing to a more sustainable future.
- Knowledge of ecosystem services and biodiversity: Understanding of nature's value and methods of protection (implicit in many green competencies).

Skills and competences need in each Heroes region

Alentejo, Portugal

The sources highlight several overarching skills requirements crucial for building smart regional resilience in Alentejo. A central theme is the need for qualified labour to address challenges such as demographic decline, climate transition, and digitalisation. The sources emphasise adapting educational and training systems to the region's strategic priorities, particularly within smart specialisation areas (RIS3), including bioeconomy, sustainable energy, mobility and logistics, tourism, creative and cultural ecosystems, and social innovation. This requires increased capacities to access regional and European funding. A consistent need exists to boost innovation capacity and knowledge transfer between research institutions and businesses. Furthermore, the importance of digital skills and leveraging digitalisation opportunities in both public and private sectors is underscored. Lastly, collaboration and networking among regional actors are emphasised as crucial for effectively addressing shared challenges.

To enhance *people's resilience* in Alentejo, the sources stress the need for qualifications and skills aligned with labour market requirements, particularly within growth sectors and areas linked to digital and green transitions. Promoting lifelong learning, digital skills, and capabilities to address demographic challenges and ensure access to essential services is vital.

- Technical and Vocational Skills: Needed in growth sectors such as renewable energy, agri-food, tourism, and construction, including specialised technical knowledge for operations and maintenance.
- Digital Competence and IT Skills: With increased digitalisation, fundamental and advanced digital skills are essential for using digital services, participating in the workforce, and fostering innovation.
- Adaptability and Reskilling: The workforce needs flexibility and readiness to reskill to meet labour market changes driven by technological developments and the green transition.
- Healthcare Skills: With an ageing and geographically dispersed population and a high incidence of chronic illness, skilled healthcare personnel are increasingly necessary, including family and community-based care competencies and digital healthcare applications.
- Social and Intercultural Skills: Essential for integration and managing demographic changes, particularly relating to immigration, requiring competencies in intercultural communication and mediation.
- Entrepreneurship and Innovation: Entrepreneurial skills and the ability to identify and leverage local resources are critical for economic development and job creation.
- Language Skills: Essential for cross-border cooperation and internationalisation, particularly proficiency in Spanish and English.

Strengthening *business resilience* in Alentejo involves increasing innovation capacity, promoting digital transformation, developing smart specialisation skills, and facilitating access to qualified labour.

Businesses also require competencies for adapting to a more sustainable and resource-efficient economy.

- Research, Development, and Innovation: Skills for conducting research, developing new products and services, and implementing innovative solutions aligned with the region's smart specialisation strategy.
- Digitalisation and Industry 4.0: Competencies in digital technology, data analysis, artificial intelligence, and automation to modernise production processes, develop new business models, and enhance competitiveness.
- Sustainability and Circular Economy: Skills for transitioning to sustainable production methods, applying circular economy principles, and reducing environmental impact.
- Internationalisation and Marketing: Skills in international business development, export strategies, and digital marketing to reach new markets.
- Leadership and Strategic Competence Planning: Ability to identify future skills needs, develop competence development strategies, and attract and retain qualified staff.
- Project Management and Collaboration: Leading complex projects and collaborating with other businesses, research institutions, and public actors are essential for accessing European funds innovation and growth.
- Cybersecurity and Data Protection: Specialised competencies in cybersecurity and data protection are necessary due to increased digitalisation.

Enhancing *nature's resilience* in Alentejo requires competencies in sustainable resource management, climate change adaptation, biodiversity protection, and environmental risk management. Developing knowledge and skills to prevent and mitigate climate change effects and ensure sustainable human-nature interactions is crucial.

- Sustainable Water Management: Skills in efficient water use, conservation technologies, water reuse, and integrated water resource management.
- Climate Adaptation: Competencies for developing and implementing climate change adaptation strategies, including risk assessment, preventive measures for extreme weather events, and nature-based solutions.
- Biodiversity Protection and Conservation: Skills in ecology, conservation, and ecosystem restoration, including managing invasive species.
- Sustainable Agriculture and Forestry: Competencies in sustainable farming methods, precision agriculture, agroecology, and sustainable forestry.
- Renewable Energy and Energy Efficiency: Competencies for developing, installing, and maintaining renewable energy systems and improving energy efficiency in buildings and infrastructure.
- Planning and Physical Environment: Skills in sustainable spatial planning, landscape architecture, and green infrastructure to sustainably manage land and water resources and enhance ecological connectivity.

Expert interviews

The interviews underscore the urgent need for digital competence, ranging from basic digital literacy to advanced expertise in cybersecurity and artificial intelligence (AI). Despite progress within research

centres, the practical application of AI on the ground—particularly in agriculture—remains largely untapped. Beyond technology, adaptability and lifelong learning are highlighted as essential, as the era of "jobs for life" has ended. In relation to the green transition, the interviews emphasise the critical need for sustainable water management and efficient irrigation technologies. The potential for a circular economy that goes beyond traditional recycling is highlighted, with new business models transforming waste into raw materials. However, complex regulations and limited access to financing are identified as significant barriers to green innovation. The interviews also reveal a shortage of entrepreneurial mindset and strategic thinking. There is a clear need to promote financial literacy, business vision, and the ability to attract investment, as well as to bridge the gap between innovative ideas and scalable business ventures. Additionally, the importance of personal and psychosocial competences—such as resilience, drive, and collaboration—is seen as crucial for young people to thrive in the region's challenging environment. Finally, the need for deeper and more systematic collaboration between educational institutions and the business sector is strongly emphasised. This includes co-creation of curricula with companies, workplace-based learning (Living Labs), and enhanced technology transfer. Attracting and retaining highly skilled professionals in key sectors such as aerospace, digital services, renewable energy, logistics, and tourism—as well as developing commercial skills—is seen as vital. The unique potential of the Alqueva project is highlighted as an important testbed for innovation and specialisation.

Some distinguishing features

The sources particularly highlight the need for qualifications in health care for an ageing and geographically dispersed population with high incidence of chronic illness, including digital health care applications. Another prominent area is the adaptation of the education system to the region's strategic priorities within smart specialisation domains (RIS3), which include bioeconomy, sustainable energy, mobility and logistics, tourism, as well as creative and cultural ecosystems and social innovation. It is emphasised that there is considerable potential for innovation and specialisation in developing new business models that transform waste into raw materials, but that this is hindered by complex regulations and limited access to funding. Sources highlight the need to improve the capacity to access regional and European funding.

Lithuania

The sources emphasise that digital competence and understanding of artificial intelligence (AI) are central to future skill requirements and national development. They highlight the need for ambitious reforms in education and science to meet the demands of a changing world, including developing key personal qualities such as curiosity, courage, resilience, and leadership. It also points out the necessity of adaptability and lifelong learning to manage rapid technological changes and a shifting labour market. Sources focus on AI-related skills, noting a current lack of systematic understanding and preparation for AI challenges in Lithuania. Both sources implicitly connect these skills to resilience, enabling individuals, businesses, and the nation to adapt and thrive amidst future challenges.

To enhance *people's resilience*, the sources highlight the need for adaptability, digital competence including AI understanding, lifelong learning, critical thinking, and social and emotional skills.

- Adaptability and Lifelong Learning: The ability to continuously learn new skills and switch competencies is crucial in a world characterised by rapid technological change. This includes a positive attitude towards change and willingness to develop new skills. Proposals include providing adults with annual education credits to promote lifelong learning.
- Digital Competence and AI Understanding: Basic digital skills are necessary to participate in an increasingly digitised society. Understanding the basic principles of AI, its opportunities and limitations, and how to safeguard against potential negative consequences is increasingly vital, especially for policymakers, educators, and the general public.
- Critical Thinking and Information Literacy: The capacity to critically evaluate information, particularly in a digitally driven world with increasing information flows, is central. Media literacy aimed at developing students' critical thinking is included in curricula.
- Social and Emotional Skills: Attributes such as agility, stress resilience, and emotional intelligence are highlighted as important future competencies. Balancing personal leadership development and community engagement is also emphasised.
- Problem-solving Skills: Identifying and solving problems is increasingly important in a complex, changing world. Educational restructuring is proposed to better support problem-solving-based learning.

To strengthen *business resilience*, the sources highlight the necessity of advanced digital competencies in AI, data analysis, cybersecurity, innovation management, flexibility, and adaptability to technological changes.

- AI-related Skills: There is growing demand for individuals with specific AI knowledge to create and apply AI technologies, including AI algorithm developers, programmers, data analysts, and "AI translators" who bridge the gap between business needs and technical solutions. A survey indicates respondents perceive a shortage of AI-related skills across policy, education, and society.
- Digital Transformation and Technological Competence: Companies need employees skilled in using new technologies and executing digital transformations, including using, maintaining, and managing technologies. In Lithuania, the usage of AI technologies in companies remains below the EU average.
- Innovation and Change Management: Competence in leading innovation processes and managing changes accompanying technological developments is critical.
- Flexibility and Adaptability: Businesses must quickly adapt to new market conditions and technological opportunities.
- Strategic Competence Planning: Companies must develop abilities to identify future skill needs, plan for skills development, and recruitment. However, uncertainty about future skill requirements is frequently cited by companies as an obstacle to developing AI-related competencies.
- Cybersecurity: Increasing digitalisation heightens the demand for competencies in data protection and cybersecurity.

While sources do not explicitly focus on competencies directly related to *nature's resilience*, they imply that sustainability competencies and the ability to understand and manage climate change are essential areas affecting all aspects of resilience.

- Climate Change and Environmental Improvement Knowledge: Understanding climate change effects and knowing how to contribute to environmental improvements are identified as significant trends. Education's role in imparting knowledge on climate change and promoting environmental improvement is emphasised.
- Sustainability Competence: Although not specifically tied to "nature's resilience" as a separate area, sustainability skills underpin all three resilience areas. The development of technologies and innovations is highlighted as a vital principle in Lithuania's future strategy, indirectly connecting to sustainability skills needs.

Expert interviews

This exploration of essential competencies, augmented by expert interviews, largely corroborates the findings presented in the initial desk research, particularly concerning the imperatives for societal, business, and environmental resilience. The interviews underscored the critical importance of digital competence and Artificial Intelligence (AI) understanding. The experts noted AI's potential to significantly boost efficiency in both education and business, via tools like virtual assistants and advanced data analytics. However, the educational sector is perceived as slower to adopt AI due to ethical concerns, contrasting with business's rapid integration. A key takeaway is the need to teach students ethical AI application and effective 'prompt engineering'. Regarding green transformation, the interviews confirmed its vital role in fostering resilience. However, significant challenges were highlighted, including a shortage of specific hydro-technical engineers for peatland restoration and the difficulty in establishing a viable market for sustainable biomass, impeding a circular economy. Furthermore, business engagement often hinges on profitability rather than solely regulatory compliance, with renewable energy being a positive example where both align. The discussions consistently reinforced the necessity of general and soft skills, such as critical thinking, communication, empathy, and the ability to express and defend one's opinion. A striking observation was the perceived deficit in strategic management and long-term innovation planning within Lithuanian businesses, which often operate on a day-to-day basis, risking future competitiveness. Interviewees championed dual learning models, where theory is immediately applied in the workplace, as highly effective. Micro-credentials were also identified as a promising tool for rapid, targeted skill development. These insights collectively confirm the need for continuous, quality-focused reforms across all educational levels to build a resilient future.

Some distinguishing features

The Lithuanian sources are unique in their emphasis on the role of business-technology intermediaries who bridge the gap between business needs and technical solutions. They highlight a current lack of systematic understanding and preparation for AI challenges at the national level. There is also a proposal to provide adults with annual training credits to promote lifelong learning. Experts noted a perceived lack of strategic leadership and long-term innovation planning within Lithuanian companies, which often focus on day-to-day operations. Cooperation between educational institutions and businesses is frequently described as lacking depth.

Halland, Sweden

The sources highlight that digital skills and competencies within AI are central to smart regional resilience in Halland. One source focus on the competency needs of Halland's companies within five priority areas for smart specialisation, emphasising a general need for digital specialists. Another source analyses future skill needs with a clear focus on smart regional resilience, identifying digital and technological skills as fundamental to innovation and data-driven solutions. Furthermore, one source stress the importance of sustainability expertise and adaptability to manage environmental and economic changes. Another source mentions needs for skills in sustainable materials, automation in the food sector, and electrification in mobility, indirectly linked to sustainability aspects. Sources also underline the importance of collaboration and networking to enhance the region's skills provision and innovation capacity.

To strengthen people's resilience, the sources indicate a need for adaptability, digital competence, and lifelong learning ability. The importance of inclusion and collaboration is also highlighted to create social cohesion and increase participation in resilience initiatives.

- Adaptability: Flexibility and the ability to manage rapid technological and economic changes. This includes a willingness to learn new skills (lifelong learning) and reskill for new job roles. A flexible workforce is necessary to meet job requirements arising from automation.
- Digital Skills: Fundamental for participation in an increasingly digitised society and workplace, including using digital tools and platforms. Within healthcare, there is a specific need for skills in using and developing applications.
- Communication and Intercultural Competence: Skills in these areas are important for strengthening social cohesion and increasing participation in resilience efforts through inclusive societal integration, facilitating cooperation and collective sustainable development initiatives.

Critical competencies identified for *business resilience* include digitalisation and AI, specialised engineering expertise, innovation management and entrepreneurship, sustainable production, logistics, and crisis management. The ability to analyse skill needs, collaborate, and develop staff is also emphasised as essential.

- Digital and Technological Skills: Programming and Software Development are required in all areas, particularly intelligent systems, innovative mobility, and healthcare. Data Analysis is essential for leveraging generated data, notably in intelligent systems. AI and Machine Learning are highly demanded in intelligent systems, innovative mobility, and future food sectors to streamline processes, develop solutions, and data analysis. Cybersecurity is increasingly important with greater digitalisation to protect against cyber threats and ensure operational resilience. Automation is especially crucial within the future food sector to streamline work processes.
- Specialized Engineering Competence: Strong demand in sustainable materials for engineers with deep knowledge in specific material areas, ideally at doctoral levels. Specialists in electrical and battery technologies required within innovative mobility. Food engineers in product development for future food.

- Innovation and Entrepreneurship: Ability to lead innovation processes and develop new solutions vital for business competitiveness and adaptability, including Project Management and R&D. "H-PDF1" notes that innovation management is rarely directly highlighted by companies, which instead focus on technical skills in hopes of fostering innovation.
- Sustainability and Environmental Adaptation: Competencies in sustainable production and circular economy are needed in line with the green transition, such as expertise in renewable energy and water management.
- Logistics and Supply Chain Management: Essential for retail companies to ensure resilient supply chains, including Logistics Planning and Sustainable Logistics, ideally aided by digital tools like AI.
- Crisis Management and Resilience Planning: Ability to manage and recover from various crises, including Risk Management and Crisis Response, potentially aided by digital early-warning tools.
- Strategic Competence Provision: Analysing current and future skill requirements, recruitment planning, staff development, and evaluation. Many businesses, especially smaller ones, lack structures for this.
- Collaboration Skills: Ability to collaborate with businesses, academia, and regional actors to strengthen skills provision and innovation capability, including networking skills.
- Leadership Competence: Leaders capable of driving digitalisation, leading innovation efforts, and staff development are highlighted across several areas.

Skills requirements for *nature's resilience* identified in the sources include sustainability expertise, environmental adaptation, and water management. Digital competencies can also play a role in developing solutions for sustainable development.

- Sustainability Expertise: In-depth knowledge of sustainable practices across various industries. Specialists needed for developing environmentally friendly materials, especially within sustainable materials, and sustainability competencies in future food.
- Environmental Adaptation: Knowledge of adapting business operations to reduce environmental impact and support a green economy, including competencies in Renewable Energy for electrification projects.
- Water Management: Competence in sustainable water resource management and mitigation of flooding impacts.
- Digital Skills for Sustainability: Although not explicitly focusing on nature's resilience, digital skills and AI can optimise resource use, monitor environmental changes, and develop sustainable solutions in energy and transport sectors.

Expert interviews

The expert interviews confirm and deepen the skills needs highlighted in the initial analysis. The importance of digital skills and AI is consistently emphasised, as are the demands of the green transition, including the need for expertise in renewable energy, circular economy, and sustainable agriculture and forestry. Entrepreneurship and innovation capacity are also stressed as central to the region's development. The interviews, however, bring forth several key perspectives that are particularly relevant for Halland. One prominent theme is the need for knowledge regarding security and the management of digital tools and AI, especially within public services handling sensitive information, where the level of maturity is still low. Major future skills needs are directly linked to

large-scale energy projects, such as the expansion of offshore wind power and potential new nuclear power, which require everything from engineers to entrepreneurs and installation technicians. At the same time, the importance of safeguarding nature, biodiversity, and cultural heritage is highlighted — areas requiring specific expertise (e.g., marine biology) and which must be addressed due to legal obligations and EU directives, even if they are sometimes politically sidelined. Another key aspect is the importance of the social dimension in innovation, including gender equality, inclusion, and the need to harness young people's ideas to address complex societal challenges. Beyond specific skills, the challenge of applying and implementing competence in companies' everyday operations is also highlighted. This requires strategic competence planning and leadership—something often lacking in smaller, traditional businesses in Halland. The difficulty of attracting and retaining senior IT talent, due to the proximity of larger growth regions, is also emphasised. Finally, there is a strong emphasis on the need to further develop collaboration between the education system and working life, moving from "collaboration" to "co-production" through a more practice-oriented "cooperative pedagogy". These aspects, particularly linked to Halland's specific business structure with both large companies and many small enterprises, offer a richer picture of the complex skills challenges that need to be addressed to ensure smart regional resilience.

Some distinguishing features

The sources from Halland, Sweden, highlight future skills needs linked to large-scale energy projects such as the expansion of offshore wind power and potential new nuclear power, which require a broad range of professional competences. The region also emphasises the importance of knowledge in safety and the handling of digital tools and AI within the public sector, where the level of maturity is still low. Furthermore, the significance of safeguarding nature, biodiversity, and cultural heritage – requiring specific expertise such as marine biology – is underscored as an area with legal obligations. Halland also points to the difficulty of attracting and retaining senior IT talent due to the proximity of larger growth regions.

Deggendorf, Germany

The sources highlight both current and future skills requirements, especially within the context of smart regional resilience. A common theme is the need for adaptation to changes, whether digital, environmental, or economic. One source provides an overview of the economic and demographic situation in Niederbayern, indicating areas where competencies may be needed to address current challenges such as labour shortages and digitalisation. Another source focuses more directly on future competency needs in Landkreis Deggendorf, aiming to build a resilient region through digitalisation and sustainability. Digital skills, sustainability expertise, and adaptability emerge as central competencies required to manage economic and environmental changes. Additionally, citizen engagement is highlighted as critical, fostering social cohesion and regional recovery. Smart regional resilience refers to the ability of regions to adapt and recover from economic, social, technological, and environmental disruptions through innovation, collaboration, and sustainable practices.

Individuals' resilience involves managing and recovering from various stresses and changes.

- Adaptability and lifelong learning: Rapid technological changes necessitate retraining and a commitment to lifelong learning. Problem-solving abilities are crucial for handling new situations and challenges, helping individuals adapt to labour market changes and reducing unemployment risks.
- Digital Competence: Participation in initiatives such as "Smart Cities Smart Regions" requires digital competence, including using smart systems and digital tools. Although not explicitly mentioned, basic digital literacy is implicitly necessary in an increasingly digitalised region, such as using digital platforms for information (traffic, alerts) and citizen dialogues.
- Communication and Collaboration: Citizen engagement demands strong communication skills to strengthen social cohesion and enable inclusive regional recovery planning. Tools like PUBinPLAN facilitate citizen interaction with regional actors. Collaboration skills enhance social resilience through inclusive processes.
- Sustainability Awareness: Basic sustainability awareness, though less explicitly detailed, is essential, especially in a region focused on sustainable development, including understanding climate change and adapting behaviours to sustainability goals.

Businesses' resilience involves withstanding disruptions, adapting to changes, and maintaining sustainable operations. Examples of skills and competence requirements:

- Digital and Technological Competence: Essential for developing smart solutions and utilising data, including programming, data analysis, AI development, and cybersecurity. IoT and smart networks require web development and data management skills, while cybersecurity protects digital infrastructure.
- Sustainability and Environmental Management: Skills in water management, renewable energy technologies, and circular economy (recycling to reduce waste and support economic sustainability) are critical for addressing climate challenges and securing long-term sustainability.
- Adaptability and Innovation: Problem-solving and retraining capabilities are needed to handle rapid technological and market changes. Innovation drives new solutions such as smart transport systems, and entrepreneurial skills support new businesses, creating jobs and enhancing regional competitiveness.
- Crisis Management and Resilience Planning: Competencies in risk assessment and crisis management enable businesses to prepare for and recover from crises, including natural disasters. Effective resilience planning can attract investments by signalling stability.
- Logistics and Supply Chain Management: Competence in logistics planning and sustainable logistics ensures robust supply chains. Digital tools optimise logistics processes, reducing costs and environmental impacts.
- Collaboration and Stakeholder Management: Effective communication and collaboration with stakeholders strengthen regional resilience.

Nature's resilience involves ecosystems' ability to withstand and recover from disturbances, including human activity and climate change.

- Water Management: Expertise in water management is critical due to flood risks, encompassing hydrological processes, flood risk mitigation, and sustainable water resource management.
- Renewable Energy Technology: Competence in renewable energy reduces fossil fuel dependency and mitigates climate change impacts, reducing greenhouse gas emissions and ecosystem pressures.
- Circular Economy and Resource Management: Principles of circular economy, including recycling and waste reduction, minimise resource extraction and pollution, preserving natural resources.
- Ecosystem Management and Biodiversity: Knowledge of ecosystem management and biodiversity conservation is crucial for nature's long-term resilience, involving ecological processes, biodiversity threat identification, and ecosystem restoration.

Expert interviews

The interviews confirm the core competence needs described above for achieving smart regional resilience, above all the importance of adapting to digital, environmental, and economic changes. Digital competence is a recurring and decisive theme. The interviews emphasise a growing demand for digital skills such as AI, digital tools, IT security, and software solutions to enable the implementation of digital business models. It is also highlighted that the region suffers from gaps in digital competence and lags behind in digital infrastructure, which affects competitiveness. This confirms the emphasis on digital competence as essential for participation in initiatives such as "Smart Cities – Smart Regions". Sustainability and environmental competence are also central. The interviews stress the urgent need to address climate change, biodiversity, and pollution. They highlight competences within the circular economy, such as understanding material cycles and recycling technologies, as well as knowledge of renewable energy systems, including solar and wind power. The interviews emphasise sustainable development through the renovation of existing buildings and sees sustainability as a key issue for the region. This aligns with the need for sustainability awareness and skills in water management, renewable energy, and the circular economy for the resilience of both nature and businesses. Adaptability and lifelong learning are crucial. Flexibility and entrepreneurial thinking are more important than ever in times of transformation. Lifelong learning is highlighted, as well as the need for health, education, and language skills to enable residents to adapt. Problem-solving and the ability to transition are vital for managing new situations. Cooperation, communication, and international integration are identified as critical. The experts stress the importance of interdisciplinary thinking and knowledge transfer between academia and industry. They view integration opportunities for international students as key to regional growth and call for intercultural skills and language competence. One of the experts emphasises social networks, civic engagement, and the importance of the German language for integration. These aspects confirm the need for strong communication and collaboration skills for social cohesion and inclusive planning. Finally, the shortage of competences is an overarching challenge. The role of the education system, particularly the Deggendorf Institute of Technology, is crucial for knowledge transfer and regional development. The experts also underlined the importance of basic skills such as reading, writing, and numeracy for young people entering vocational education.

Some distinguishing features

Deggendorf stands out for specifically highlighting civic engagement as crucial for social cohesion and regional recovery. The source also points to challenges related to deficiencies in basic skills such as reading, writing, and arithmetic among young people in vocational training, which is seen as a broader skills gap. One of the experts especially emphasised integration opportunities for international students as a key to regional growth, which requires intercultural skills and language proficiency.

The Netherlands, Brainport, Greenport and Midpoint

The sources emphasise that future smart regional resilience increasingly requires a combination of digital skills, sustainability and environmental adaptation competencies, and the ability to adapt through lifelong learning. Technological advancements, climate change, and global disruptions drive these needs. One source highlight how digitalisation and automation transform the labour market in Brainport Eindhoven, increasing demand for ICT and technical skills. Another source stresses the importance of educating individuals who can navigate and thrive amidst changing circumstances, underpinned by a solid knowledge base and continuous learning. Both sources indicate that competencies in programming, data analysis, water management, and crisis management are increasingly crucial for managing economic and environmental shifts. Inclusion and collaboration are also highlighted as critical for strengthening regional resilience.

People's resilience pertains to adapting to and recovering from changes and challenges in work and society.

- Adaptability and lifelong learning: Rapid technological changes require continuous reskilling and learning. Fontys' "Learning for Life" programme encourages continuous education through online courses and seminars. Flexibility, problem-solving, and openness to change are critical.
- Digital Competence: Fundamental and advanced digital skills, including programming, data analysis, AI, and general ICT skills, are necessary. ICT skills are increasingly demanded across occupations. If advanced skills are not present the ability to develop is essential.
- Soft Skills: Beyond technical abilities, soft skills like communication, collaboration, initiative, independence, flexibility, result orientation, critical thinking, and self-development are increasingly important. Managers particularly value these skills.
- Sustainability Awareness: Basic sustainability awareness enables individuals to contribute effectively to regional resilience, particularly in water management and transitioning to a green economy.

Businesses' resilience involves withstanding disruptions, adapting to changes, and maintaining sustainable operations.

- Digital and Technological Competence: Advanced digital and technological skills such as programming, data analysis, AI development, and cybersecurity are essential. The automotive sector exemplifies this with AI-based production management systems.

- Sustainability and Environmental Adaptation: Competencies in renewable energy technology, circular economy, and water management are critical. Collaborations like those between Fontys and regional water authorities demonstrate effective applications.
- Innovation and Entrepreneurship: Skills in innovation, business model innovation, design thinking, and creative problem-solving are essential. Fontys Startup Lab exemplifies support through mentorship and funding.
- Crisis Management and Resilience Planning: Skills in risk assessment, crisis preparedness, and recovery strategies are vital, demonstrated by Fontys' crisis management coordination during the COVID-19 pandemic.
- Logistics and Supply Chain Management: Efficient and adaptable logistics management is crucial. Competencies in warehouse management, transport planning, and supply chain optimisation, as illustrated by the Smart Logistics Hub, are required.
- Inclusion and Collaboration: An inclusive work environment and collaborative business culture support innovation. Competencies in intercultural communication, teamwork, and diversity management are needed.

Nature's resilience relates to ecosystems' ability to withstand and recover from disturbances.

- Water Management and Climate Adaptation: Essential for regional resilience, involving solutions like smart green roofs (RESILIO project in Amsterdam) and nature-based strategies.
- Sustainability and Green Technology: Skills in renewable energy and circular economy are vital for reducing climate impacts and supporting ecological sustainability.
- Ecosystem Management: Underlying knowledge of ecosystems and biodiversity is crucial for implementing sustainable water management and green technologies.

Expert interviews

The expert interviews largely confirm the findings presented above regarding essential skills for future regional resilience in the Netherlands. The interviews underscore the critical importance of digital and technological skills, echoing the demand for ICT, programming, data analysis, and AI proficiency. Similarly, the emphasis on sustainability and circular economy competencies directly aligns with the focus on environmental adaptation, renewable energy, and green economy transitions. Furthermore, the interviews reiterate the paramount need for adaptability and flexibility, highlighting the ability to adjust to evolving technologies and work environments, alongside a willingness to embrace continuous learning and growth. The significance of soft skills and a positive work attitude is also strongly confirmed, encompassing self-reflection, perseverance, respect, and crucial teamwork in diverse, multidisciplinary environments. Entrepreneurship and innovation are presented as vital, spanning both impact-driven ventures and intrapreneurship within existing organisations, which complements the discussion on business model innovation. Communication and commercial skills, including marketing, sales, and storytelling, are identified as essential, though challenges in telephone and interpersonal communication for younger generations are noted. Beyond these core confirmations, the interview overview offers crucial educational and contextual insights. Effective skill development methods like challenge-based and project-based learning, alongside the necessity of living labs and internships for early workplace exposure, are also stressed to close the gap between functioning in an educational environment and real-world practice. Regionally, the overview points to

high demand in sectors like Semiconductor industry, Energy, and Defence in the areas such as Brainport and Midpoint Brabant, and notes that while SMEs focus on short-term needs, larger firms engage in long-term planning. These insights underscore the dynamic interplay between educational readiness, industry demands, and regional collaborative efforts.

Some distinguishing features
The sources from the Netherlands stand out for emphasising the development of T-shaped professionals, who combine broad employability with deep specialisation. The experts specifically advocate challenge-based and project-based learning, as well as "living labs" for early workplace exposure as effective skills development methods.

Czech Republic

The sources emphasise that future skill requirements in the Czech Republic, particularly focusing on smart regional resilience, include digital competencies, adaptability, and expertise in sustainability. Research indicates that skills such as programming, data analysis, crisis management, and interdisciplinary collaboration are central to addressing economic and environmental challenges. A notable aspect is the emphasis on aligning higher education outcomes with labour market needs, enhancing inclusion and social resilience through a qualification's framework. The IPN Q-RAM project aimed to establish a National Qualifications Framework for Higher Education (NKR-TV) in the Czech Republic to achieve this alignment. One of the sources describes national descriptors for this qualifications framework, translating educational objectives into expected learning outcomes in terms of knowledge, skills, and competencies among students.

People's resilience involves the capacity of individuals to adapt to and recover from various stresses and changes.

- Digital Competence: Two sources highlight digital skills as key competencies for future and regional resilience, including using information technology to manage information, communicate, collaborate, and understand digital systems.
- Adaptability: Adapting to new situations and changing market demands is vital. One of the sources stresses developing flexible skills to meet societal and market changes.
- Lifelong Learning: While not explicitly mentioned, the need for adaptability implies continuous learning and skill development throughout working life.
- Crisis Management: One of the sources identifies crisis management as crucial, involving effectively handling personal or professional crises.
- Interdisciplinary Collaboration: Highlighted as essential for addressing complex challenges, involving effective teamwork across diverse backgrounds and expertise.

Businesses' resilience refers to their ability to withstand disruptions, adapt to changes, and sustain operations.

- Digital and Technological Competence: Strong emphasis on digital expertise including programming and data analysis. Businesses require employees to implement digital solutions and innovate.
- Sustainability Expertise: Both sources indicate sustainability expertise as key, encompassing sustainable business models, resource efficiency, reduced environmental impact, and green technology implementation.
- Adaptability: Businesses must adapt swiftly to market, technological, and societal changes, involving transitioning operations, developing new products, services, and identifying new markets.
- Innovation: Essential for competitiveness and growth, including developing innovative ideas, products, services, and processes.
- Crisis Management: Vital for resilience, involving risk identification, contingency planning, and crisis response to ensure continuity.
- Interdisciplinary Collaboration: Necessary for solving complex issues and developing innovative solutions through collaboration with various stakeholders.

Nature's resilience involves ecosystems' capacity to resist and recover from disturbances.

- Sustainability and Environmental Expertise: Emphasis on sustainability indirectly points to environmental competencies including ecosystems knowledge, biodiversity, climate change, and sustainable resource management.
- Water Management: Given indirect mentions of climate change impacts, water management competencies are important to mitigate drought and flooding.
- Green Growth: Aligning with EU strategies and Czech recovery plans suggests competencies supporting sustainable development and environmental protection.

Expert interviews

The interviews strongly confirm and deepen the skills requirements identified in the document study, particularly regarding digital competencies, adaptability, and expertise in sustainability. An interdisciplinary foundation, encompassing economic, sociological, and environmental perspectives, is emphasised as a crucial advantage for functioning as universal and flexible candidates in the labour market of the future, where there is an increasing demand for individuals capable of integrating different fields, and where expertise in isolated niches is no longer sufficient. The future labour market is not solely about knowledge, but about competencies, skills, and flexibility. Graduates are expected to work flexibly across sectors such as municipalities, public administration, non-governmental organisations, and the private sector. To meet these demands, the importance of extensive practical experience—often through internships—as well as structured organisational feedback to develop relevant competencies is highlighted. The market needs individuals who can handle real-world situations and contribute tangible solutions. Among the most critical future skills, work with artificial intelligence (AI) is specifically highlighted as essential. This includes the ability to prompt and, most importantly, to critically evaluate AI-generated results in order to assess their relevance and truthfulness. The Sustainable Development Goals (SDGs) are central and are expected to be understood broadly – encompassing not only the environmental dimension, but also the social and

economic aspects. There is a demand for sustainability managers who can apply sustainability principles and manage non-financial reporting (ESG). The ability to seek funding for projects and activities, such as fundraising and project applications, is also considered an important skill. Other key competencies regarded as essential include project management, teamwork, global communication, presentation skills, and academic writing. Critical thinking is consistently emphasised as a fundamental ability to assess the relevance and accuracy of information and to identify reliable sources in an increasingly complex information environment. Hard skills such as GIS, data analysis, and statistical methods are also in demand, as is the ability to find, manage, and analyse data in areas such as demography and territorial planning. Finally, there is an emphasis on the need for individuals entering the labour market to be confident, motivated, and eager to make a difference. The ability to handle problems, stand by decisions, and demonstrate a willingness to contribute is seen as crucial for success and adaptability in a changing work environment. Individuals are expected to be able to see the deeper meaning in their work.

Some distinguishing features
In the Czech Republic, particular emphasis is placed on the effort to translate educational objectives into expected learning outcomes through a national qualifications framework for higher education. The experts stress the unique need to be a "universal and flexible candidate" in the future labour market, capable of integrating different fields rather than possessing isolated niche expertise. Another distinctive feature is the ability to critically evaluate AI-generated results in order to assess their relevance and accuracy. The ability to secure funding for projects and activities, such as fundraising and project applications, is also highlighted as an important future skills requirement.

Nordjylland, Denmark

The sources highlight that Nordjylland's future growth and development heavily depend on employees possessing the right skills. Analyses point out three central trends impacting skill requirements up to 2026: the green transition, digitalisation and automation, and employee engagement. A shortage of skilled workers in technical fields, particularly at vocational, short-cycle and medium cycle levels of education, is anticipated. Concurrently, readiness for change, innovation skills, and interdisciplinarity are emphasised as crucial for meeting these challenges and building smart regional resilience. The green transition demands competencies across various job functions and educational levels, with particular emphasis on leadership. Digitalisation and automation drive the need for STEM skills (science, technology, engineering, and mathematics). Employee engagement highlights the importance of involvement, development opportunities, and meaningful workplaces for recruiting and retaining competent staff.

People's resilience in Nordjylland involves adapting to labour market and societal changes driven by the green transition and digitalisation.

- Adaptability and Readiness for Change: Emphasised strongly to address changes driven by green transition and digitalisation, including willingness to learn new skills.

- Digital Competence: Essential for performing tasks in an increasingly digitalised world, including basic digital literacy and advanced technical skills.
- STEM Competencies: Increasing demand for scientific, technical, engineering, and mathematical skills across educational levels due to digitalisation and automation.
- Lifelong Learning Capability: Continuous upskilling and retraining are necessary as the existing workforce is expected to drive the green transition.
- Sustainability Awareness: Fundamental knowledge and understanding of sustainability and the green transition, recognising how existing skills apply in green contexts. • Interdisciplinary Collaboration: Increasingly important for effective teamwork across various professional disciplines.

Businesses' resilience in Nordjylland involves navigating a changing environment marked by green transition, digitalisation, and workforce competition.

- Strategic Competence in Green Transition: Leadership must formulate strategies guiding the green transition, understanding its impact on business models and future skill needs.
- Innovation Skills: Required for developing new products, processes, and solutions aligned with the demands of green transition and digitalisation.
- Digital and Technological Competence: Integration competencies to adopt new technologies, alongside specialist skills in programming and digital solution development.
- Sustainability Expertise: Growing need for knowledge about sustainable business models, resource efficiency, and environmental reporting.
- Recruitment and Retention Capability: Ability to attract and retain staff by creating workplaces offering participation, developmental opportunities, and meaningful work.
- Competence in Environmental Scanning: Ability to identify trends and demands related to green transition from customers, markets, and regulations proactively.
- Project Management Competence: Skills in managing sustainability-focused and cross-functional projects effectively.

Nature's resilience in Nordjylland involves building a sustainable region capable of managing environmental challenges through relevant skills development.

- Green Technology and Energy Optimisation: Skills in heat pumps, energy efficiency, and technical consulting to support greener energy solutions.
- Sustainable Agriculture Knowledge: Emphasis on sustainable farming practices, transitioning to new technologies, pesticide-free cultivation, and energy optimisation.
- Environmental Awareness and Ecosystem Understanding: Increased awareness of environmental issues and sustainable solutions across all stakeholders.
- Environmental Law Expertise: Legal professionals need expertise in evolving EU and national environmental regulations.
- Circular Economy Competence: Essential knowledge in material reuse and waste management, increasingly critical in construction and manufacturing sectors.
- Research and Development in Sustainability: Necessity for specialised expertise supporting innovation in sustainable solutions and green technologies.

Expert interviews

The comprehensive insights gathered from regional stakeholders robustly confirm the other sources foundational trends regarding Nordjylland's future competence needs. Digitalisation and automation, the green transition, and employee engagement consistently emerge as pivotal drivers shaping skill demands. A paramount requirement is enhanced digital competence, including foundational AI understanding, for all employees and leaders. As AI increasingly automates tasks, the focus shifts to validating AI outputs and applying critical thinking to ensure quality and human relevance. A pervasive and unmet demand exists for IT security and cybersecurity expertise, posing recruitment challenges across sectors. For the green transition, strategic leadership competence is crucial for guiding organisational adaptation and leveraging business opportunities from sustainable initiatives. This demands innovative approaches that challenge conventional thinking to address complex technical and operational shifts. Crucially, personal and cross-cutting competences are repeatedly highlighted. Adaptability and readiness for change are essential, requiring continuous learning and rapid "unlearning" in dynamic environments. Interdisciplinary collaboration is vital, necessitating effective teamwork across diverse professional fields and strong relationship management, ideally integrated early in education to mitigate "practice shock". Furthermore, strong leadership skills are indispensable for managing diverse teams, fostering well-being, and integrating new technologies effectively. The importance of employee well-being and resilience also stands out, advocating for supportive work cultures that encourage feedback and view errors as learning opportunities. The education system's role is pivotal: prioritising broader, practice-oriented programmes that foster lifelong learning capabilities over overly niche specialisations. Moreover, there's an untapped potential to make continuing education more appealing to businesses, moving beyond its perceived "public vibe" to better serve the private sector. These findings collectively underscore the imperative for a responsive and flexible competence development framework in Nordjylland.

Some distinguishing features

The Danish sources present a distinct perspective on future competence needs, framing them around three interconnected trends: Green Transition, Digitalisation and Automation, and the Employee Agenda. A key feature is the strong focus on upskilling and continuous education of the existing workforce, rather than large-scale reskilling. This includes fostering a crosscutting “green mindset” and interdisciplinarity across organisational functions and education levels, aiming for a fundamental shift in thinking and collaboration to embed sustainable practices. The “Employee Agenda” is highlighted as critical for employers in attracting and retaining talent. It involves offering development opportunities, influence, co-determination, and purpose in work, especially to meet the expectations of younger generations. This holistic framing of the “Employee Agenda” as a competence challenge for employers is particularly pronounced in the Danish sources.

Flanders, Belgium

The Flemish regions face significant transformations driven by digitalisation, technological disruptions, and the green transition. These trends affect the skill requirements of individuals and businesses across various sectors. Digital competence emerges as a universally necessary skill at all levels. The

green transition creates an increasing demand for green skills, although its full impact on skills requirements is still evolving in many sectors. Soft skills such as collaboration, independence, and flexibility are crucial within changing workplace structures. Challenges related to the retirement of experienced personnel (aged 55+) and the need for knowledge transfer are also highlighted. Sources suggest that the green transition is expected to have an overall positive impact on employment, albeit unevenly distributed across sectors, with some potentially experiencing decline.

People's resilience in Flanders involves adapting to changes in the labour market and society, particularly related to digitalisation and the green transition.

- Digital Competence: Basic digital literacy to manage digital communication and information at work, including using e-documents, e-invoices, and electronic signatures. Advanced digital skills like data processing and cybersecurity become increasingly important as data generation grows. Ability to adapt to new digital tools and systems across various professions, even those traditionally less digitally oriented. A positive attitude towards technology and willingness to learn new digital skills, even in sectors such as elderly care.
- Green Skills: Awareness of environmental standards and risks, including waste sorting and compliance with environmental regulations. Ability to identify and mitigate daily environmental impacts. Knowledge and skills in applying new sustainable technologies and materials, such as solar panels and heat pumps in construction.
- Adaptability and Lifelong Learning: Willingness to continuously learn new skills to meet evolving labour market demands driven by digitalisation and green transitions. Flexibility in adapting to new tasks and roles.
- Soft Skills: Increasing importance of collaboration in digitalised and potentially more cross-functional work environments. Independence in organising and carrying out tasks, even within teams.
- Experience and Expertise: Importance of transferring sector-specific and business-specific knowledge from older to younger generations, particularly as the 55+ generation retires.

Businesses' resilience in Flanders involves adapting to ongoing trends, maintaining competitiveness, and contributing to smart and sustainable regional development.

- Digital and Technological Competence: Need for employees with advanced digital skills to implement and manage new technologies such as 3D printing, big data, and AI. Ability to integrate digital solutions into existing business processes to improve efficiency and customer experience. Awareness of and competence in managing cybersecurity risks alongside increasing digitalisation.
- Sustainability Expertise: Knowledge of sustainable business models, including circular economy and resource efficiency. Expertise in environmental legislation and standards to ensure compliance and leverage opportunities from the green transition. Ability to assess and reduce environmental impacts from business operations. Investment and proficiency in green technologies to reduce emissions and support a carbon-neutral economy.
- Innovation and R&D Competence: Ability to identify and implement innovative technological and sustainable solutions within sectors. Collaboration with research institutions and other companies to foster innovation.

- Organisational and Leadership Competence: Ability to lead and coach employees through transitions related to digitalisation and the green shift. Capability to structure workplaces promoting flexibility, collaboration, and independence.
- Lifelong Learning Competence: Ability to identify and meet ongoing employee skill needs. Establishing a culture of lifelong learning within organisations.

Nature's resilience involves knowledge and capabilities required to understand, protect, and encourage sustainable interactions with the environment.

- Environmental and Ecological Expertise: Knowledge of ecosystems and biodiversity to assess and manage environmental impacts. Understanding regional climate change impacts and adaptation requirements.
- Sustainable Resource Management Competence: Skills and knowledge in implementing circular economy principles to reduce resource use and waste. Expertise in sustainable forestry and agriculture practices. Technical Competence for Environmental Monitoring and Management: Ability to utilise digital tools and technologies for environmental monitoring, such as drones for environmental assessments. Knowledge of waste management systems, wastewater treatment, and recycling.
- Regulatory and Policy Competence: Deep understanding of environmental legislation and policies at regional, national, and EU levels. Capability to translate regulations into practical guidelines and actions.
- Collaboration and Communication: Cooperation among various stakeholders (businesses, authorities, researchers) to advance sustainable solutions. Effective communication of environmental issues to diverse audiences.

Expert interviews

The interviews confirm that digital competence is universally essential, with particular emphasis on advanced skills such as data processing and cybersecurity awareness. Moreover, the rapid development of AI is underscored, implying that employees must understand how AI tools function and be able to use them effectively—even for tasks such as coding. Although the green transition is seen as important, the interviews nuance this by strongly emphasising that green competences must be integrated with economic realities and strategic thinking to ensure long-term sustainability. A central and consistent theme concerns soft skills, which are described as crucial for adaptability and resilience in a changing labour market. The interviews highlight mindset, a willingness to engage in continuous learning, and personal responsibility for one's career as more important than narrow expertise. The ability to learn from failure, to dare to fail, and to handle feedback and criticism is seen as critical for both personal and professional development. Furthermore, critical thinking is highlighted as essential for navigating complex information and media, while collaborative abilities and teamwork are seen as key to both success and wellbeing in an increasingly polarised world. The interview transcripts also point to a significant need for basic economic understanding and business insight among students and recent graduates. The ability to comprehend a business model, revenue and expenditure streams, and budgeting frameworks is considered vital—regardless of academic discipline. Finally, the importance of a stronger connection between education and practice is repeatedly noted. Interviewees suggest longer, but possibly part-time, project-based collaborations

with companies rather than traditional block placements, in order to give students more realistic experience and better prepare them for the dynamics of working life. There is a shared recognition that traditional teaching methods need to adapt to meet a new generation's expectations regarding learning and content consumption.

Some distinguishing features
The sources from Flanders, Belgium, point to future challenges related to experienced staff (55+) retiring, creating a need for knowledge transfer to younger generations. The experts also stress the central importance of "mindset" and the willingness to take risks, handle feedback and criticism for both personal and professional development. The sources further highlight a significant future need for basic economic understanding and business acumen among students and recent graduates, regardless of academic discipline.

Finland

Finnish regions face significant transformations driven by the green transition, digitalisation, economic conditions, and geopolitical factors. Sources highlight the necessity of adaptability and readiness for change among individuals and businesses to manage these transformations. The green transition is seen as an opportunity for positive regional development, especially in Western Finland and Ostrobothnia, although its most significant employment impacts are expected to emerge primarily in the 2030s. Simultaneously, economic downturns and geopolitical tensions negatively affect employment and lead to cautious behaviour among consumers and businesses. Digital skills, sustainability expertise, innovation capabilities, and international collaboration are emphasised as essential competencies for building smart regional resilience. Lifelong learning and reskilling are highlighted as crucial for ensuring inclusion and social resilience.

People's resilience in Finland involves adapting to labour market and societal changes, as well as maintaining well-being during transitional periods.

- Digital and Technological Competence: Skills in programming, data analytics, artificial intelligence (AI), and cybersecurity are critical for participation in an increasingly digital economy and safeguarding digital infrastructure. Basic proficiency in digital tools and IT systems.
- Sustainability and Environmental Competence: Expertise in sustainable production and renewable energy, with particular importance given to water management in areas prone to flooding. Environmental awareness and understanding of sustainability principles.
- Adaptability and Lifelong Learning: Willingness and readiness for continuous learning and reskilling to respond effectively to automation and digital shifts in the labour market.
- Innovation and Entrepreneurial Competence: Project management and entrepreneurial skills essential for fostering growth, particularly in sustainable technologies and digital manufacturing.
- Crisis Preparedness and Resilience Planning: Ability to conduct risk assessments and utilise digital early warning systems, particularly relevant in regions like Lapland facing climate-related risks.
- Communication and Engagement: Effective communication and stakeholder engagement are vital for enhancing social resilience and inclusive regional development.

Businesses' resilience in Finland involves adapting to economic, technological, and environmental challenges while maintaining competitiveness and growth.

- Digital and Technological Competence: Businesses require expertise in programming, data analytics, AI, and cybersecurity to innovate and protect digital infrastructure.
- Sustainability Expertise: Understanding sustainable production, circular economy, renewable energy, and initiatives within the bioeconomy. Export promotion activities in regions like Ostrobothnia highlight the economic benefits of sustainability.
- Innovation and R&D Competence: ◦ Capability to undertake research and development for creating innovative sustainable and digital products and services, supported by collaboration with higher education institutions.
- International Business Competence and Collaboration: Skills to navigate international partnerships and expand globally, exemplified by export promotion activities.
- Crisis Management and Resilience Planning: Conducting risk assessments and preparing for crises such as natural disasters, including utilising digital systems for rapid recovery.
- Lifelong Learning and Adaptability: Supporting ongoing skills development among employees to respond flexibly to technological advancements, especially relevant in regions like Pirkanmaa.

Nature's resilience involves the skills and knowledge needed to sustainably manage natural resources and address environmental challenges.

- Sustainable Resource Management and Circular Economy: Competencies in bioeconomy and sustainable food systems, with emphasis on resource efficiency and circular business models.
- Renewable Energy and Environmental Technology Expertise: Skills in developing renewable energy solutions and energy-efficient systems.
- Water and Risk Management: Expertise in managing climate-induced risks, particularly extreme weather events such as floods.
- Environmental Research and Innovation: Scientific and innovative capacities for developing environmental technologies and nature-based solutions.

Expert interviews

The experiences of South Ostrobothnia, according to the expert interviews, significantly corroborate and elaborate on pivotal themes presented in the overarching analysis of Finland's transformations. The region, particularly its hub Seinäjoki, is widely recognised for its robust entrepreneurial spirit, repeatedly named Finland's foremost entrepreneurial city. This ethos underscores the significance of innovation and entrepreneurship as crucial drivers for growth, especially within sustainable technologies and digital manufacturing. The interviews highlight the region's readiness to develop new operational models fostering stronger links between businesses and education, reinforcing a core finding about innovation capability. Digitalisation emerges as a paramount factor for building regional resilience, with considerable interest in digital training and widespread acknowledgement of skills gaps in this domain. Crucial digital competencies, including understanding AI, machine learning, data literacy, and the ability to swiftly adopt new digital systems, are deemed essential for individuals and businesses. While technical expertise is developing, the interviews also reveal growing concern over

declining social skills among younger generations, noting that “strengthening the labour market and business environment requires more social than technical skills". Sustainability and the green transition are likewise indispensable. The interviews point to the necessity of expertise in circular economy and sustainability reporting, stressing the vital connection between technology and environmental responsibility. This aligns with Finland's broader strategy of leveraging the green transition for positive regional development. Furthermore, internationalisation is acknowledged as a key developmental area for South Ostrobothnia, despite challenges such as insufficient foreign language skills and limited employment opportunities for international students. The need for lifelong learning and adaptability is also evident, with the region showing a capacity for quick changes when needed, although the education system struggles to rapidly adjust beyond a 3–5-year horizon. In conclusion, South Ostrobothnia exemplifies a region with pronounced ambition to advance education, competencies, and entrepreneurship towards a more agile, international, and digital future. Its focus on strengthening the resilience of individuals, businesses, and nature through targeted skill development and closer collaboration between education and the working world directly mirrors and enriches the broader Finnish narrative of progressive transformation.

Some distinguishing features

The sources from Finland are unique in their emphasis on how geopolitical factors negatively affect employment and consumer behaviour. The interviews highlight South Ostrobothnia’s pronounced entrepreneurial spirit – often referred to as Finland’s leading entrepreneurial city – which reinforces the role of entrepreneurship in regional development. In addition, there is a growing concern about deteriorating social skills among younger generations, with the observation that “strengthening the labour market and business environment requires more social than technical skills.”

Appendix 1 - Collection and analyses of regional documents

Collecting the data

The following instruction was distributed to all partners on 2025-02-17: *Please add titles of the reports you want to be included in the analyses of future skills needs with focus on smart regional resilience within your region. If the information is available via a website - add a clickable link. If the document is available as a full-text publication - upload the document to our shared folder. Document and websites could be in any language.* The deadline for this task was set to 15 March. The submitted data consisted of 11 PDF files, 1 Word file and links to eleven (11) websites. To facilitate the analysis, the websites in their entirety have first been analysed individually. An AI tool (Grok 3) was used to examine what these websites, including all subpages and links, say about future skills needs in the nine Heroes regions/countries. These were then saved as PDF files. A total of 26 PDF files has formed the basis for analysis. An overview of the submitted files and the files created through analysis of the websites are presented in the table below.

Analysis of all regions

A first way to get an overview of the content of the documents, with regard to smart regional resilience for people, businesses and nature has been done with NotebookLM. All sources were used, and the following task was given to NotebookLM: "You are a meticulous research assistant. Your task is to create a detailed compilation of all sources. Conduct a thorough and in-depth analysis of the competence requirements outlined in the sources. Carefully address the question: Which are the current and future skills and competence requirements, especially with a focus on smart regional resilience in the following areas and their intersections: 1) people's resilience, 2) businesses' resilience, and 3) nature's resilience. The response should initially include an overview of the entire context. Subsequently, within each respective area, provide ample examples of skills and competence requirements. Provide a brief summary of the content under each main heading. Particularly highlight which specific skills and abilities are important within each area".

Analyses of each region

To get an overview of the content of the sources, with regard to smart regional resilience for people, businesses and nature in each region, the following task was given to NotebookLM: "You are a meticulous research assistant. Your task is to create a detailed compilation based on the sources "xxxx" and "xxxx" (Sources from each region separately). Conduct a comprehensive and in-depth analysis of the skills and competence requirements presented in these sources. Answer precisely the question: Which are the current and future skills and competence requirements, especially with a focus on smart regional resilience in the following areas and their intersections: 1) people's resilience, 2) businesses' resilience, and 3) nature's resilience? The response should initially provide an overview of the whole. Subsequently, under each subsection, provide numerous examples of skills and competence requirements. Include a brief summary under each main heading. Clearly highlight which actual skills and abilities are important within the various subsections".

List of analysed regional documents

Halmstad University, Sweden
Skills provision in Halland County, https://regionhalland.quarto.pub/kompetens/
Skills needs within smart specialisation in Halland
Thomas More University of Applied Sciences, Belgium
Employment support centre - Future competence needs in Flemish sectors and companies
Report on Green Skills in Flanders
HRW The transition to a green labour market
Mendel University, Czech Republic
Qualification Framework for Tertiary Education, https://msmt.gov.cz/vzdelavani/vysoke-skolstvi/ipn-q-ram-kvalifikacni-ramec-terciarniho-vzdelavani -
Fields of Education – combined files
https://www.cedefop.europa.eu/en/tools/skills-forecast CEDEFOP
University College of Northern Denmark, Denmark
Recommendations by the Danish Resilience Commission
FremKom 4
Ready for a More Sustainable Society: Skills for the Future Green Job Market
Seinäjoki University of Applied Sciences, Finland
Education and competence of the Regional Council of South Ostrobothnia, https://epliitto.fi/tilastot/tilannekuva-ja-tilastot/koulutus-ja-osaaminen/
Regional development outlook in autumn 2024
South Ostrobothnia's Situation Overview 2025
https://tem.fi/sv/regionala-utvecklingsutsikter
Deggendorf Institute of Technology
Unsere Projekte | Landkreis Deggendorf
Strukturdaten-2024-25
Vilniaus Kolegija/Higher education institution, Lithuania
Feasibility Study on Addressing Education and Skills Challenges (STRATA, 2022)
Artificial Intelligence: Skills Issues in Lithuania (STRATA 2023)
Development and strengthening of green skills in Lithuania in response to the needs of the green economy
Fontys University of Applied Sciences, the Netherlands
Brainport future skills research
Talant-oriented Education Framework
Competent NL https://www.werk.nl/arbeidsmarktinformatie/skills/competentnl-standaard-voor-skills-in-nederland
https://www.fontys.nl/Talentgericht-onderwijs.htm
Polytechnic University of Beja, Portugal
Alentejo 2030 – Challenging the Future
PR Alentejo
Training Needs in Alentejo

Appendix 2 - Summary of framework for expert interviews

The objective of task 3.1 is to conduct a comprehensive assessment of the current and future skills and competence requirements within Heroes regions, with a dedicated emphasis on *smart regional resilience*. The assessment should be done by desk research and supplementary expert interviews at two occasions during the project; February to May 2025 and February to May 2027. Combining desk research and interviews helps to triangulate the findings, providing a more comprehensive understanding. The specific aims of doing expert interviews are to validate and deepen insights from the desk research as well as to highlight areas not covered by desk research, guiding further investigation. By comparing early and late desk research results with the interviews, one can see how the understanding of the topic has developed over time.

About interviews and analysis
Each partner is responsible for selecting and approaching five persons that they consider to be experts in regional skills provision in their respective context. The experts should represent a mix of public authorities, industry, and the public sector. They could be interviewed separately or as a focus group. The suggested interview questions below serve as examples of initial questions, which could be followed up with additional probing questions and context-specific questions. The interviews are recommended to be at least 30 minutes. The interviews should be transcribed and made available to HH not later than June 15. The deadline was then extended to June 25.

Suggested examples interview questions
What types of skills do you consider most essential for peoples, businesses and natures resilience in your region, in general but also specifically concerning digital innovation?

- Which technical skills (e.g. AI, cybersecurity) do you see as most important for strengthening the labour market and business environment in your region? Are there any particular gaps in these areas within your region?
- Which green transition skills (e.g., renewable energy, circular economy, resilient agriculture and forestry) do you think are most relevant for future development in your region? Are there any particular gaps in these areas within your region?
- Which entrepreneurial skills (e.g., business acumen, strategic thinking) are for strengthening innovation in your region? Are there any particular gaps in these areas within your region?

Prompt för analysing expert interviews (NotebookLM)
You are to write a section of approximately 300 words that will serve as the final part of the chapter *"Halland, Sweden"*. The section you write should be based on all the other sources (the transcribed interviews). It should highlight what in the other sources confirms the findings presented in *"Halland, Sweden"*, while also describing the most central content of the additional sources (the transcribed interviews).